

***FIELD INSPECTION  
OF  
TRAFFIC SIGNAL STRAIN POLES***



**CONSTRUCTION AND TECHNOLOGY DIVISION**

This report, authorized by the transportation director, has been prepared to provide technical information and guidance for personnel in the Michigan Department of Transportation, the FHWA, and other reciprocating agencies. The cost of publishing 50 copies of this report at \$3.81 per copy is \$190.25 and it is printed in accordance with Executive Directive 1991-6.

Technical Report Documentation Page

1. Report No. Research Report R-1370		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Field Inspection of Traffic Signal Strain Poles				5. Report Date May, 1999	
7. Author(s) David Juntunen, Mike Isola, Peter Wessel				6. Performing Organization Code	
9. Performing Organization Name and Address Michigan Department of Transportation Construction and Technology Division P.O. Box 30049 Lansing, MI 48909				8. Performing Org Report No.  R-1370	
12. Sponsoring Agency Name and Address Michigan Department of Transportation Construction and Technology Division P.O. Box 30049 Lansing, MI 48909				10. Work Unit No. (TRAIS)	
				11. Contract/Grant No.	
15. Supplementary Notes				13. Type of Report & Period Covered Final Report	
				14. Sponsoring Agency Code 94TI-1706	
16. Abstract This report presents the results of inspections of three selected groups of strain poles in the State of Michigan. A total of 243 strain poles were inspected. Approximately 48 percent of the poles inspected were painted steel, 32 percent galvanized steel, and 20 percent were wood. Of the 243 poles inspected, only two were found to be defective. One of these was a wood pole with approximately 90 percent section loss, and the other was a heavily corroded painted steel pole. Another concern was that approximately 30 percent of the anchor bolt nuts tested were loose. Strain poles should be inspected for any obvious problems when utility work is being done at a site, when the section of road is being scoped for upcoming projects, and during grade inspections. Areas of concern are corrosion of steel poles, decay of wood poles, loose anchor bolt nuts, and accelerated corrosion to steel poles caused by trapped debris in anchor bolt/nut covers.					
17. Key Words Strain Poles			18. Distribution Statement No restrictions. This document is available to the public through the Michigan Department of Transportation.		
19. Security Classification (report) Unclassified		20. Security Classification (Page) Unclassified		21. No of Pages	22. Price

**MICHIGAN DEPARTMENT OF TRANSPORTATION  
MDOT**

**FIELD INSPECTION OF TRAFFIC SIGNAL STRAIN POLES**

David A. Juntunen, P.E.  
Mike Isola, P.E.  
Peter Wessel

Testing and Research Section  
Construction and Technology Division  
Research Project 94 TI-1706  
Research Report No. R-1370

Michigan Transportation Commission  
Barton W. LaBelle, Chairman;  
Jack L. Gingrass, Vice-Chairman;  
John C. Kennedy, Betty Jean Awrey  
Ted B. Wahby, Lowell B. Jackson  
James R. DeSana, Director  
Lansing, May, 1999

## **ACKNOWLEDGMENTS**

The following people participated and were instrumental to this project. Larry Pearson, Chris Davis, Nick Lefke, and co-op students who worked on this project while in the Structural Research Unit.

## BACKGROUND

Traffic signals are often supported by span wires that are stretched taut between poles, called strain poles. The State of Michigan uses wood, painted steel and galvanized steel strain poles, as shown in Figures 1, 2, and 3, respectively. The base plates for the steel poles can either be buried (Figures 2 and 3) or be above ground (Figure 4).

In Illinois, a painted steel traffic pole on a grouted anchor base foundation failed. Investigators from the Illinois Department of Transportation (IDOT) found the pole had severe section loss above the base plate. They inspected other poles of this type and reported that nearly 18 percent of the poles they inspected had section loss severe enough to require immediate replacement. This section loss occurred within the bottom 150 mm of the pole, especially the bottom 50 mm of the poles, apparently due to the grout preventing air circulation. As a result, IDOT no longer allows the use of grout under the base plates and has removed grout from existing poles. The Illinois investigation prompted the Michigan Department of Transportation's (MDOT's) Structural Research Unit to investigate Michigan's strain pole population.

## INSPECTION

The Structural Research Unit developed an inspection procedure to evaluate a sample of the strain pole population in Michigan. For wood poles, we made a visual inspection of the poles, and we probed the poles to determine the soundness of the wood (Figure 5). For steel poles, in addition to a visual inspection, we used a manner to sound any anchor bolts/nuts (Figure 6), we measured the thickness of the steel above the ground surface or base plate ultrasonically (Figure 7), and we checked anchor bolts ultrasonically. For fatigue cracking (Figure 8).

An inspection form was completed for each pole inspected. A sample of a form is shown in Figure 9.

## RESULTS

The Structural Research Unit inspected a total of 243 poles in District 8 on M-43 and M-50 and in the Metro District on US-12. Approximately 48 percent of the poles inspected were painted steel, 32 percent galvanized steel, and 20 percent wood. The sample population showed that the poles, for the most part, are performing well. Of the 243 poles inspected, only two were found to be defective. One of these was a heavily corroded painted steel pole with a buried foundation (Figure 10). The other was a wood post with 90 percent section loss at ground level (Figure 11). A representative form the Maintenance Division was contacted about the steel pole, and he said the pole was scheduled for replacement. The SRU contacted the Lansing Board of Water and Light that maintains the wood pole, and the pole has been replaced.

Of the 243 poles inspected, 104 were connected to their bases with anchor bolts. Of these, 14 had decorative bases that prevented access to the anchor bolts for testing, i.e., the decorative base

completely covers the base of the pole and all anchor bolts. Only an access panel is provided for electrical work. From the remaining 90 poles, we inspected 359 anchor bolts (we could not remove one cover) by sounding with a hammer and checking for cracks with ultrasonic methods. We found 107, or 30 percent, of the nuts were loose; i.e. - when we hit the nut with a hammer it loosened. There were no fatigue cracks discovered in any of the anchor bolts. We found several anchor bolts had been cut to accommodate the anchor bolt/nut covers. We measured the thickness of each of the steel poles at its base by ultrasonic methods. There was no evidence of section loss, except for the steel pole discussed above.

For the sample population of poles we inspected, grout was not used between the base of the pole and the foundation, so problems similar to IDOT did not occur. One potential problem area on many of the steel poles is the anchor bolt/nut covers. These covers trap debris and moisture, accelerating the corrosion of the nuts and bolts as shown in Figure 12. Sometimes the anchor bolts had to be cut to allow the installation of the covers.

## CONCLUSIONS AND RECOMMENDATIONS

The sample population of strain poles we inspected are performing well. However, this may or may not be representative of strain poles in other areas of the state. Condition of strain poles in a given area are dependent on several factors; age, type of poles used, and proximity to harsh environment. Strain poles should be inspected for any obvious problems when utility work is being done at a site, when the section of road is being scoped for upcoming projects, and during grade inspections.

Areas of concern are as follows:

1. **Corrosion.** Painted steel poles, which comprise the largest percentage of poles in the survey, are more corrosion susceptible than galvanized steel poles. Inspectors should closely examine the base of these poles for section loss and corrosion buildup. Although galvanized steel strain poles are more corrosion resistant, with time they also are subject to corrosion. The estimated life of the protective zinc coating in a potentially salt-laden environment, i.e., in the immediate proximity of a highway, is 30 years. Therefore, the bases of galvanized poles should be examined.
2. **Loose Nuts.** The anchor bolts and nuts on the base of the pole should be sounded with a hammer to check for obvious fracture of the bolts or loose nuts. When a loose nut is discovered, it should be removed, a lock washer should be placed on top of the washer, and the nut should be replaced, turning the nut until the lock washer flattens out. One new poles, Subsection 920.04.D.2 of the 1996 Standard Specification for Construction specifies that lock washers are to be used on the anchor bolts.
3. **Anchor Bolt Nut Covers.** Anchor bolt nut covers should be removed because they trap debris which promotes corrosion of the anchor bolt and nut.

4. **Decorative Bases.** Decorative based that prevent access to the anchor bolts should not be used.
5. **Decay.** Wood Poles are subject to decay, especially at the base of the pole. Inspectors should closely examine the base of these poles for section loss and signs of deterioration. Signs of deterioration are staining or discoloration of the wood, surface depressions, and obvious section loss. A simple test that can be performed is probing the surface with a moderately pointed tool, such as a knife, awl, or screw driver. A decayed wood will be evident by excessive softness or a lack of resistance to probe penetration<sup>1</sup>.

New poles that are installed should be galvanized steel or wood instead of painted steel poles. Strain poles must not be installed with anchor bolt/nut covers because the covers accelerate corrosion in the anchor bolts and nuts, and bolts have been cut to allow the installation of the covers.

Local governments maintain many of the poles, therefore local government officials should be made aware of potential problems with painted steel and other strain poles.

---

<sup>1</sup>Michael A. Ritter, Timber Bridges. Design, Construction, Inspection, and Maintenance, United States Department of Agriculture, Forest Service, Engineering Staff, August 1992.



## FIGURES

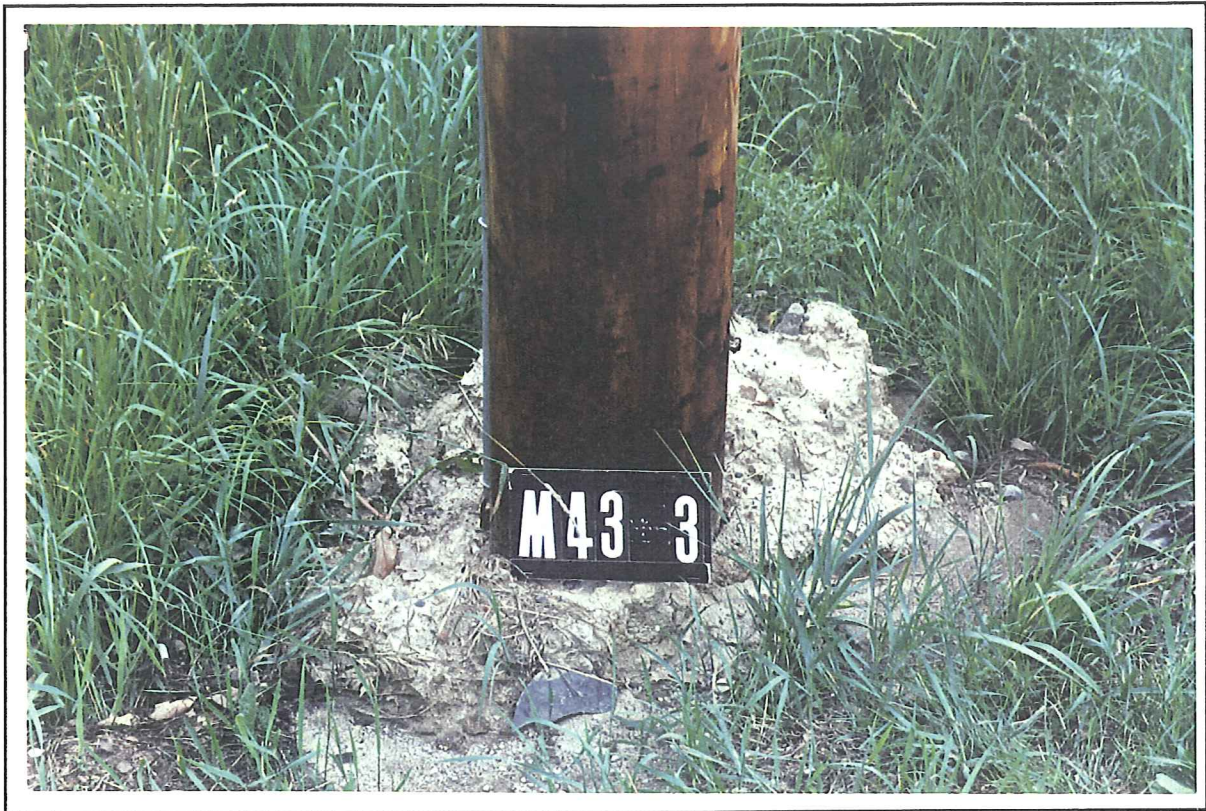


Figure 1 - Typical Wood Strain Pole



Figure 2 - Typical Painted Steel Strain Pole with Buried Foundation





Figure 3 - Typical Galvanized Steel Strain Pole with Buried Foundation



Figure 4 - Typical Galvanized Steel Strain Pole with Raised Base Plate





Figure 5 - Probe Test for Soundness of Wood Strain Pole



Figure 6 - Hammer Test to Sound Anchor Nuts/Bolts





Figure 7 - Ultrasonic Testing to Measure Thickness of Steel Near Base of Pole



Figure 8 - Ultrasonic Testing of Anchor Bolts for Fatigue Cracks



## TRAFFIC SIGNAL STRAIN POLE INSPECTION REPORT

(Revised 6/21/94)

Report No. <b>1</b>	Inspected By <b>MCI, CPD, SZ</b>	Date <b>6-28-94</b>				
Route <b>M43</b>	County <b>INGHAM</b>	District <b>8</b>				
Control Section		Picture Number <b>M43-1</b>				
Location <b>M43 @ PUTNAM ST. - WILLIAMSTON SW CORNER</b>						
Pole Material <b>PAINTED STEEL</b>		Height of Pole <b>30'</b>				
Probe Depth Measurements (Wood Poles Only)	1	2	3	4	5	6
Hammer Test For Anchor Bolt/Nut Sounding	1 <b>LOOSE</b>	2 <b>OK</b>	3 <b>OK</b>	4 <b>OK</b>	5 <b>X</b>	6 <b>X</b>
Ultrasonic Anchor Bolt Test Results (Where required)	1 <b>OK</b>	2 <b>OK</b>	3 <b>OK</b>	4 <b>OK</b>	5 <b>X</b>	6 <b>X</b>
Anchor Bolt/Nut Comments (Thread Condition, Plumbness, Corrosion, etc.): <b>NUT COVERS HOUSE LARGE AMOUNT OF DEBRIS</b>						
Projection of Bolt Beyond Top Nut	1 <b>0"</b>	2 <b>0"</b>	3 <b>0"</b>	4 <b>0"</b>	5 <b>X</b>	6 <b>X</b>
Base Weld Condition <b>OK</b>						
Foundation Condition : Above Ground Surface <b>OK - FLUSH MOUNTED</b>			Below ground surface (if feasible) <b>N/A - IN SIDEWALK</b>			
Ultrasonic Thickness Measurements	Above Ground	1 <b>.243</b>	2 <b>.259</b>	3 <b>.232</b>	4 <b>.243</b>	5 <b>X</b>
	Below Ground	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	
Upright Condition <b>OK - SLIGHT TOP BEND</b>						
Base Elevated: Yes <input checked="" type="radio"/> No	Handhole Cover: <input checked="" type="radio"/> Yes No	Can Pole Reach Roadway: <input checked="" type="radio"/> Yes No				
Additional Comments <b>3 NUT COVERS - TRAPPED DEBRIS</b>						

Figure 9 - Typical Completed Traffic Signal Strain Pole Inspection Report Form





Figure 10 - Heavily Corroded Painted Steel Strain Pole



Figure 11 - Wood Strain Pole with Severe Section Loss





Figure 12 - Corrosion of Anchor Bolts and Nuts Accelerated by the Use of Nut/Bolt Covers