INSPECTION OF SIGN SUPPORT STRUCTURES

MICHIGAN DEPARTMENT OF TRANSPORTATION

MATERIALS and TECHNOLOGY DIVISION

INSPECTION OF SIGN SUPPORT STRUCTURES

Sonny Jadun

Research Laboratory Section
Materials and Technology Division
Research Project 83 TI-955
Research Report No. R-1302

Lansing, September 1989

ABSTRACT

A number of sign support systems are used on Michigan's highways. Over the years the performance of these structures has been satisfactory. As the majority of these sign support structures are more than 15 years old, this project set out to determine their overall condition before any major problems were encountered in the field. It was decided to randomly select 10 percent of the sign support structures from various districts of the State, making a total of 82 cantilever and 36 overhead trusses. Originally it was proposed to inspect 118 bridge-mounted supports, but since their inspection required traffic control, it was decided to postpone this study. Maintenance records regarding the condition of bridge-mounted sign supports justified leaving their inspection until a later date. The selected sample structures were visually inspected and deficiencies such as splitting, bending, and cracking of the tubular members were recorded. Welds were checked for cracking and any crack found was recorded and reported to the Maintenance Division. In addition, the connecting bolts were also thoroughly inspected. After each structure was inspected, its overall condition was determined. Based on visual inspection of these structures it was concluded that the sign supports in this state are in good condition.

INTRODUCTION

A number of different types of sign support structures are in use on the Michigan highway system. These include steel and wooden breakaway posts, bridge-mounted supports, and overhead sign supports. Overhead supports include cantilever and truss type structures. Some of these structures have been in use for as long as 30 years and seem to be performing satisfactorily. In the past, structural deficiencies noticed on these structures during routine maintenance inspections were brought to the attention of the Design Division and the overhead sign crew of the Maintenance Division, who would then determine the cause of the problem and the appropriate action required to eliminate it.

In the late 1970's, problems were encountered with the anchor bolts that were used to connect cantilever sign structures to their concrete bases. The Structural Research Unit of the Materials and Technology Division investigated separate parts of this problem, and it was during these investigations that the overall condition of Michigan's sign structure population came into question (1, 2). Since many of these structures had been in service for decades, it was decided to investigate the condition of a selected sample of truss, cantilever, and bridge-mounted sign structures, along with high mast luminaire poles.

Scope

The scope of this investigation was to determine the condition of both sign support structures and high-mast luminaire poles. Two possible ways to carry out this investigation were considered: to visually inspect the structures, and then determine their condition; or to perform detailed destructive and non-destructive testing to determine the condition of the sign support structures.

In the past, MDOT's Maintenance Division has inspected the sign structures only if they were reported damaged. The Overhead Sign Structure Unit of that Division then performed the necessary repairs. Since a random sample of these sign structures had never been inspected before, it was decided to visually inspect a selected group of sign support structures. The results obtained from this inspection might later justify the use of destructive or non-destructive testing. The process of visual inspection adopted for this investigation considered the general appearance of the sign structure, location and size of cracks in a particular member or weld, location of splitting in a particular member, condition of nuts and bolts at various connections, alignment of the sign structure, damage to the sign structure due to vehicular impact, excessive deflection of the sign structure, and the damaging effects of corrosion.

Procedure

The following procedures were adopted for carrying out this investigation. An initial visual inspection was performed on a randomly selected number of cantilevers and overhead trusses in Districts 5 through 9 (Table 1). The information obtained from this initial survey was used to determine if problem areas existed in these structures and if so, what additional evaluations should be performed in order to determine adequately

TABLE 1
NUMBER OF STRUCTURES INVESTIGATED IN THIS STUDY[1]

District	Cantilever[2]			Truss		
	Total Number	Sample Size[3]	Inspected	Total Number	Sample Size	Inspected
5	266	27	23	82	8	7
6	159	16	13	61	6	5
7	86	8	8	49	5	5
8	195	17	12	95	10	8
9	497	26	26	303	12	11
Total	1203	94	82	590	41	36

[1]A total of 118 sign structures were inspected.
[2]8 painted cantilever structures inspected are included in this count.
[3]10 percent of total number in all Districts except District 9.

the presence of defects. With this initial information, a statistical analysis was performed to determine the sampling numbers of each type of structure required to attain a given confidence level. Inspections were limited to off-roadway portions of the structures in order to eliminate the need for lane closures and traffic control.

It was proposed initially that bridge-mounted sign supports be inspected along with other sign support structures, but since most bridge-mounted sign supports are located above the traffic lane of the roadway, they were not inspected in this study. Another project (86 TI-1181) was initiated in order to carry out visual and non-destructive testing of uncoated weathering steel sign support structures.

To ensure that all required areas of the structures were inspected, different standard inspection sheets were used for cantilever and overhead sign trusses (Figs. 1 and 2).

FIELD INSPECTION

Before the large scale visual inspection of the sign support structures began, a statistical analysis determined that approximately 10 percent of the sign structures in each District would have to be inspected before any conclusion could be reached about the overall condition of the sign structure population. During the course of this investigation 82 cantilevers and 36 overhead trusses were inspected, and their types and locations are listed in the Appendix. At locations where randomly selected structures could not be inspected due to insufficient space on the shoulders, every effort was made to find an alternate sign structure within the same vicinity. Twenty-one alternate sign structures were chosen during the field inspection, and these have been indicated by an 'A' after their numerical designation in the Appendix.

Each structure inspected in the field was classified according to one of these four categories: Good, Fair, Poor, and Critical. 'Good' is the general classification that requires no action. 'Fair' implies that the structure needs some minor maintenance, such as replacement of flange bolts, washers, etc. 'Poor' indicates that there is a possibility that major maintenance or rehabilitation will be needed in the near future. 'Critical' is the only condition that requires immediate action. The sign fabrication shop of the Maintenance Division was notified of the few locations where critical conditions existed.

During the process of visual inspection, each structure was thoroughly inspected to detect cracks in the welds or in the constituent members of the sign structure. If a crack was found, its location, orientation and width were noted on the inspection sheet. Precision measurement of crack width was not considered essential, so cracks were placed in one of three categories: hairline, narrow, or wide. A hairline crack will not allow the inspector to force anything into it other than liquid, a narrow crack will admit a paper edge, and a wide crack will allow the paper to wiggle somewhat. Examples of some of the structural deficiencies are cracks in the welds, splits in tubular members, splitting or 'exfoliation' of aluminum nuts and bolts, deterioration of paint on painted cantilever structures, loosened nuts, and peeling of the galvanized coating.

474 (N 1/82)

TRUSS INSPECTION

Report No. ______

BY SAJ / JAG					
DATE 8-16-88					
DIST. 5	COUNTY OTTAWA	ROUTE US-31	CONT. SEC. 70016	BUDGET CODE	STA.
LOCATION NB AT N. EDGE GRAND RIVER BRIDGE					
TYPE	LENGTH	SPEC. NO.	STD. PLAN	BOX	TUBE ✓
END SUPPORT HEIGHT		L.H.		R.H.	
SIGN CONNECTION	Mounting Supports GOOD			U-BOLTS STAINLESS STEEL (HEATED)	
SIGN BOLTS RIVETS USED (FINE)		SIGN CLIPS NOT USED		DIRECT BOLTING FAIR, RUSTY APPEARANCE	

TOP

FRONT

BOTTOM

BACK

ANCHOR BOLTS	L.H. BLACK STEEL RUSTY APP.		R.H. GALVANIZED	
CONN. BOLTS AT BASE	L.H. NONE USED		R.H. NONE USED	
TRUSS U-BOLTS (STAINLESS STEEL)	L.H. GOOD		R.H. GOOD	
TRUSS CONN. BOLTS (STAINLESS STEEL)	1. GOOD	2.	3.	4.
WELDS GOOD (NO CRACKS FOUND)		GENERAL APPEARANCE		
NO. OF SIGNS 2	TYPE OF SIGN EXT. ALUM.	O'LAY GOOD	LIGHTS	LIGHT CONN.

NOTES
1. OPTIONAL SPLICES GOOD IN POST.
2. BASE IN PRETTY GOOD CONDITION.
3. LIGHT TOWER CONNECTED TO STRUCTURE - WELDS O.K.

Figure 1. Inspection sheet for truss-type supports.

SIGN STRUCTURE INSPECTION SHEET

Date: 6-10-88		
Inspectors: SAJ/TJL/JAG		
District: #9	County: WAYNE	Route: I-94
Location: I-94 AT MERRIMAN RD.		
Sign Legend: EXIT I 96 ROMULUS WAYNE 1/2 MILE	Type of Structure: CANTILEVER	Type of Cantilever or Truss:
Condition of Drain Holes in Vertical Supports: GOOD - PROPERLY SECURED		Condition of Optional Splice Areas: (a) In Posts N.A. (b) In Arms N.A.
Condition of Gusset Plate Welds in Post-to-Base Connections: GOOD (SOME NUTS & WELDS COULD NOT BE INSPECTED DUE TO SOIL OVER PLATE)		
Condition of Gusset Plate Welds in Arm-to-Flange Connections: (a) Upper POOR QUALITY WELDING (UNDERCUTS) (b) Lower		Condition of Gusset Plate Welds in Post-to-Flange Connections: (a) Upper (b) Lower
Condition of Bolts on Flanged Connections: SOME HAVE RUSTY APPEARANCE		Condition of Welds on Truss Framing:
Condition of Sign Bolts: N.A.		Condition of Sign Clips: O.K.
Condition of U-Bolts: (a) Sign-to-Arm Connections: GOOD - STAINLESS STEEL (b) Truss-to-Post Connections: N.A.		Condition of Truss to Post Mounting Supports:
		Condition of Sign: O.K. - LEANS TOWARDS WEST (5°-10°)
Condition of Overlay: O.K.		Type of Bridge Connection: N.A.
Condition of Bridge Connections: N.A.		Approximate Amount of Skew: N.A.
Condition of Bridge Fascia Beam Web at Location of Sign Supports: N.A.		Cantilever Alignment: SLIGHTLY OUT OF ALIGNMENT
General Overall Appearance of Structure: FAIR		

Remarks: BOTTOM CANTILEVER ARM BENT, SEEMS TO BE HIT BY TRAFFIC. CONCRETE BASE IN GOOD CONDITION. NO CRACKS IN CONCRETE DETECTED. LOT OF VIBRATION INDUCED IN SIGN STRUCTURE DUE TO PASSING TRAFFIC. CANTILEVER ARM SHOWING RUSTY APPEARANCE ON TOP SURFACES. FLAKING OF GALVANIZED COATING AROUND FLANGES IN THE LOWER ARM OF CANTILEVER.

Figure 2. Inspection for cantilever supports.

Inspection of Cantilever Structures

Cantilever structures, in general, were built of galvanized steel although a few old painted steel cantilever structures were encountered. The latter are relatively small supports when compared to the size of the newer ones, and represented 9 percent of the total cantilever structures inspected. Extreme difficulty was encountered inspecting these structures due to peeling paint, which made it very difficult to locate cracks in these areas. Although these structures were rated in poor condition due to their need for painting, there did not seem to be any visible major structural problems.

Very few cracks indicating distress were found on the galvanized structures. Ninety-nine percent of the hairline cracks that were detected were along the length of the weld where the 3/4-in. horizontal gusset plate is welded to the post (Fig. 3). These cracks, even though hairline,

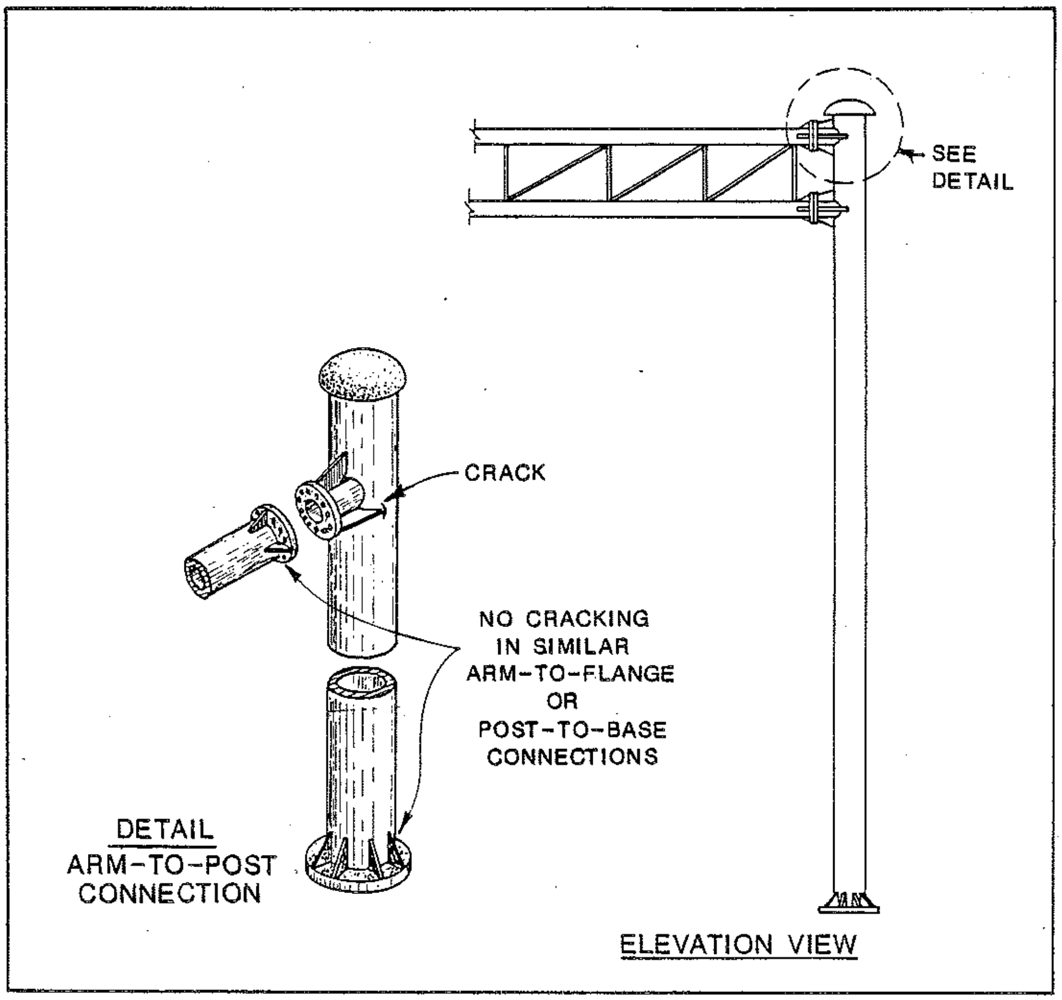

Figure 3. Hairline crack location near horizontal gusset plate.

are of some concern because vibration induced in the cantilever structure due to wind loading can make this detail fatigue-critical. A further in-depth study of this particular situation should be considered. The condition of the similar gusset plates and gusset plate welds in the arm-to-flange connection and post-to-base connections are good, and not a single crack was detected (Fig. 3). Overall, cantilever type sign support structures are in good condition.

Inspection of Overhead Truss Structures

Forty overhead trusses were inspected in this investigation, all fabricated from aluminum alloy material. During the random sampling a few uncoated weathering steel structures had been selected. Since the weathering steel trusses had already been inspected, nearby aluminum alloy trusses were substituted. A variety of aluminum alloy truss types were inspected. The current age of the trusses inspected varied from newly installed to 20-25 years of age. A few problems which were repeatedly observed during the visual inspection process were:

1) Cracking of the welds at various locations, particularly in the smaller tubular members.

2) Splitting of the thinner aluminum tubular members.

3) Splitting or 'exfoliation' due to corrosion of aluminum alloy bolts, nuts, and U-bolts.

Cracking of welds and splitting of tubular truss members - Ninety-five percent of this cracking was located around the weld that connected the tubular truss members to the top and bottom chords. In some instances, the cracking in the weld led to the splitting of the tubular member, possibly due to water getting into the tube and freezing during the winter. This type of cracking and splitting of the tubular truss members was neither localized geographically, or by its position in the truss, nor dependent on the age of the structure (Fig. 4). Cracks in the welds and splits in the tubes were observed on trusses installed as little as a year ago. Several possibilities exist such as inadequate weld penetration and stresses due to shrinkage during weld cooling, but we believe that the majority of these weld cracks were caused during the transportation and erection process. While erecting the trusses the construction crews often have a tendency to force the flanges of misaligned trusses into full contact by overtightening the connection bolts rather than shimming between the flanges. This practice may lead to the overstressing of individual members causing the development of random cracks.

After examining current fabrication procedures with several MDOT inspectors, we have found that shops that fabricate trusses for the State of Michigan have already solved this problem. Flanges are bolted together, the trusses aligned, and the flanges are then welded to the tubular truss members. This prevents any misalignment from occurring.

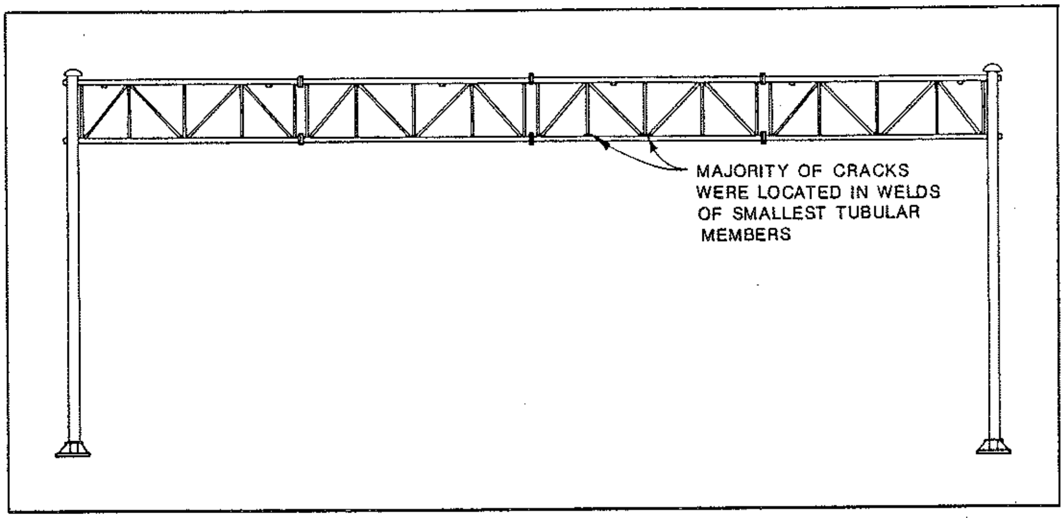

Figure 4. Typical overhead truss installation.

These procedures should prevent most misalignment problems in the future, though there might be a problem if the structure has been hit and damaged truss members are replaced. Here, careful use of already existing procedures will assure a proper fit.

Improper transportation procedures have also led to the cracking of welds in truss members. Depending upon the type of truss, the length of the individual truss sections can vary from 15 to 25 ft. In order to obtain the desired span length individual truss sections are bolted together. In the past, there have been some instances where the sign contractor bolted the individual truss sections at the fabrication plant and then transported them to the job site. The contractor did not realize that, when combined, the truss sections have a camber. If they are not properly cribbed under each joint, but simply pulled down tight to the truck bed, they will be subjected to bending loads during the transportation process. These bending loads could have resulted in cracking found in the welds. Therefore, we recommend that the truss sections be transported separately to the job site, bolted together on the ground, then erected.

Splitting of aluminum alloy nuts and U-bolts - Engineers in MDOT have long been aware of the effect of corrosive highway environment on certain aluminum alloy nuts and bolts (2000 series aluminum alloys). The large majority of aluminum nuts and bolts have been replaced by stainless steel AISI 300 series, or 6000 series aluminum alloy nuts and bolts. At locations where the 2000 series aluminum alloy nuts and bolts are still in use, severe splitting of nuts and U-bolts is clearly visible. This type of problem can be seen much more readily in the Detroit metropolitan area, possibly due to the large amount of salt used there.

A separate study (79 TI-597) was made as to the corrosion of the stainless steel nuts and bolts when subjected to the mainly aluminum environment of the sign structure. There does not appear to be any significant adverse effects when these two materials are used in conjunction. The aluminum of the larger sign structure is sacrificial to the smaller stainless steel bolts, so the adverse effects are not localized to the connection area. These two materials appear to work quite well together and this type of connection should continue to be used. However, the opposite arrangement of aluminum bolts in a steel structure can cause serious problems and definitely should not be allowed.

Weathering Steel Luminaires

A preliminary inspection of uncoated weathering steel high-mast luminaire poles was also carried out. The supports were found to be in generally good condition in spite of the one potential problem area that was discovered. That potential problem is due to the fact that some of the bases did not allow proper drainage and water could build up inside, causing increased corrosion problems. The present rate of deterioration should not be a cause for concern during the life of the installation.

RECOMMENDATIONS AND CONCLUSIONS

1) In spite of the problems discussed above that were encountered on various sign structures, it can be concluded that these structures are safe and providing the intended service.

2) The problems that were frequently encountered on overhead sign trusses include cracking of welds, splitting of tubular members, and the splitting of aluminum nuts and bolts due to corrosion. Certain fabrication and erection procedures seem to be the cause of some of these problems. The Maintenance Division is already aware of these problems and every effort is being made to take corrective action. The corrective action involves rewelding the cracked welds, replacing the split members, and replacing aluminum nuts and bolts by stainless steel ones, or aluminum series 6000 alloy nuts and bolts where available.

3) In the Detroit metropolitan area splitting of aluminum nuts and bolts at the base connection on aluminum sign trusses could be seen at a much higher rate. The corrosive environment encountered in the Detroit area justifies early removal and replacement of these defective parts.

4) The performance of galvanized cantilever sign structures has been excellent, except for a few hairline cracks that were observed in the post around the gusset plates where the arm is connected to the post. If these cracks are fatigue-induced they may indicate potential problems. Further determination of the cause of these cracks is desirable; otherwise, there do not seem to be any problems with this type of structure. These structures are still capable of providing trouble

free service for years to come. Recent inspection of the old galvanized supports on the Lodge Freeway reconstruction confirmed excellent performance over many years.

5) The coating on a few of the painted cantilever structures that were inspected is in poor condition. The majority of these structures need immediate painting or replacement with galvanized steel structures. The Maintenance Division has been replacing painted cantilever structures with galvanized steel structures for quite some time.

6) The majority of the flange connecting bolts on overhead trusses were stainless steel AISI 300 series. These bolts are holding up excellently in the field and there seems to be no problems associated with them. Since the failure of these bolts in service has not been seen or reported, determination of their properties by means of destructive testing does not seem necessary at the present time. The use of these bolts should be continued.

7) The majority of connecting bolts at arm-to-post connections are galvanized steel except for a few old structures that use ordinary steel bolts. These bolts are showing signs of corrosion but are in fair condition. Even though these bolts were not tested for any mechanical properties in the laboratory, at the present time there does not seem to be significant sectional loss in these bolts due to corrosion. Replacement of these bolts is recommended, however, since they will continue to corrode.

8) Even though high-mast luminaire supports were not included in this investigation, based on a preliminary inspection their field performance appears to be satisfactory at the present time. The existence of improper drainage at the base of the post presents a potential problem on some installations. Reinspection of another random sample of these supports after an additional five years of service is recommended.

REFERENCES

1. Arnold, C. J., Johnson, D. F., and Chiunti, M. A., "Static and Dynamic Properties of Anchor Bolts for Sign Supports," MDOT Research Report No. R-1197, June 1982.

2. Lower, B. R., "Static and Dynamic Properties of Anchor Bolts for Sign Supports (Final Report)," MDOT Research Report No. R-1283, June 1987.

APPENDIX

District	Number	Control Section	Mile Point	Type Structure: Cant.	Type Structure: Truss	General Location
DISTRICT 5	1	29011	18.69		X	US 27 in Alma[1]
	2A	29016	- 0.18	X		US 27BR at US 27
	3	29016	- 0.29	X		US 27BR at US 27[2]
	4	29031	- 0.19	X		BR 27 in Alma[2]
	5	29041	- 9.13	X		M 46 at US 27
	6	34061	-13.26	X		M 21 at M 66
	7	34062	- 0.03	X		M 21 at M 66
	8	37014		X		US 27 at Rosebush Int.[2]
	9	37022	- 1.40	X		M 20 at US 27
	10	37022	- 1.56	X		M 20 at US 27
	11	41024	- 0.00	X		I 96 at 28th Street
	12	41024	- 0.24		X	I 96 at 28th Street
	13A	41025	6.53	X		I 96 at E. Beltline
	14	41026	6.12	X		I 96 at C&O Penn Central RR (West River Drive)
	15	41026	- 6.31		X	I 96 at US 131
	16A	41027	- 1.32		X	I 196 at G.T.W. Railroad
	17A	41027		X		I 196 at Ionia Street
	18	41027		X		I 196 at College Avenue (2nd)
	19	41027		X		I 196 at College Avenue (4th)
	20	41027		X		I 196 at Fuller (2nd)
	21A	41029	- 9.61	X		I 196 at I 296
	22	41051	4.15	X		M 44 at I 96
	23	41121	- 9.72	X		M 46 at US 131
	24A	41131	-12.91		X	US 131 at Franklin Street
	25A	41131	-13.60	X		US 131 at Market Street
	26A	41131	14.39	X		US 131 at I 196 (C-D Lane)
	27	41131	17.62		X	US 131 at I 96
	28	41131		X		US 131 at 28th Street
	29A	41131		X		US 131 at 44th street
	30	61022	2.15	X		M 46 at Home Street (Muskegon)
	31	61072		X		I 96 at Laketon
	32	61075	2.85	X		US 31 near Cedar Creek (2nd)[2]
	33	61075	3.29	X		US 31 near Cedar Creek (3rd)
	34	70016	0.00		X	US 31 North Edge of Grand River Bridge (in Ferrysburg)
	35	70016	- 0.43		X	US 31 at M 104
DISTRICT 6	1	09034	1.41	X		I 75 North of County Line
	2	09042	- 0.13		X	M 25 at I 75
	3	09042	- 2.81	X		M 25 at Saginaw River
	4	09101	11.46	X		US 10 at I 75
	5	09101	-11.57	X		US 10 at I 75
	6	25031			X	I 75 at I 69
	7	25032	- 0.46		X	I 75 at Miller Road
	8	25042		X		I 69 at Morrish Road
	9A	25051	4.78	X		M 54BR at 8th Street (Flint)
	10	25072	4.56	X		M 54 near G.T.W. Railroad (X01)
	11	25084	1.97	X		M 21 near Averill Avenue
	12	25084	3.37	X		M 21 Between X-Over and Genesee Road
	13	25085	1.12		X	M 21 at Carmen Creek (Flint)[1]
	14	25085	2.48		X	M 21 Ent. from M 54BR (8th Street)
	15	25131	- 2.67	X		US 10, I 75 at Holly Road
	16	56032	0.10	X		M 30 at US 10[2]
	17	56044		X		US 10 at West River Road[2]
	18	73063	3.51	X		M 46 at Eastbound Exit from Southbound I 75
	19	73081	1.04	X		M 81 Ent. to Southbound I 75
	20	73101	- 1.58	X		I 675 at 14th Street
	21	73101	- 2.75	X		I 675 at Saginaw River
	22	73112	- 3.52		X	I 75, US 10, US 23 (North of M 13)
DISTRICT 7	1	03023	-12.15	X		M 89 Near US 131
	2	03041	10.03	X		M 118 at US 131
	3A	03112		X		US 131 at 135th Avenue
	4A	11015	22.38	X		I 94 at US 33
	5A	11016	- 0.42	X		I 94 at US 33
	6	11016	6.60		X	I 94 at I 196, US 31
	7	13033	3.14	X		I 194 at Dickman Road
	8	13073		X		I 69 at I 94
	9	13082	- 5.70		X	I 94 at 11 Mile Road
	10	39022	- 4.60		X	I 94 at BL 94
	11	39024	6.45		X	I 94 at US 131
	12A	39024	- 7.09		X	I 94 at US 131
	13	39024	- 9.17	X		I 94 at Westnedge Avenue

District	Number	Control Section	Mile Point	Type Structure Cant.	Type Structure Truss	General Location
DISTRICT 8	1	23012	- 0.04	X		I 69 at M 50, US 27BR
	2	23031	3.56	X		I 69BL near Miller Road and Stine Road[2]
	3	33032	4.02		X	I 496 at Cedar Street
	4	33035	6.16		X	Northbound US 127 at Eastbound I 96
	5	33045			X	I 496 at US 127, Trowbridge/ Kalamazoo Interchange
	6	33045	- 0.82		X	I 496 at US 127, Trowbridge/Kalamazoo Interchange
	7	33171	0.18	X		US 127 (Homer-Howard Area)
	8	33171	1.04	X		US 127 (Homer-Howard Area)
	9	38083	1.09	X		I 94BL (Washington) at NYC Railroad[2]
	10A	38103	- 0.27	X		I 94 at Sargent Road
	11	38111	14.06		X	Southbound US 127 at Westbound I 94
	12	47013	1.23	X		Northbound US 23 at Northbound M 36
	13	47121	0.03	X		M 155 at Grand River Avenue (BL 96)
	14	58151	5.32	X		I 75 Near Weigh Station
	15	58151	8.03	X		I 75 Near Sulphur Creek
	16	58151	-13.60	X		I 75 at Elm Avenue
	17	58152	5.67	X		I 75 Between I 275 Ramps and Newport Road Ramps
	18	58152	- 6.26		X	I 75 at Newport Road
	19	58152	9.82	X		I 75 - One Mile North of Sigler Road
	20	81062	6.03	X		I 94, 0.4 Mile North of Platt Road Interchange[2]
	21	81062		X		I 94 at Saline Road Interchange[2]
	22	81062			X	I 94 at US 23[2]
	23	81063	4.48		X	I 94 Near Junction Eastbound M 17 (Ecorse Road) and Southbound Ford Blvd. and North Eastbound US 12[2]
	24	81075	0.00	X		US 23 Huron River - NYC Railroad - Barton Drive[2]
	25	81075	- 2.15	X		US 23 at Warren Road
	26	81103	- 0.44		X	M 14 at Pontiac Trail
	27	81103	- 2.95		X	M 14 Near Earhart
DISTRICT 9	1	50111	13.27	X		I 94 at Mile Pt. 239
	2	50111	-12.78	X		I 94 Near Joy Boulevard
	3	63022	- 9.40	X		I 96, M 102 Near Rest Area
	4	63031	- 7.22	X		US 10, US 24 Near Maple Road
	5	63052	6.79	X		US 10BR at Lahser Road
	6	63171	0.68		X	M 39 Southbound Ramp from South Eastbound I 696BS
	7	63172	0.32	X		I 75 at US 24 Connector
	8	63174	- 9.50	X		I 75 at Livernois Road Overpass
	9A	63174	9.74	X		I 75 Near 16 Mile Road
	10	63174	15.46		X	I 75 at Adams and Square Lake Roads
	11	82022	4.81	X		I 94 at Merriman Road
	12	82022	10.97	X		I 94 at M 39
	13A	82022	-12.85	X		I 94 at Oakwood Boulevard
	14	82022	-11.84	X		I 94 at Ecorse Road
	15	82022	-10.90	X		I 94 at M-39
	16	82023	1.95	X		I 94 at Wesson Avenue
	17	82023	3.20		X	I 94 Exit Ramp to Grand River Avenue
	18	82025	3.85		X	I 94 Near Pedestrian Overpass
	19	82053	9.54	X		US 24 at Norfolk
	20A	82053	- 2.21	X		US 24 at George
	21	82061	5.37	X		US 12 Near Haggerty Road
	22	82061	- 5.69	X		US 12 Near Lotz Road
	23	82111	- 3.84	X		US 10, I 375, I 375BS at Clinton Ave. Ped. Overpass
	24A	82112	- 0.42		X	US 10 Exit to Greenfield
	25	82142	3.58	X		M 102 at Lichfield Road
	26A	82191	8.25	X		I 75 at US 24 Connector
	27	82194	8.16		X	I 75 at I 96
	28	82194	- 2.25	X		I 75 at Schaefer Highway
	29	82251	0.47		X	I 75 Interchange to I 94 (Do Two Trusses)
	30	82251	0.69		X	I 75 Interchange to I 94
	31	82251			X	I 75 to I 75 South and M 3 Gratiot Avenue
	32	82252	4.50	X		I 75 at Greendale Pedestrian Overpass
	33	82192	2.02		X	M 39 at Norwood Street
	34A	82192	7.79	X		M 39 at Warren Avenue
	35	82192	9.84		X	M 39 at Plymouth Road
	36	82192	- 3.06	X		M 39 at Outer Drive
	37	82193	2.72	X		M 39 North End of Freeway
	38	82193	3.62		X	M 39 at Pembroke Avenue[1]

[1] Unable to inspect

[2] No structure present