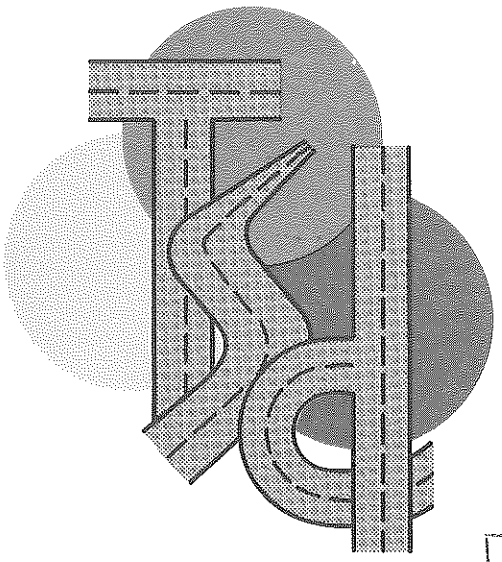
REPORT ON THE USE OF THE SECTIONAL CANTILEVER

TSD-0-124-69



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

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REPORT ON THE USE OF THE SECTIONAL CANTILEVER

TSD-0-124-69

Report

By

Hernando Mendez

Contributor to the Report

R. G. Stockmeyer

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

Henrik E. Stafseth	State Highway Director
J. P. Woodford	Deputy Director-Chief Engineer
G. J. McCarthy	Assistant Deputy Director for Engineering and Operations
J. G. Hautala	Chief, Bureau of Operations
H. H. Cooper	Engineer of Traffic and Safety
R. A. Rigotti	Traffic Operations Engineer
W. F. Savage	Supervising Engineer, Reflective Devices Unit

Department of State Highways
State Highways Building - P. O. Drawer K
Lansing, Michigan 48904

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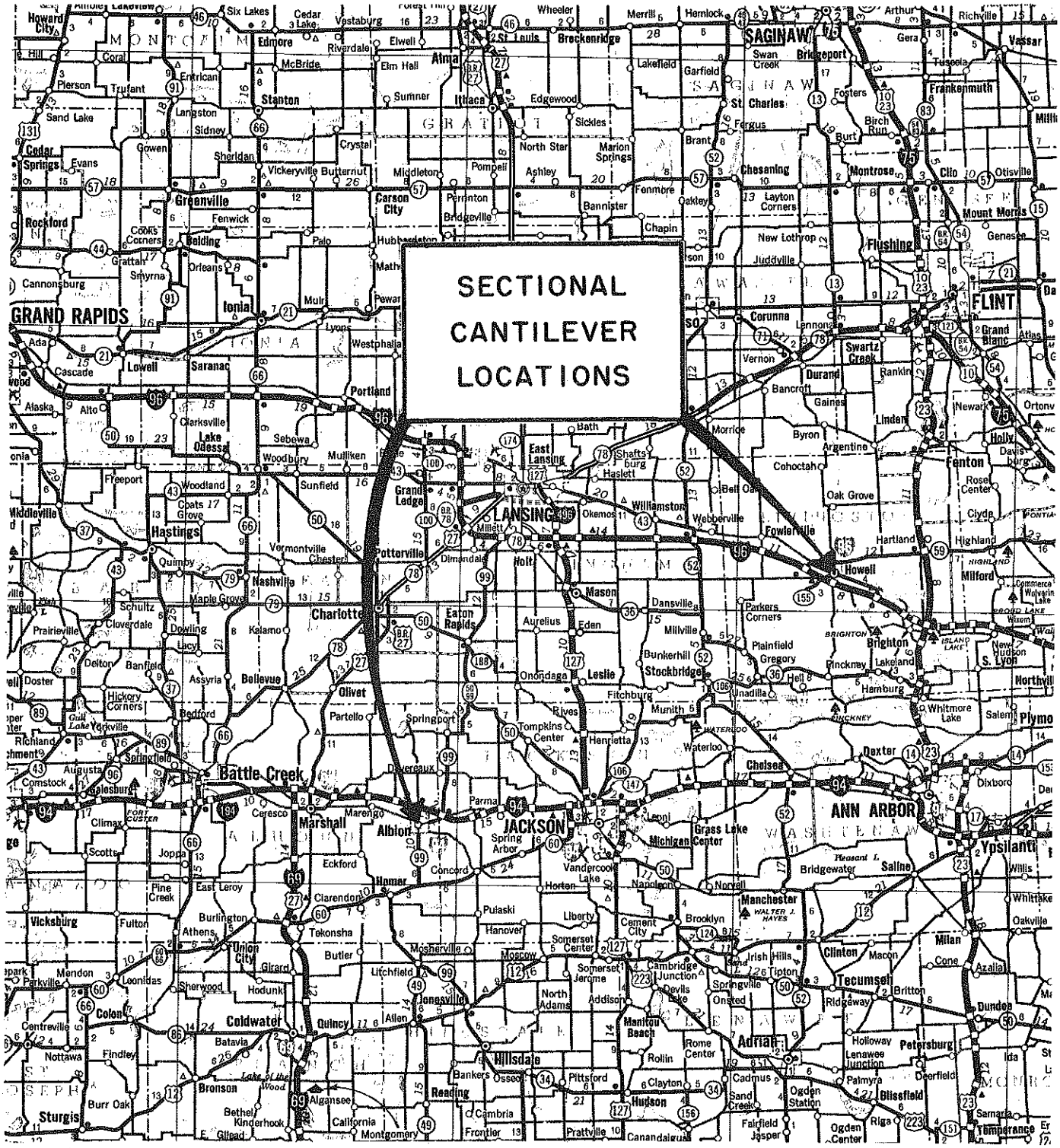

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SYNOPSIS

The following is a report on the use of the sectional cantilever to support overhead lane assignment signs. Our present method of supporting lane assignment signs utilizes two steel poles with span wires and has been used on many trunklines passing through urban and suburban areas. Two sectional cantilevers, one in the City of Howell and the other in the City of Albion, were installed on September 8 and 9, 1969, respectively. They are at present the only sectional cantilever installations on state trunklines. However, similar installations exist at several non-trunkline locations in Lansing, Flint and Detroit. The findings in this report are based upon safety, performance and economic comparisons between the sectional cantilever method and that which utilizes two steel poles with span wires. As will be shown, the sectional cantilever is a safer installation because of the elimination of one roadside obstruction. This report also shows that, from an economic standpoint, a sectional cantilever installation can be as much as $300 cheaper than an installation utilizing two steel poles with span wires. The amount of saving varies with the size of the sectional cantilever required. Maintenance of the two types of installations requires practically the same amount of materials and labor to protect the pole surfaces against corrosion, and the expected life of each is comparable.

INTRODUCTION

Our present method of supporting lane assignment signs, utilizing two steel poles with span wires, has proven satisfactory in most

instances where there is sufficient right-of-way available and it is desired to keep roadside obstructions sufficiently removed from the pavement edge for safety purposes. Also, two steel poles with span wires can support overhead lane assignment signs for as many lanes of operation as needed on the traveled way. However, placing this type of installation at a desirable location may prove difficult because existing driveways or utility poles and lines may interfere.

The sectional cantilevers at Howell and Albion are good examples of how the cantilever support may serve to replace the installation of steel poles with span wires. The cantilevers were transported and installed in accordance with the manufacturer's specifications with very good results as to the handling of the cantilever parts and the short time required for installation.

Figure #1 illustrates an installation utilizing two steel poles with span wires in Kalamazoo and the sectional cantilever installations at Howell and Albion. Note, however, that the latter type involves only two-lane operation while the former is capable of supporting lane assignment signs over a greater pavement width.

DESCRIPTION OF SECTIONAL CANTILEVER

The sectional cantilevers are made up of tubular tapered sections. The sections and fittings of the cantilevers are constructed of low-alloy, high tensile strength steel with self-rusting capacity

FIGURE #1

TWO STEEL POLES WITH SPAN WIRES INSTALLATION SUPPORTING LANE ASSIGNMENT SIGNS ON US-131 BR, BL-94, M-43 (MICHIGAN AVE.) @ US-131 BR (PARK ST.), CITY OF KALAMAZOO.

SECTIONAL POLE CANTILEVER ON M-155 @ BL-96 (GRAND RIVER AVE.), CITY OF HOWELL. DATE OF ERECTION: 9-8-69.

SECTIONAL POLE CANTILEVER ON BL-94 (EATON ST.) @ AUSTIN ST., CITY OF ALBION. DATE OF ERECTION: 9-9-69.

(ASTM A-242 steel) with minimum yield strength of 55,000 psi. They are hot-dipped galvanized in accordance with ASTM-A-123 specifications. Each section is approximately half the weight of a comparable piece of steel, a fact which accounts for ease of transportation and erection of the cantilever. Figure #2 illustrates the method of storing and handling the sections for assembly of the cantilever.

The sectional cantilever is structurally designed to support electrical devices, such as signals and street lamps, as well as signs. However, the manufacturer provides a variety of designs for the different functions the cantilever is intended to serve. The designs are both structurally and geometrically adequate to support overhead lane control signs. Figure #3 shows two cantilevers recently erected by the City of Lansing supporting lane control signs that serve two and three lanes of operation, respectively.

COMPARISON OF SECTIONAL CANTILEVERS VERSUS STEEL POLES WITH SPAN WIRES

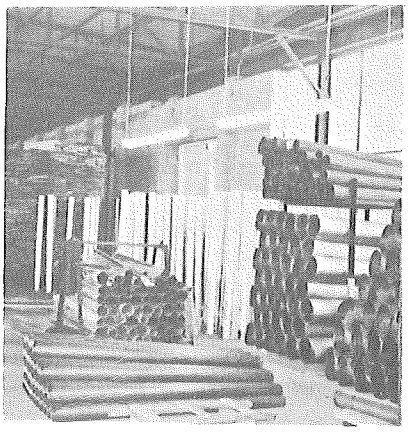
EQUIPMENT REQUIRED

1. SECTIONAL CANTILEVER

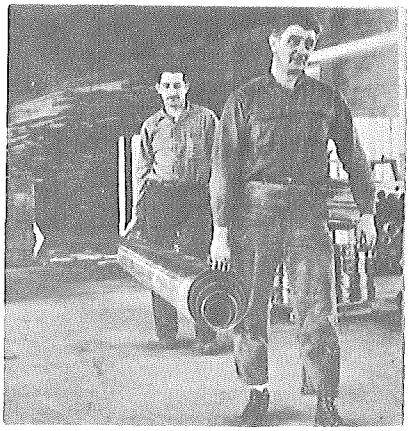
   The following (on page 7) is a listing and description of the actual equipment used by the State of Michigan for the cantilever installation at Howell and Albion.

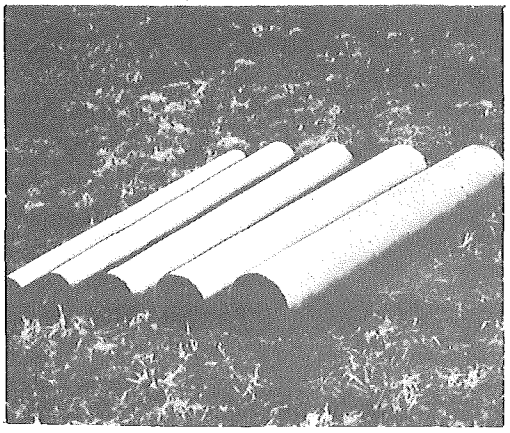
FIGURE #2

STORAGE OF CANTILEVER SECTIONS.

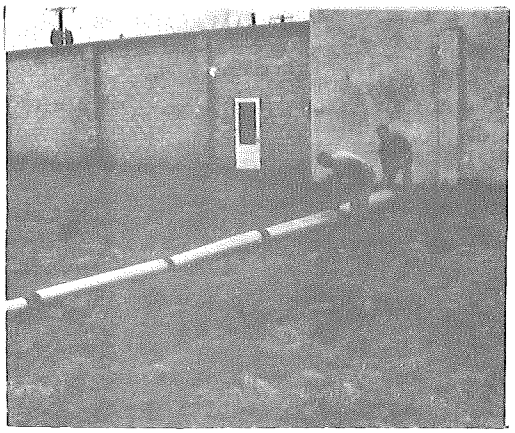


POLES SHIPPED NESTED TOGETHER FROM PLACE OF STORAGE.



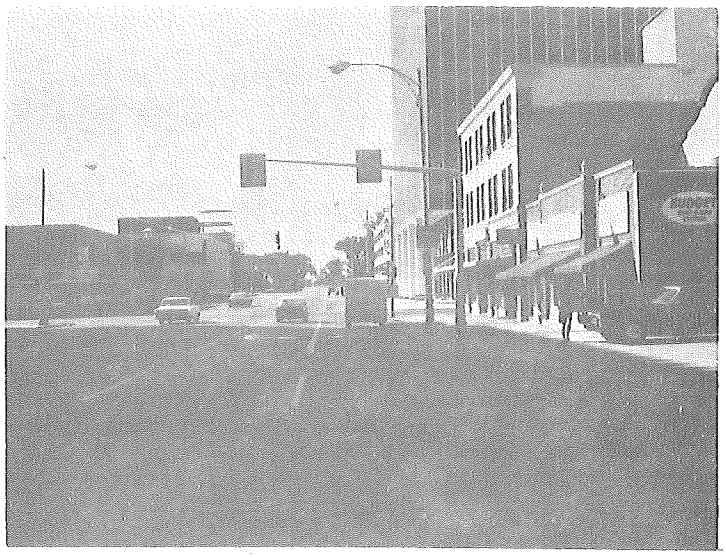


POLE SECTIONS LAID ON GROUND IN NUMERICAL ORDER AFTER BEING REMOVED FROM THEIR NESTING.

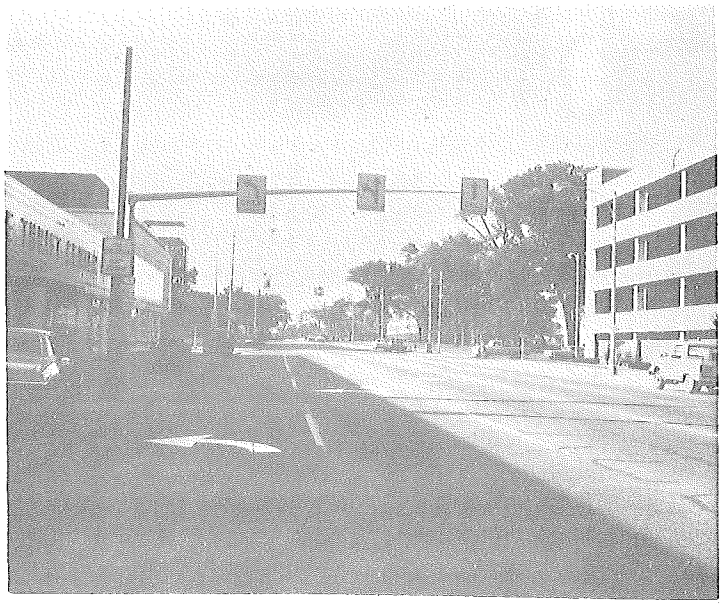


POLE SECTIONS BEING ARRANGED IN PROPER ORDER TO FORM A CONE.

FIGURE #3



SECTIONAL CANTILEVER SUPPORTING LANE CONTROL SIGNS FOR TWO LANES OF OPERATION ON CAPITOL AVE. @ WASHTENAW AVE., CITY OF LANSING.



SECTIONAL CANTILEVER SUPPORTING LANE CONTROL SIGNS FOR THREE LANES OF OPERATION ON CAPITOL AVE. AT KALAMAZOO STREET, CITY OF LANSING.

Equipment No.*	Description
04-0554	1967 International Truck
19-0010	1961 Air Compressor (On 04-0554)
10-0026	1960 45' Aerial Tower (On 04-0554)
03-0665	1966 Dodge Truck
22-0501	Derrick Crane (On 04-0554)

II. MONOTUBE STEEL POLES AND SPAN WIRES

The installation of two steel poles with span wires requires the following additional equipment to that listed above for the sectional cantilever:

Equipment No.*	Description
04-0418	Tractor
67-0202	Trailer (Carrier of Poles)
03-0711	Stake Truck

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* This equipment numbering is per actual coding of the Traffic Field Services Section.

INSTALLATION PROCEDURES

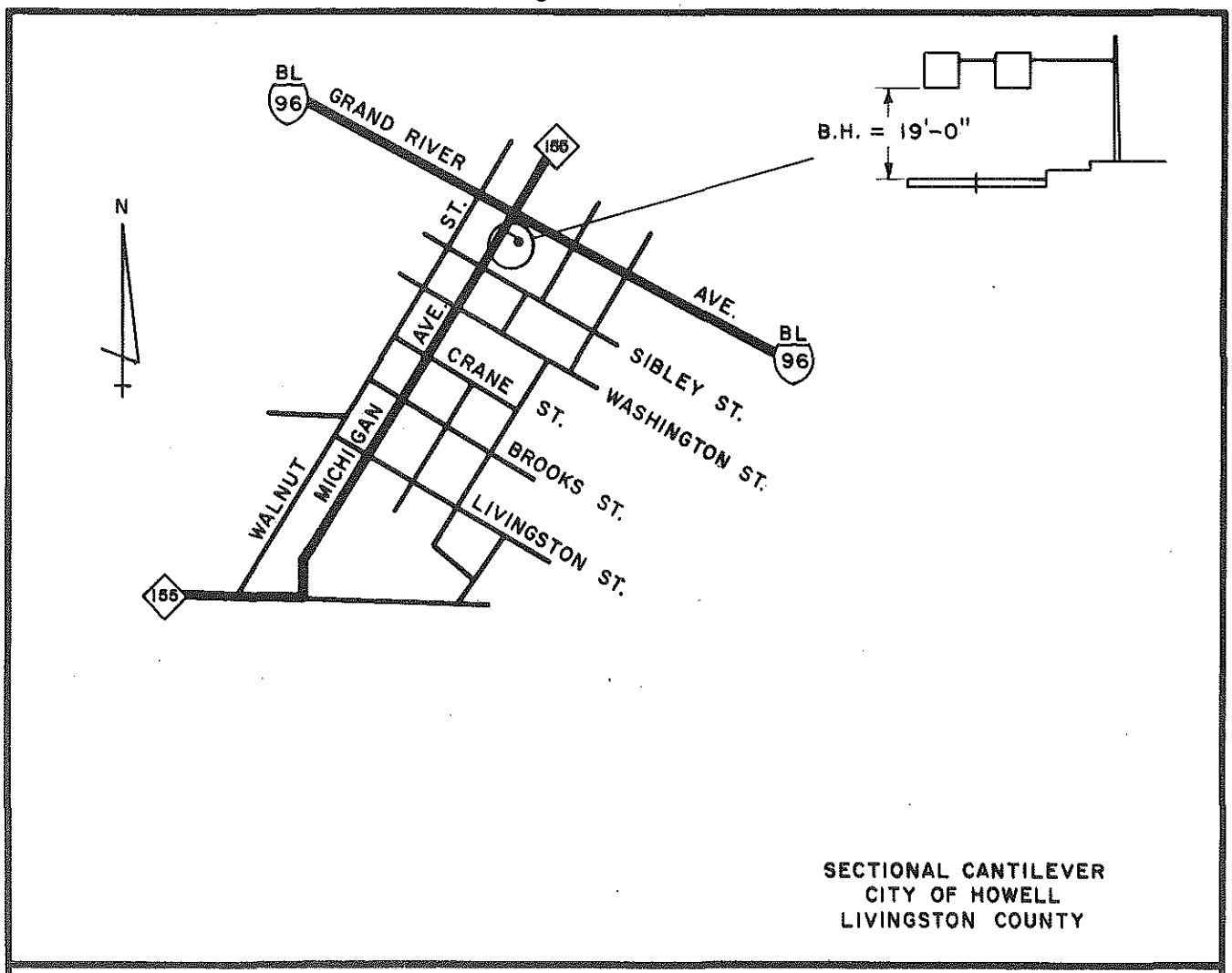
I. SECTIONAL CANTILEVERS AT HOWELL AND ALBION

Prior to the installations at Howell and Albion, it was necessary to design the bases adequate to sustain the cantilever dead loads and wind forces exerted on the cantilever. These bases were built three weeks in advance of the cantilever installations. Four men were used to pour each of these bases, and four hours were employed in each case. On September 8, 1969, the first

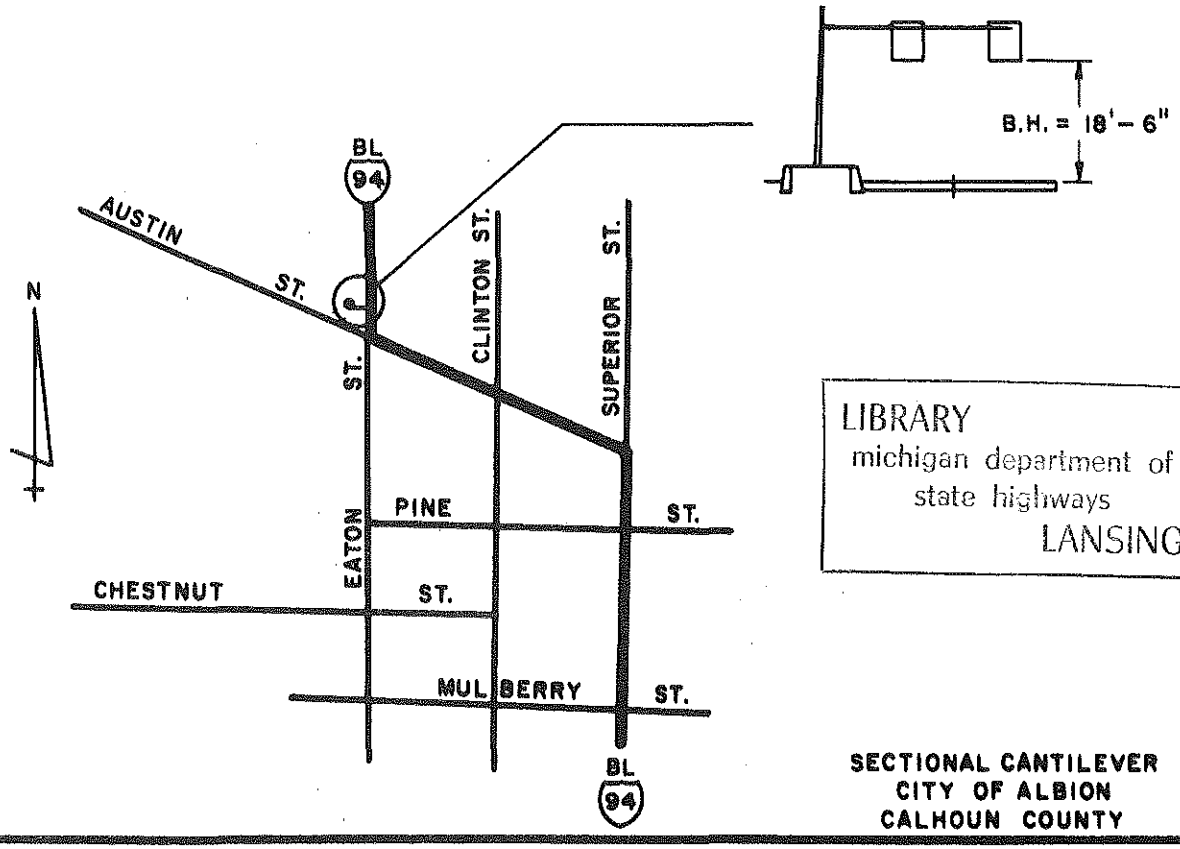
sectional cantilever was installed on M-155 in the City of Howell. On the following day, the erection crew erected the cantilever installation on BL-94 in the City of Albion. Figure #4 depicts the sites of these cantilever locations.

The following installation procedure was used at Howell. The field crew removed the sections from their nesting and laid them on the ground in numerical order. The assembly of the vertical shaft was first. The two longest sections of the shaft had been furnished already joined. The remaining smaller sections of the shaft were joined as illustrated in Figure #5, in which each section overlaps the next larger between marks made on each section. By this means, the assembly of the vertical shaft was completed. The horizontal arm assembly was performed in a similar manner. The cantilever was then completed by bolting the arm on the shaft. The next step was to mount the cantilever on the existing foundation. This was accomplished by raising the cantilever with the crane. The anchor bolts at the foundation were made to pass through the holes at the base till the cantilever could rest on the leveling nuts. Then the pressure nuts were tightened to their maximum torque to insure rigidity at the base. The installation of the cantilever was then completed. The lane control signs were attached to the horizontal arm, grease was placed into the nut covers

Figure # 4



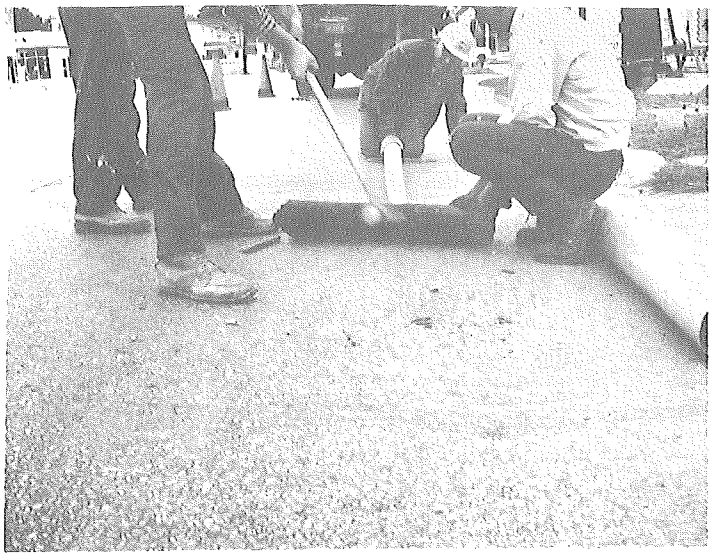
SECTIONAL CANTILEVER
CITY OF HOWELL
LIVINGSTON COUNTY



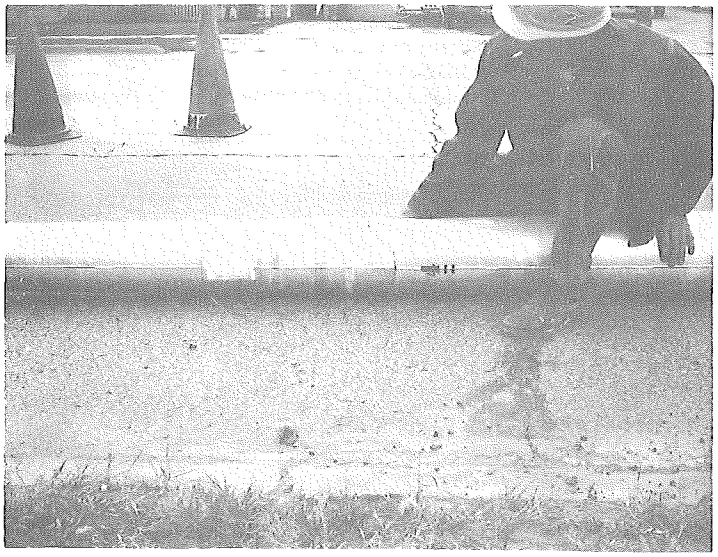
SECTIONAL CANTILEVER
CITY OF ALBION
CALHOUN COUNTY

FIGURE #5

ASSEMBLY OF SECTIONS OF CANTILEVER



WAY OF DRIVING SECTIONS ONE ONTO THE OTHER.



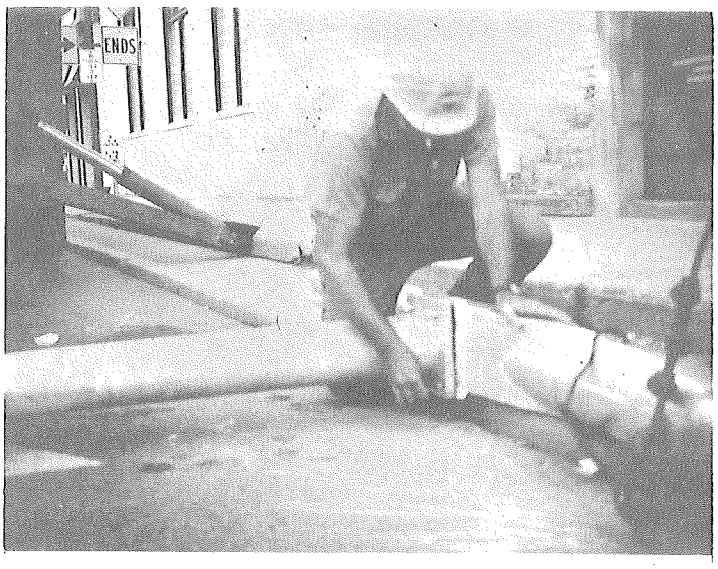
OVERLAP MARKS ON SECTION 4 TO BE REACHED BY SECTION 3.

before their being bolted on the pressure nuts, and a sealing mortar grout was poured at the base. The complete operation of assembling and installing the cantilever required two hours and the skills of four men. The final bottom height of the signs above pavement was 19' -0". This height was somewhat greater than normal because the foundation had to be poured flush with the highest point of sidewalk. For further details of the cantilever installation at Howell, refer to Figure #6.

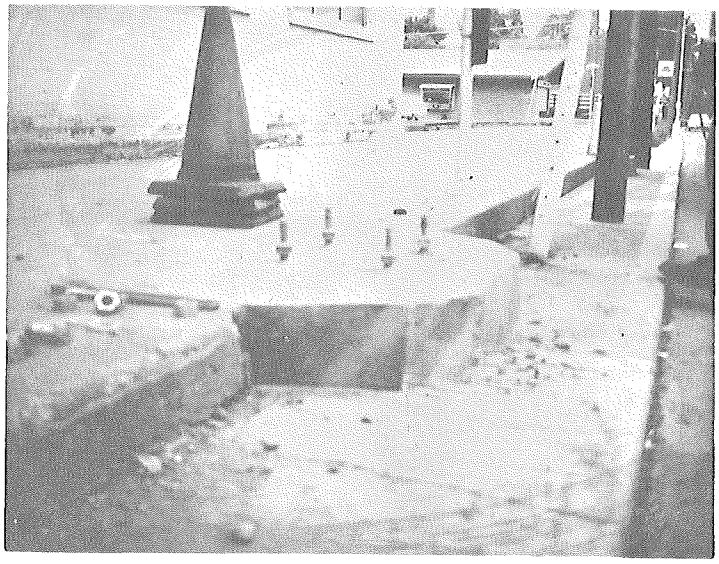
The installation procedure of the cantilever at Albion was essentially the same as at Howell, except for the following two modifications. First, it was necessary to erect the vertical shaft before bolting on the arm because the two largest sections of the vertical shaft detached from the cantilever when it was being raised on its foundation. Secondly, the flange section of the shaft had to be trimmed off 44 inches from the top because obstructing lines of an existing telephone pole did not allow the full usage of the twenty-three foot height of the vertical shaft. These two modifications are illustrated in Figure #7. The final height of the lane control signs was 18' -6" above the pavement. Once again, the skills of four men were required. The time employed for assembling and installing the cantilever and signs was one and one-half hours.

FIGURE #6

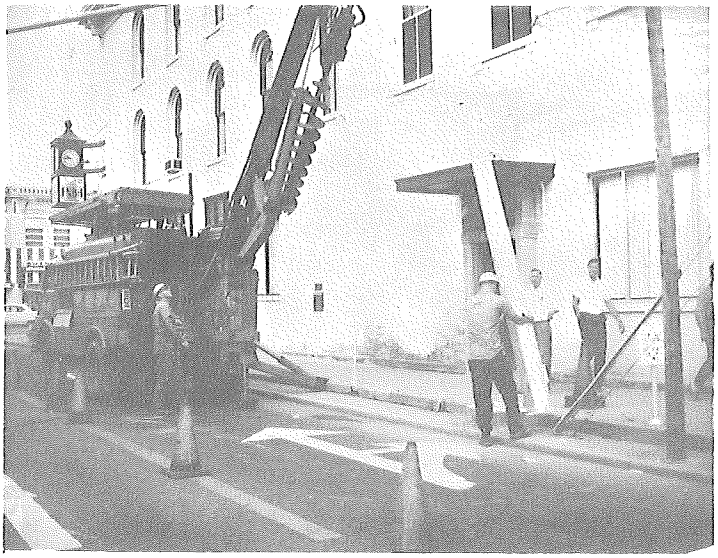
ILLUSTRATIONS OF THE CANTILEVER INSTALLATION
AT HOWELL



BOLTING ARM ON SHAFT OF CANTILEVER.



CONCRETE BASE SHOWING ANCHOR BOLTS AND LEVELING NUTS PROJECTING OFF FOUNDATION.

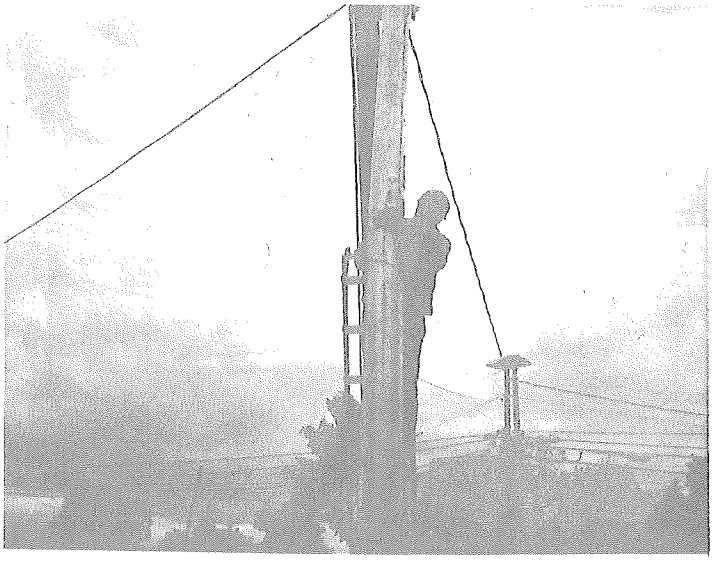


RAISING ASSEMBLED CANTILEVER TO MAKE IT REST ON BASE.

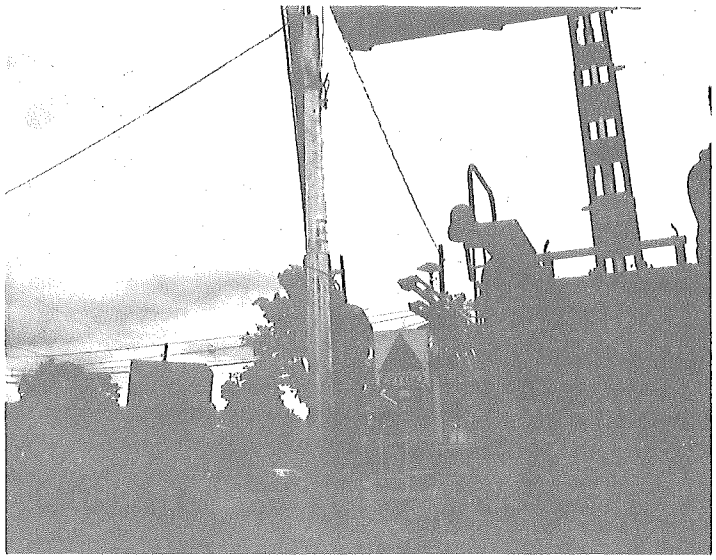
FINISHED BASE OF CANTILEVER AFTER ERECTION WAS COMPLETED.

FIGURE #7

ILLUSTRATIONS OF THE CANTILEVER INSTALLATION
AT ALBION

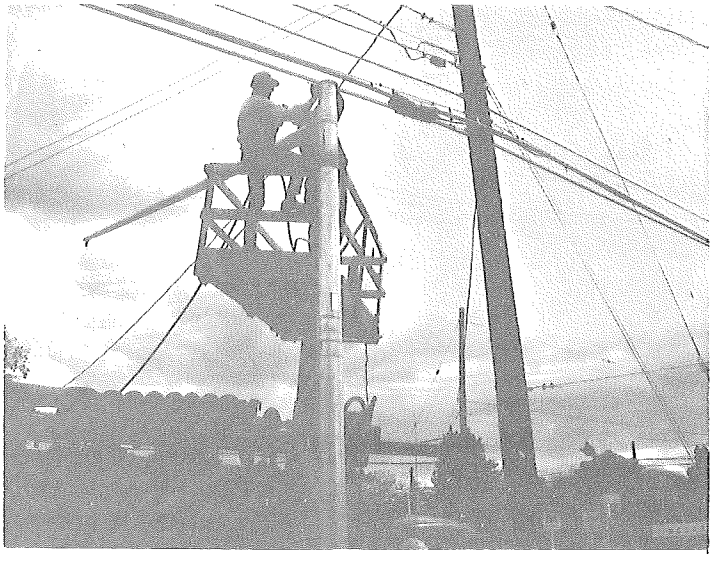


DRIVING OF SECTIONS FOR VERTICAL SHAFT.



ELEVATION VIEW OF FINISHED VERTICAL SHAFT.

BOLTING OF ARM ON SHAFT.



PLACING A FIELD-MADE CAP ON VERTICAL SHAFT.

II. TWO STEEL POLES WITH SPAN WIRES

No purpose would be served by detailing the installation procedure associated with the steel pole span wires method. However, it should be pointed out that the erection of two steel poles in their concrete foundations is an operation that generally requires the skills of four men and a time period of four hours, and an additional four hours are needed to erect the span wires and lane control signs.

TOTAL COSTS

An economic comparison between the installations of a sectional cantilever and two steel poles with span wires can best be shown by the break-down of costs detailed in Figures #8 and #9, for the installations in Howell and Albion, and in Figure #10 for the costs involved in a typical installation of two steel poles with span wires.

From an observation of these costs, the following conclusion can be made:

1. The cost of a sectional cantilever ($328.00) is significantly lower than two monotube steel poles ($427.80).
2. The equipment cost involved in the installation of a sectional cantilever (average $97.98) is much lower than the equipment cost for installing two monotube steel poles ($253.36) since less equipment is needed.

FIGURE #8

Work Order No. 1-064-9
Control Section 47121

District # 8	County: Livingston	Municipality: Howell	Job Started: 9-2-69 Job Finished: 9-8-69

Intersection of M-155 @ BL-96 (GRAND RIVER AVE.) IN CITY OF HOWELL

DESCRIPTION OF WORK: INSTALLATION OF SECTIONAL POLE CANTILEVER

MATERIAL	QUANTITY	UNIT COST	AMOUNT
SECTIONAL 20' POLE CANTILEVER	1EA.	328.00	328.00
CONCRETE	1 1/2 yd.	1.06	28.75
3/4" x 4 1/2" U BOLTS	2EA.	2.12	
DRY-MIX	1SK.	1.05	1.05
TRAVEL TIME(BASE INSTALLATION)	4MEN	4 HRS (Ea.)	16HRS.
DIG HOLE, INSTALL BASE, POUR CONCRETE	4MEN	4 HRS (Ea.)	16HRS.
TRAVEL TIME(CANTILEVER & SIGN ERECTION MEN)	5MEN	4 HRS (Ea.)	20HRS.
CANTILEVER & SIGN ERECTION	5MEN	4 HRS (Ea.)	20HRS.
EST.COST = 775.00 on W/O			
TRAVEL EXPENSE 8.10			8.10
MATERIAL TOTAL			368.02

LABOR COSTS

EMPLOYEE	HOURS	RATE	AMOUNT
A*	16	4.13	66.08
B*	16	3.48	55.68
C*	16	2.88	46.08
D	8	2.77	22.16
E	8	5.18	41.44
LABOR TOTAL			231.44

EQUIPMENT COSTS

EQUIPMENT	HOURS	RATE	AMOUNT
04-0554	16	5.69	91.04
03-0665	16	0.80	12.80
19-0010	1	0.88	0.88
10-0026	4	2.25	9.00
22-0501	2	4.56	9.12
01-0492**	106 MI.	0.06	6.36
EQUIPMENT TOTAL			129.20

GRAND TOTAL 728.66

* Employees A,B, & C stayed overnight to work in the installation at Albion next day.

** Car of the crew supervisor. Not needed for installation of the sectional pole cantilever.

FIGURE #9

Work Order No. 1-063-9
Control Section 13043

District # 7	County: Calhoun	Municipality: Albion	Job Started: 9-3-69 Job Finished: 9-9-69

Intersection of BUS-94 (EATON) AT AUSTIN IN CITY OF ALBION

DESCRIPTION OF WORK: INSTALLATION OF SECTIONAL POLE CANTILEVER

MATERIAL	QUANTITY	UNIT COST	AMOUNT
SECTIONAL 20'POLE CANTILEVER	1EA.	328.00	328.00
CONCRETE	1 1/2 yd.	30.00	30.00
3/4" x 4 1/2" U BOLTS	2EA.	1.00	2.12
DRY MIX	1BG.	1.05	1.05
TRAVEL TIME(BASE INSTALLATION)	3MEN	4 HRS. (Ea.)	12HRS.
DIG HOLE, INSTALL BASE POUR CONCRETE	3MEN	4 HRS. (Ea.)	12HRS.
TRAVEL TIME(CANTILEVER & SIGN ERECTION)	4MEN	4 HRS. (Ea.)	16HRS.
CANTILEVER & SIGN ERECTION	4MEN	4 HRS. (Ea.)	16HRS.
EST. COST = 700.00 W/O			
TRAVEL EXPENSE 54.02			54.02
MATERIAL TOTAL			415.19

LABOR COSTS

EMPLOYEE	HOURS	RATE	AMOUNT
A	16	4.13	66.08
B	8	3.48	27.84
C	16	2.88	46.08
D	8	2.77	22.16
F*	8	3.48	27.84
LABOR TOTAL			190.00

EQUIPMENT COSTS

EQUIPMENT	HOURS	RATE	AMOUNT
04-0554	8	5.69	45.52
03-0665	8	0.80	6.40
19-0010	1	0.88	0.88
10-0026	4	2.25	9.00
22-0501	1	4.56	4.56
EQUIPMENT TOTAL			66.36
GRAND TOTAL			671.55

* This employee was in the Albion area and replaced employee E who returned to Lansing after completion of work in Howell.

FIGURE #10

DESCRIPTION OF WORK: TYPICAL INSTALLATION OF TWO STEEL POLES WITH SPAN WIRES

MATERIAL	QUANTITY	UNIT COST	AMOUNT
TWO STEEL POLES	2EA.	213.90	427.80
CONCRETE	4YDS.	18.00	72.00
HUB EYE BOLTS, POLE BANDS DIST.CLAMPS, BOLT CLIPS, DOUBLE ARMOR BOLTS, SQUARE WASHERS, OVAL EYE NUTS			15.20
TRAVEL TIME(BASE INSTALLATION)	4MEN	4 HRS. (Ea.)	16HRS.
DIG HOLE, INSTALL BASE, POUR CONCRETE	3MEN	4 HRS. (Ea.)	12HRS.
TRAVEL TIME(MONOTUBE POLES & SIGN ERECTION)	4MEN	4 HRS. (Ea.)	16HRS.
MONOTUBE POLES & SIGN ERECTION	4MEN	4 HRS. (Ea.)	16HRS.
EST. COST = 1000.00 W/O			
TRAVEL EXPENSE* 50.00			50.00
MATERIAL TOTAL			

LABOR COSTS

EMPLOYEE	HOURS	RATE	AMOUNT
M	16	4.13	66.08
N	16	3.48	55.68
O	16	2.88	46.08
P	16	5.18	82.88
LABOR TOTAL			250.72

EQUIPMENT COSTS

EQUIPMENT	HOURS	RATE	AMOUNT
04-0554	16	5.69	91.04
19-0010	1	0.88	0.88
10-0026	4	2.25	9.00
03-0665	8	0.80	6.40
22-0501	2	4.56	9.12
04-0418	16	3.58	57.28
67-0202	16	3.85	61.92
03-0711	16	0.80	12.80
12-0101	6	0.82	4.92
EQUIPMENT TOTAL			253.36

GRAND TOTAL** 1069.08

*Men have to stay overnight for erection of span wires and signs next day.

**Grand total based on the assumption that men and equipment are transported for the sole purpose of this installation.

3. Installation of a sectional cantilever requires fewer man-hours than the installation of two steel poles with span wires. Four men are involved in both installation procedures, but the former requires only approximately half the time employed for the latter.
4. Handling and transporting a sectional cantilever is an easier operation than handling and transporting two monotube poles.
5. Installation of a sectional cantilever requires only one base; therefore, maintaining traffic during the erection of the cantilever involves approximately half the effort expended during erection of two monotube poles, span wires and lane control signs.

DISCUSSION

Our experience to this date with the sectional cantilever is limited to the installations at Howell and Albion. We feel that we obtained very good results due to the ease of transportation of the cantilever sections, the short time of erection and the limited number of man-hours required. However, we believe that because of the inconvenience encountered at Albion during the cantilever erection, we will have to determine in future installations how much height is needed for the shaft section to avoid possible interference with lines of existing utility poles. By doing so, our field crew will

not have to trim this section to make the vertical shaft fit at a required height. The bottom height of the lane control signs above pavement after final installation (19'-0" in Howell and 18'-6" in Albion) is somewhat excessive when one considers a height of 15'-6" is commonly used. The manufacturer provides several designs according to the required span length of cantilever arm and set-back distance for the base. Due to the fact that the sectional cantilever can be pieced together, its parts can be replaced in case of damage. In terms of safety, the base section of the cantilever appears less of a hazard upon impact than a monotube steel pole since the thickness of a monotube steel pole is approximately four times that of the base section of the cantilever. Additionally, the sectional cantilever installation offers one roadside obstruction as compared with two of the monotube poles for the span wire installation method.

SUMMARY AND CONCLUSIONS

The aim of this report is to describe the use of the sectional cantilever to support overhead lane control signs and to compare its use with the installation of two steel poles with span wires, the method currently used for this purpose. From an economical comparison, we have concluded that a sectional cantilever installation is less expensive than that utilizing two monotube steel poles with span wires wherever either installation could be used to support overhead lane assignments within the same dimensional requirements. We have also expressed our belief that a sectional cantilever is a safer installation than two monotube steel poles

with span wires. Maintenance of both types of installation requires painting of the surfaces to protect them against the progressive effects of corrosion due to weather and de-icing salts. Light standard supports and sign supports made of low-alloy steel (A-242) are among the structures not requiring painting according to published reports of the Highway Research Board. It is our opinion, however, that we should paint the sectional cantilever at least as often as we paint the monotube poles (once every five years) and after the protective coat of zinc has been completely weathered. By doing so, we will obtain more service life from the structure.

The Michigan Department of State Highways has, at present, several locations where it is felt practical to erect sectional cantilevers to support lane control signs. We therefore recommend the continued and expanded use of sectional cantilever installations within the limitations and recommendations set forth in this report.