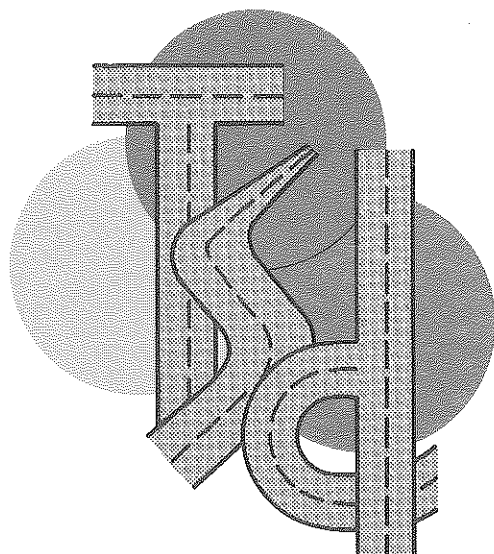


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PARCLO TERMINAL STUDY

Evaluation of driver errors  
and turning movements

TSD-G-110-69



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PARCLO TERMINAL STUDY

Evaluation of driver errors  
and turning movements

TSD-G-110-69

I-196 at Coloma Road  
Hagar Township, Berrien County

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Prepared By

Standards Unit  
Geometrics Section  
Traffic and Safety Division

February 1969

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Traffic Geometrics Engineer . . . . . R. A. Rigotti

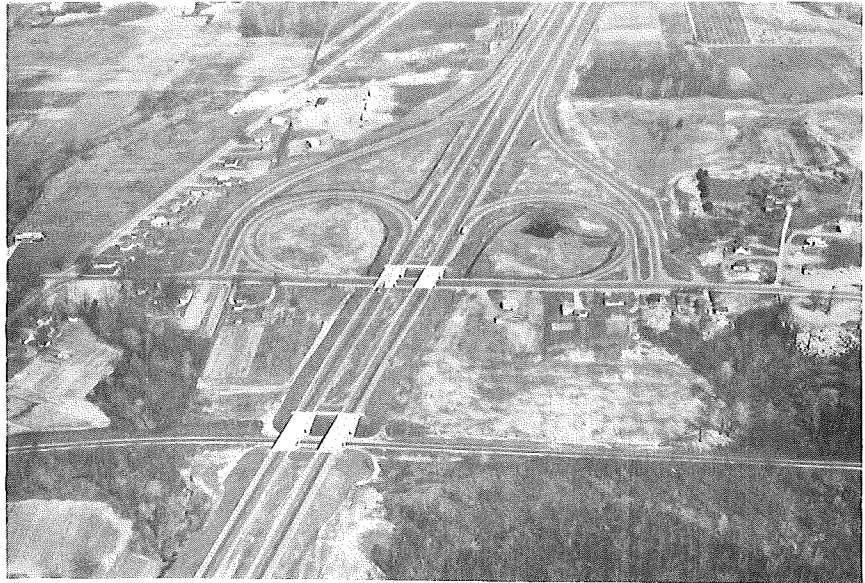
Standards Engineer . . . . . J. J. Kanillopoulos

Traffic Technician . . . . . L. E. Shaw

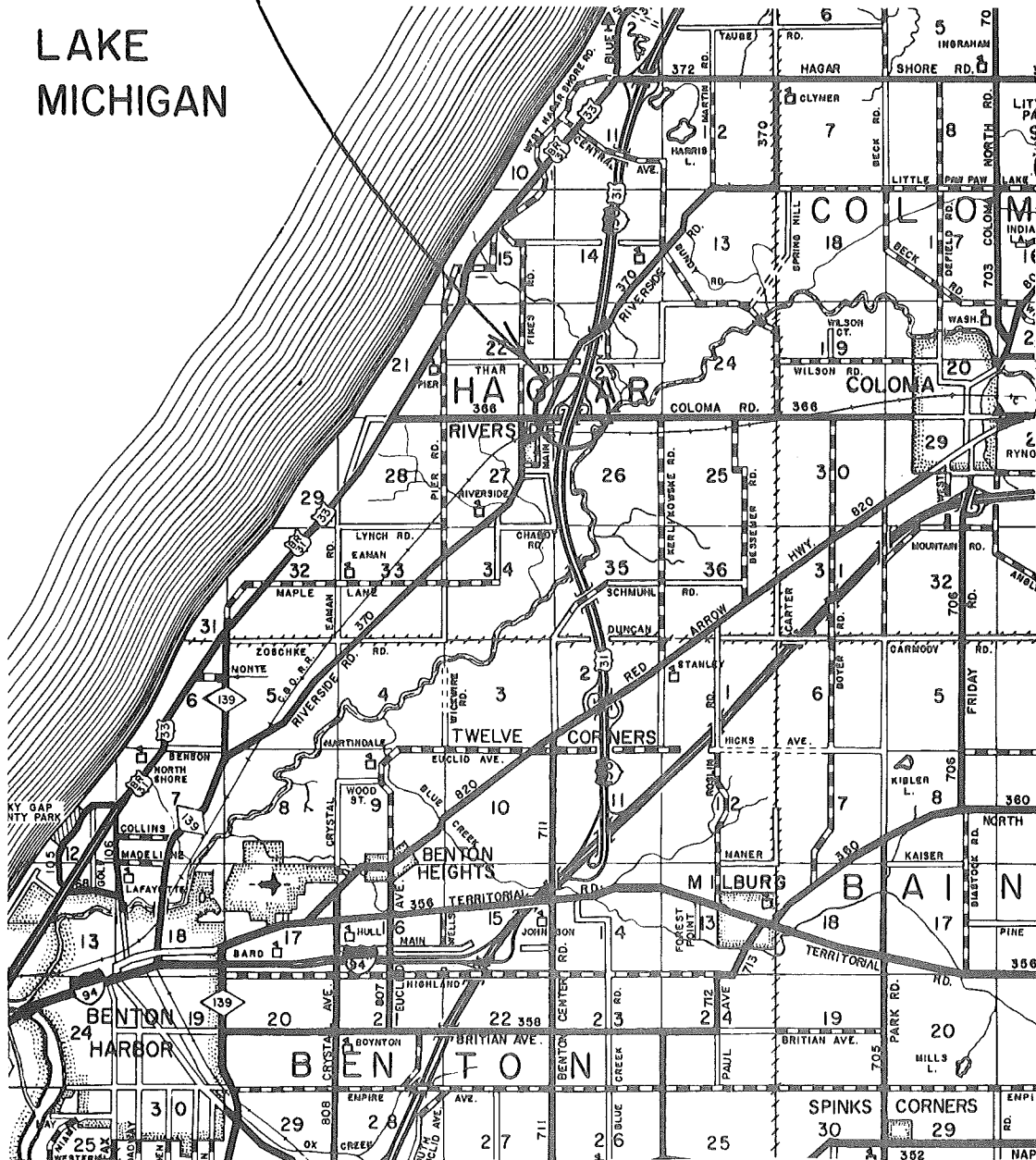
Contributor to the Report:

Allen A. Lampela  
Former Standards Engineer

Study Location  
I-196 & Coloma Rd.



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A study of errors and turning movements was conducted at the interchange of I-196 and Coloma Road before and after its reconstruction. The replacement of a nearby bridge and improvement in sight distance necessitated lowering the grade on Coloma Road, thereby requiring the ramps to be reconstructed. This provided an excellent opportunity to reconstruct the ramp terminals in the configuration that had been recommended as the result of previous parclo terminal studies and to compare the difference in operational characteristics of the old design to the new proposed design. The terminals at this location were reconstructed from the general design shown in Standard Guide E-20-7A (Exhibit #1) to the designs shown on Exhibits #2 and #3 (see Appendix - Photos 1 through 4).

The study consisted of evaluating the errors and turning paths of vehicles at the ramp terminals which were recorded in the following classifications:

1. Errors occurring at the ramp terminals; these were noted as:
  - A. Mistake - when a vehicle entered the wrong ramp (the exit ramp).
  - B. S-turn - when a vehicle started to enter the wrong ramp (the exit ramp) but was able to recover by swinging around the median nose and into the correct ramp.

- C. Miss - when the driver went past the ramp terminal and had to back up or turn around to enter.
  - D. Hesitation - when the driver paused before entering the ramp, apparently because he was uncertain as to which ramp to enter.
2. Turning movements.

- A. The point on the crossroad, relative to the median edge of the ramp, at which the vehicles turning left into the ramp crossed the center line (left front wheel was used as a control).
- B. The distance the driver's eye was from the edge of the crossroad in those vehicles which stopped before turning left from the exit ramp.

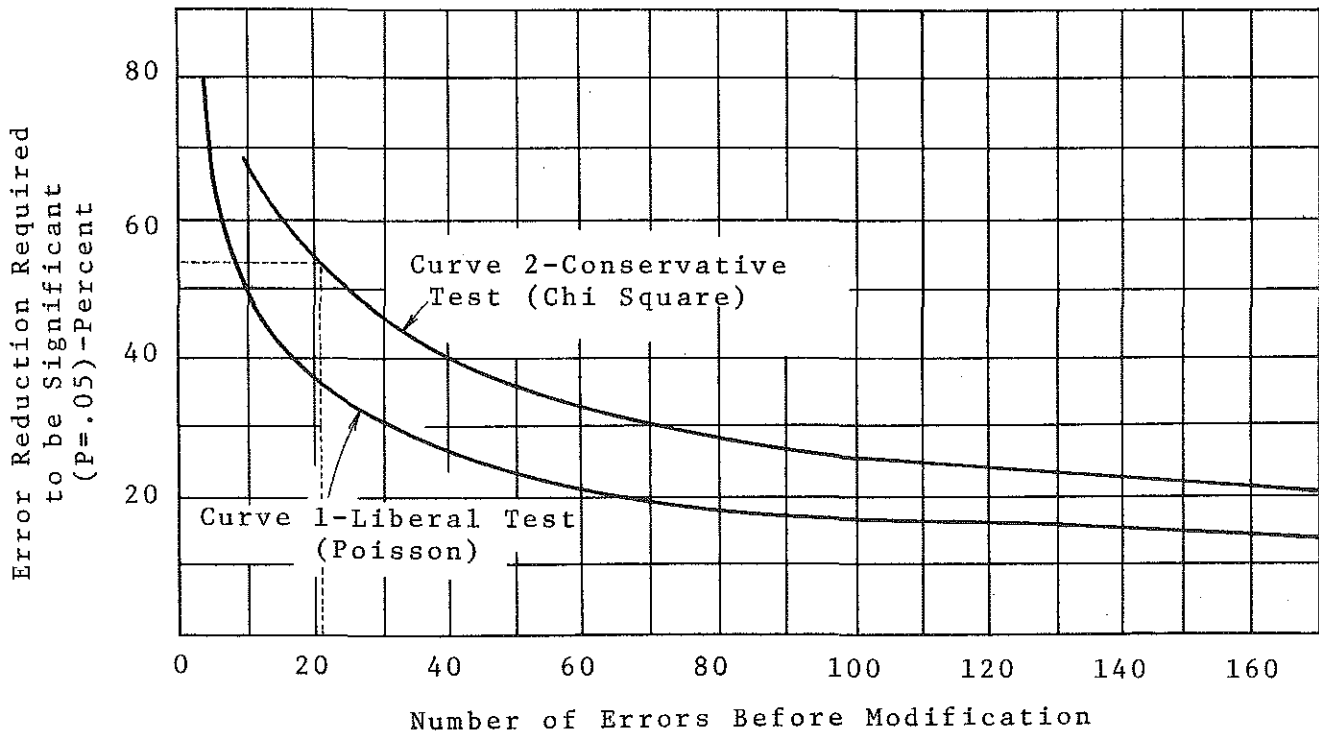
During the first study in August and September of 1965 before the terminals were reconstructed, errors were committed by 10.4% of the vehicles entering the ramps at this interchange. After reconstruction of the ramps, the study was repeated in August of 1967, and the errors dropped to 5.8%. In further breaking down the errors, before reconstruction, the east terminal experienced 10.0% errors; after reconstruction, only 0.2% errors were observed, a rather remarkable improvement. The western terminal originally experienced 10.5% errors, whereas after reconstruction 7.4% errors were observed with all

but one of these errors being misses (where the driver went past the ramp terminal and made a U-turn into the free-flow diverge ramp connection, as shown on Exhibit #4). On close inspection of this terminal, it appeared that some of these misses might possibly be attributed to signing deficiencies since the route signs labeling the entrance ramp were across Coloma Road and were obscured by trees. In addition, the "Do Not Enter" and "Keep Right" signs were situated so they appeared to pertain to the whole terminal, rather than just the exit ramp. Thus it appeared that the variations in errors between the eastern and western ramp terminals (since the terminals are similar in geometric design) might be largely attributable to the variation in signing, in addition to limited visibility of the sign opposite the western terminal.

Therefore, the signing at the western terminal was changed to conform with that of the eastern terminal (see Appendix - Photos 5 and 6), and the study was repeated in August 1968. The errors committed by vehicles entering the western ramp dropped from 7.4% to 2.9%, with only one vehicle making the previously-described U-turn movement into the free-flow connection. The overall rate of errors for vehicles entering both ramps dropped to 1.9%.

Since the signing change at the western terminal produced a larger drop in driver errors than reconstruction accomplished, it may appear that the reconstruction was not necessary. However, without the reconstruction, it was not possible to provide the signing that produced the results obtained in this study.

Further evaluation of the data was performed to be certain that the reduction in errors was due to the redesign and not chance. The data, using a base of 200 exposures before and after reconstruction, was subjected to the conservative test for determining the significance of improvements, as described in the article by Richard H. Michaels in "Public Roads" in 1959.



With 21 errors before reconstruction, the conservative test (curve 2) requires an improvement of approximately 54% to be significant. Therefore, with an 81% reduction of errors after reconstruction, the improvement is definitely significant.

As for the turning movements, in the original studies, the left turns from Coloma Road into the terminals were taken at a point 34 feet in advance of an imaginary line, representing

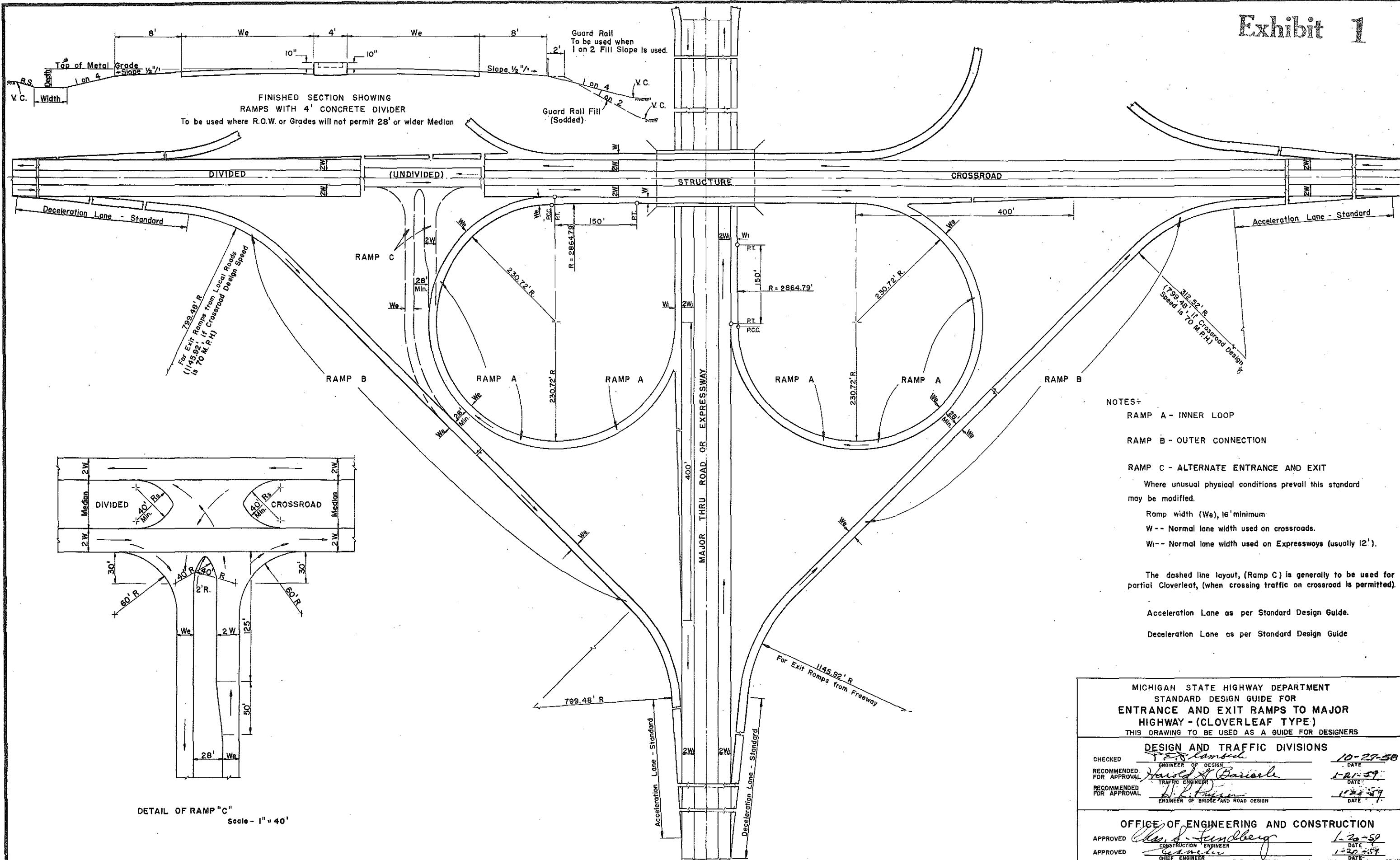


the edge of ramp pavement extended to the centerline of Coloma Road. In the study following reconstruction, the left turns began 43 feet and 44.5 feet in advance of the imaginary line for the western and eastern terminals, respectively. The distances indicate a definite shift in the left-turn movements, which was expected; however, the shift is not critical.

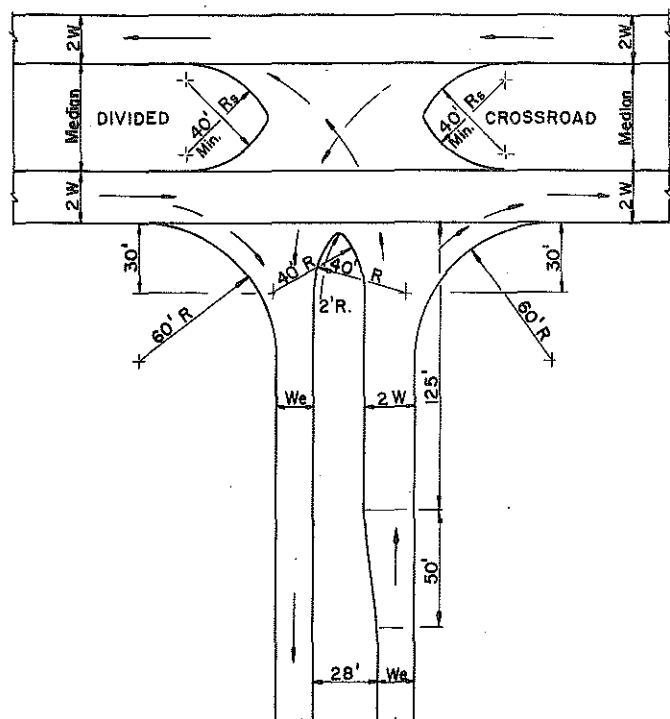
The position of the driver's eye relative to the edge of the crossroad prior to making a left turn onto Coloma Road (eastbound) is approximately 12 feet both before and after reconstruction. Apparently the position of the median nose in this instance has little effect on the driver's position, since the entering sight distance remained the same.

In conclusion, it is evident that with the total errors for both terminals reduced from roughly 10% to 2% and no adverse effect upon either the entering left-turn movement or the stopping position of exiting vehicles, the new parclo terminal is superior to the old design. Therefore, this basic configuration has been incorporated into the revised Standard Guide E-20-7B for cloverleaf type interchanges (see attached Guide E-20-7B).

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FINISHED SECTION SHOWING  
RAMP WITH 4' CONCRETE DIVIDER  
To be used where R.O.W. or Grades will not permit 28' or wider Median



**NOTES:**

- RAMP A - INNER LOOP
- RAMP B - OUTER CONNECTION
- RAMP C - ALTERNATE ENTRANCE AND EXIT

Where unusual physical conditions prevail this standard may be modified.

- Ramp width (We), 16' minimum
- W - Normal lane width used on crossroads.
- W<sub>i</sub> - Normal lane width used on Expressways (usually 12').

The dashed line layout, (Ramp C) is generally to be used for partial Cloverleaf, (when crossing traffic on crossroad is permitted).

- Acceleration Lane as per Standard Design Guide.
- Deceleration Lane as per Standard Design Guide.

MICHIGAN STATE HIGHWAY DEPARTMENT  
STANDARD DESIGN GUIDE FOR  
ENTRANCE AND EXIT RAMPS TO MAJOR  
HIGHWAY - (CLOVERLEAF TYPE)  
THIS DRAWING TO BE USED AS A GUIDE FOR DESIGNERS

**DESIGN AND TRAFFIC DIVISIONS**

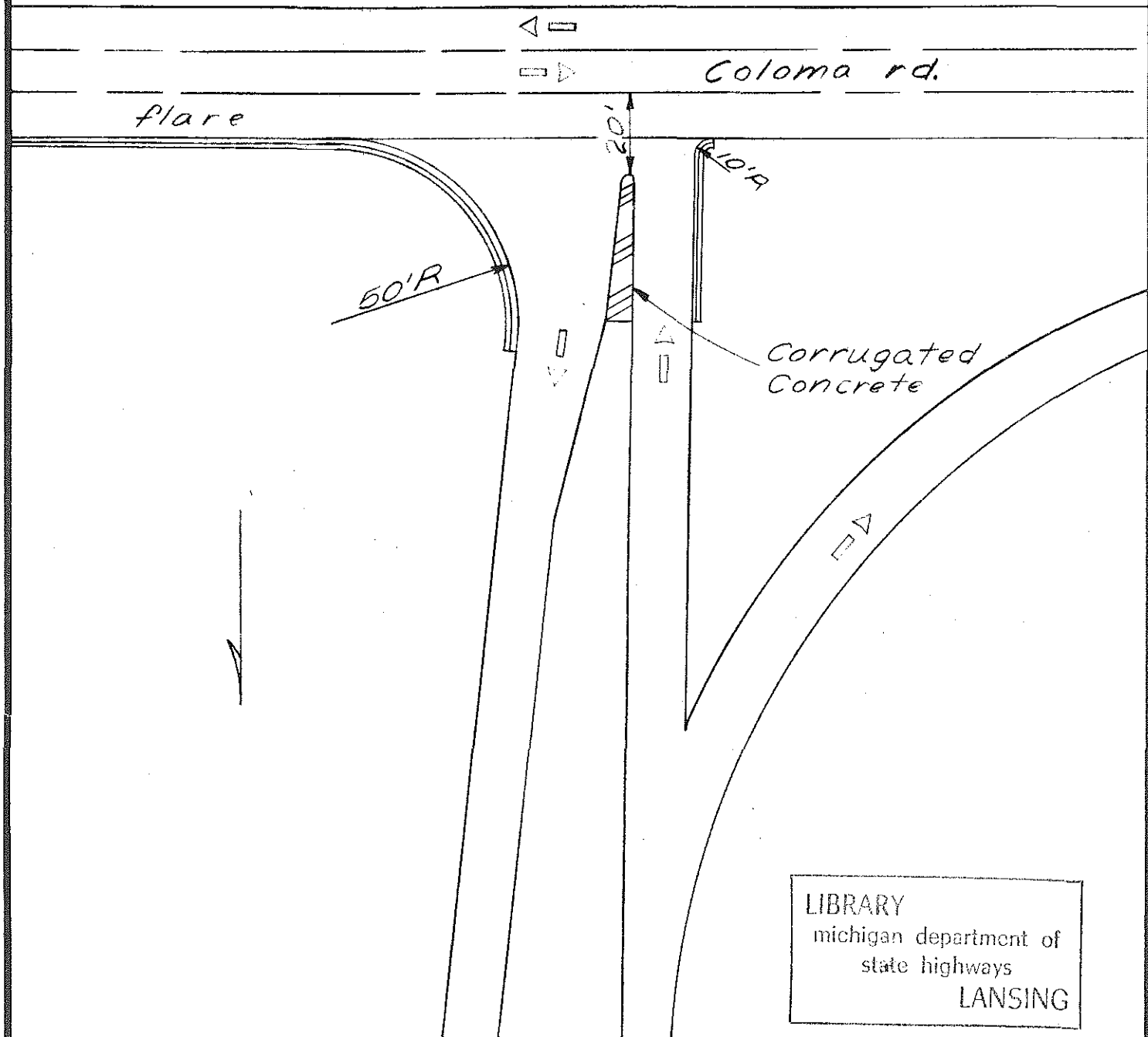
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|--------------------------|--------------------|----------|
| CHECKED                  | <i>[Signature]</i> | 10-27-58 |
| RECOMMENDED FOR APPROVAL | <i>[Signature]</i> | 1-21-59  |
| RECOMMENDED FOR APPROVAL | <i>[Signature]</i> | 1-20-59  |

OFFICE OF ENGINEERING AND CONSTRUCTION

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|----------|--------------------|---------|
| APPROVED | <i>[Signature]</i> | 1-20-59 |
| APPROVED | <i>[Signature]</i> | 1-20-59 |

DRAWN BY: W.H.S. CHECKED BY: W.H.S. TRACED BY: W.H.S.

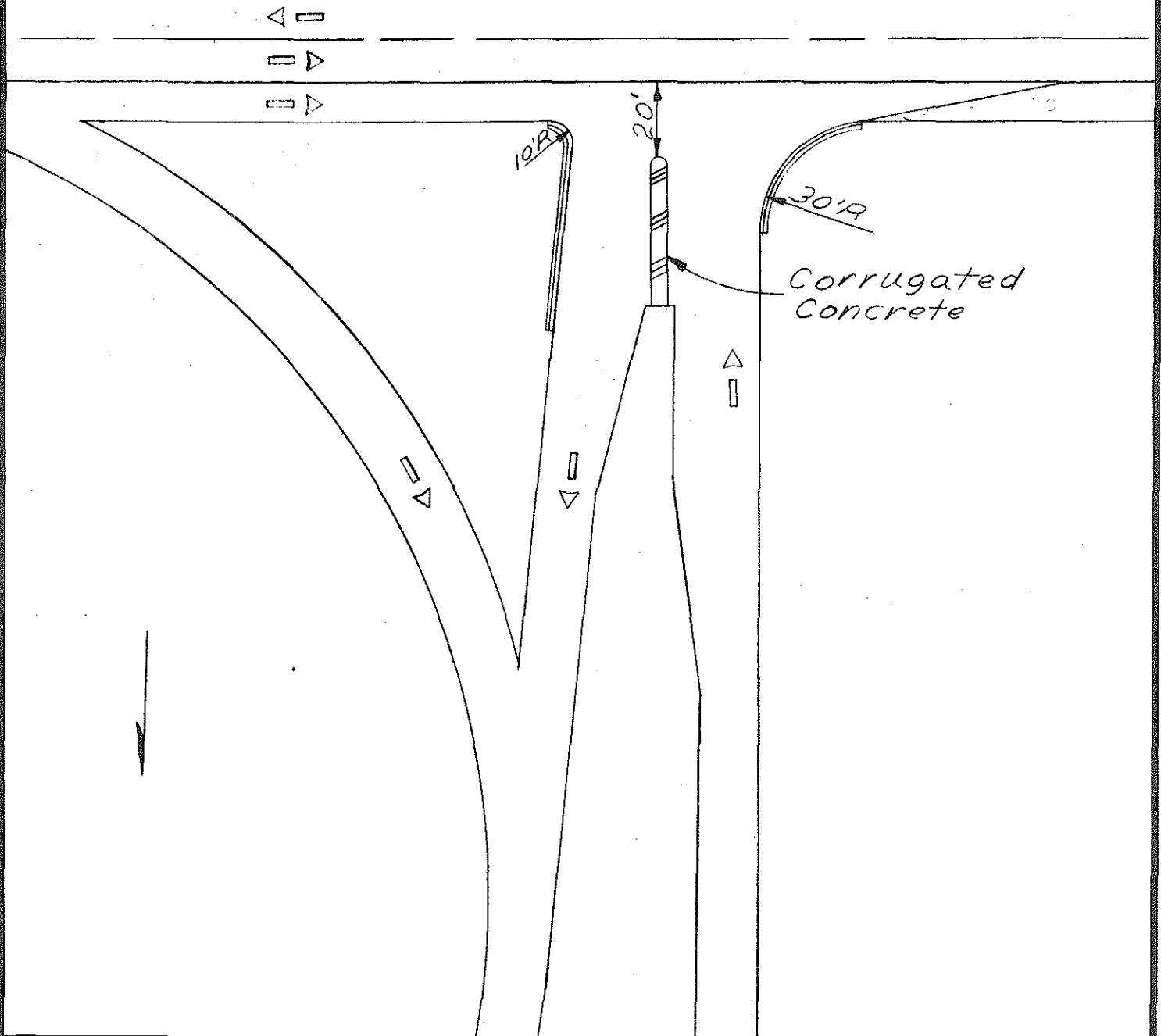
Exhibit #2



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|  |            |                        |   |
|--|------------|------------------------|---|
| MICHIGAN<br>STATE HIGHWAY DEPARTMENT<br><br>TRAFFIC DIVISION | AUTH. NO.  | DRAWN<br><i>L.E.S.</i> | <i>I-196 @ Coloma rd.<br/>         Eastern terminal<br/>         After reconstruction</i> |
|  | CONT. SEC. | DATE                   |   |
|  | REF.       | SCALE<br><i>1"=40'</i> |   |
|  | SHEET OF   | PLAN                   |   |

Exhibit #3



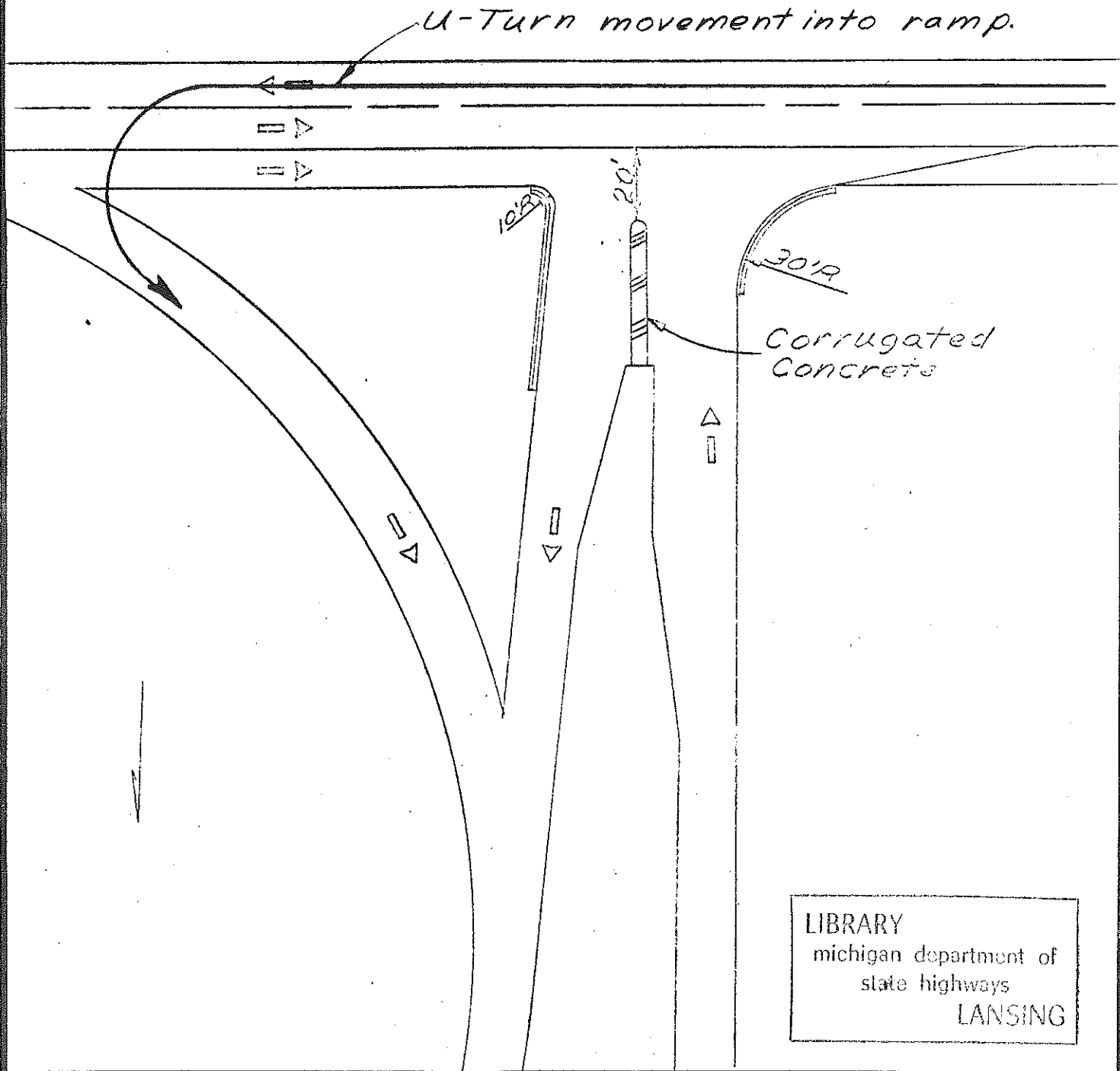
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STATE HIGHWAY DEPARTMENT  
TRAFFIC DIVISION

AUTH. NO.  
CONT. SEC.  
REF.  
SHEET OF PLAN

DRAWN  
L.E.S.  
DATE  
SCALE  
1"=40'

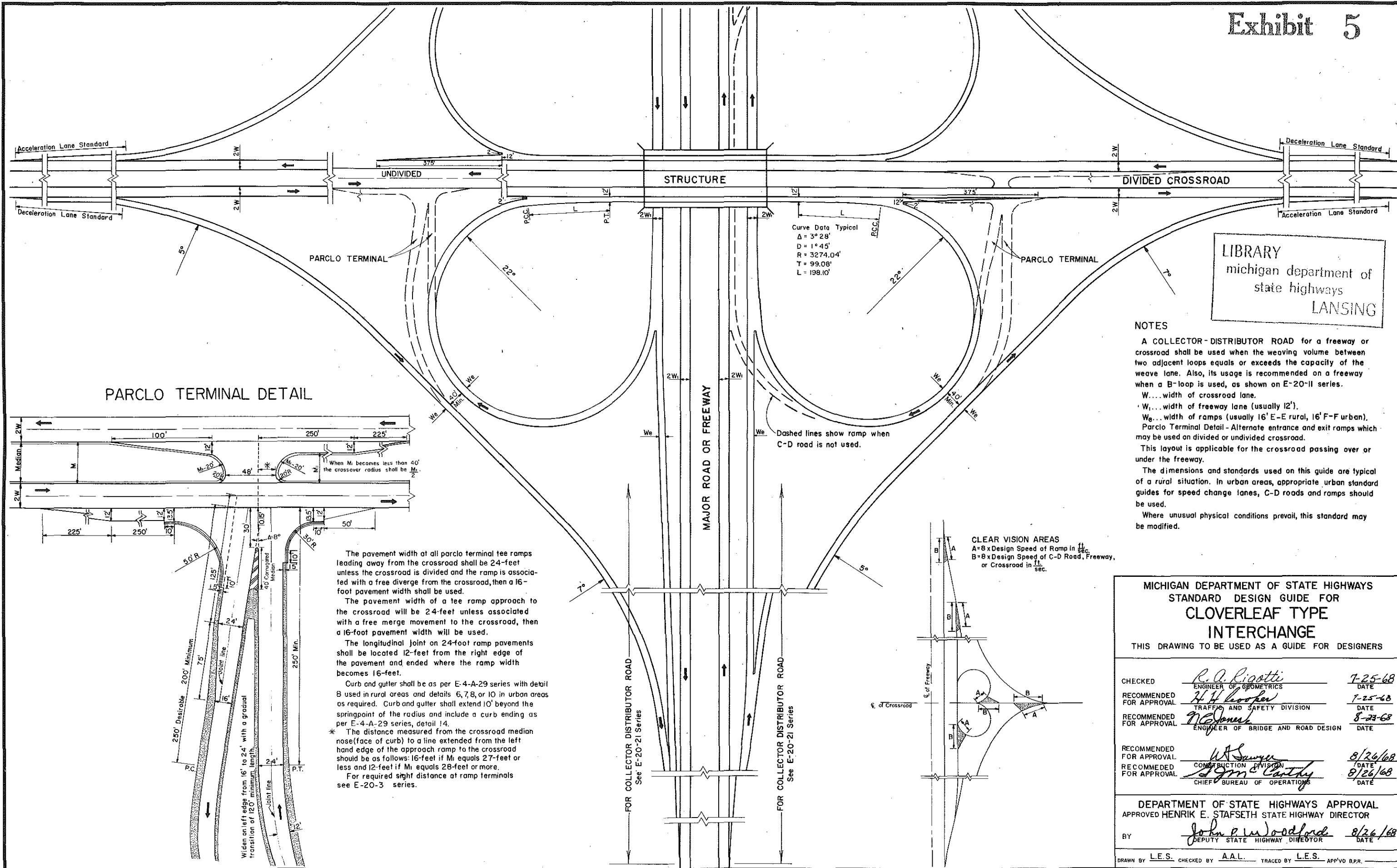
I-196 @ Coloma rd.  
Western Terminal  
After Reconstruction

Exhibit #4



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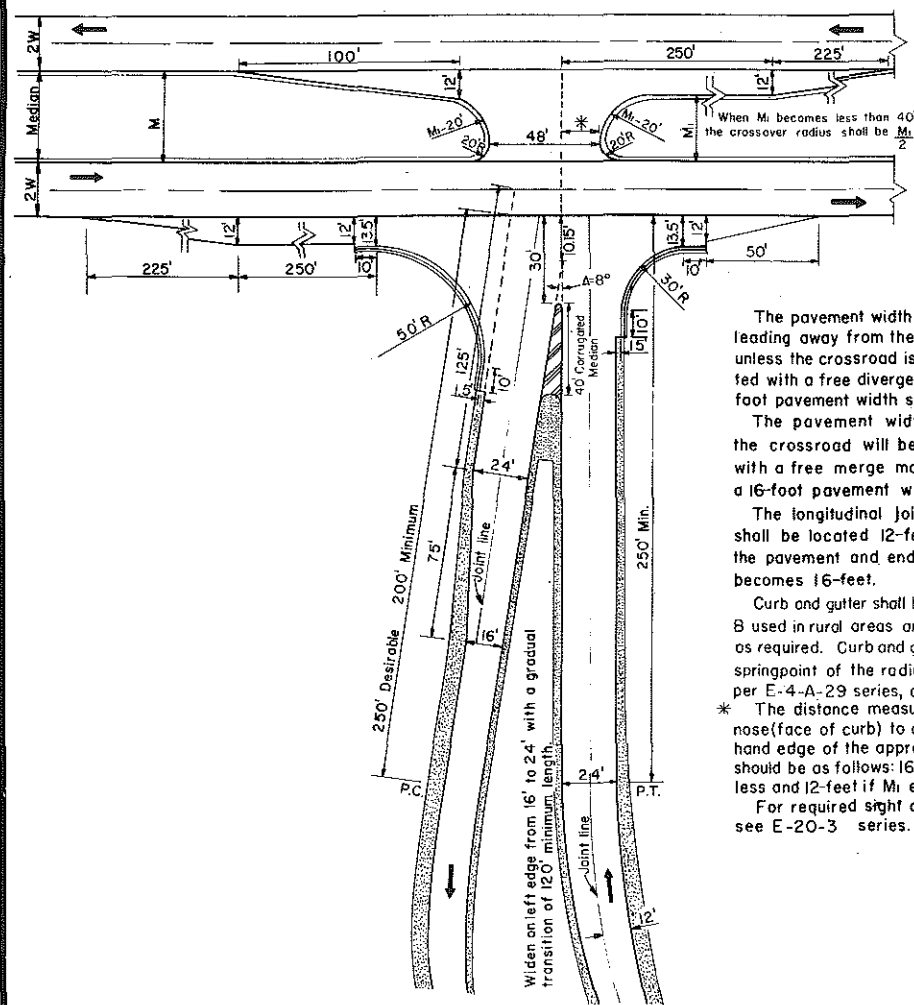
|  |            |                 |  |
|--|------------|-----------------|--|
| MICHIGAN<br>STATE HIGHWAY DEPARTMENT<br><br>TRAFFIC DIVISION | AUTH. NO.  | DRAWN<br>L.E.S. | I-196 @ Coloma rd.<br>Eastern terminal<br>After reconstruction |
|  | CONT. SEC. | DATE            |  |
|  | REF.       | SCALE<br>1"=40' |  |
|  | SHEET OF   | PLAN            |  |



Curve Data Typical  
 $\Delta = 3^\circ 28'$   
 $D = 1^\circ 45'$   
 $R = 3274.04'$   
 $T = 99.08'$   
 $L = 198.10'$

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PARCLO TERMINAL DETAIL



The pavement width at all parclo terminal tee ramps leading away from the crossroad shall be 24-feet unless the crossroad is divided and the ramp is associated with a free diverge from the crossroad, then a 16-foot pavement width shall be used.

The pavement width of a tee ramp approach to the crossroad will be 24-feet unless associated with a free merge movement to the crossroad, then a 16-foot pavement width will be used.

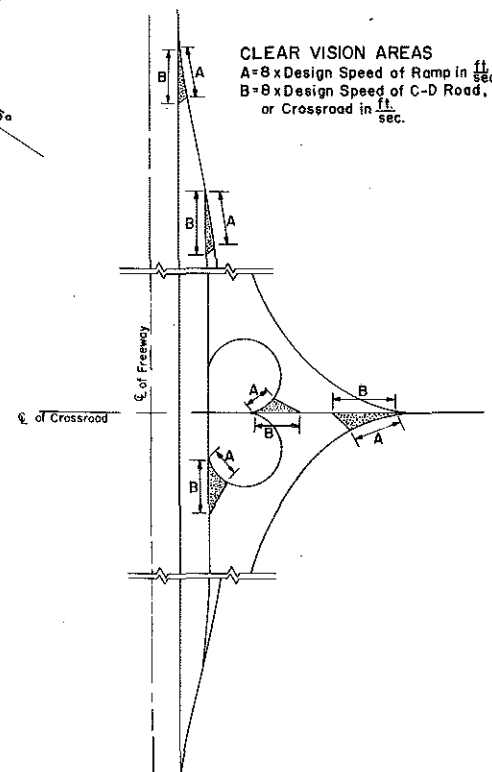
The longitudinal joint on 24-foot ramp pavements shall be located 12-feet from the right edge of the pavement and ended where the ramp width becomes 16-feet.

Curb and gutter shall be as per E-4-A-29 series with detail B used in rural areas and details 6, 7, 8, or 10 in urban areas as required. Curb and gutter shall extend 10' beyond the springpoint of the radius and include a curb ending as per E-4-A-29 series, detail 14.

\* The distance measured from the crossroad median nose (face of curb) to a line extended from the left hand edge of the approach ramp to the crossroad should be as follows: 16-feet if  $M_i$  equals 27-feet or less and 12-feet if  $M_i$  equals 28-feet or more.

For required sight distance at ramp terminals see E-20-3 series.

CLEAR VISION AREAS  
 $A = 8 \times \text{Design Speed of Ramp in } \frac{ft}{sec}$   
 $B = 8 \times \text{Design Speed of C-D Road, Freeway, or Crossroad in } \frac{ft}{sec}$



NOTES

A COLLECTOR-DISTRIBUTOR ROAD for a freeway or crossroad shall be used when the weaving volume between two adjacent loops equals or exceeds the capacity of the weave lane. Also, its usage is recommended on a freeway when a B-loop is used, as shown on E-20-II series.

W...width of crossroad lane.  
 $W_f$ ...width of freeway lane (usually 12').  
 $W_r$ ...width of ramps (usually 16' E-E rural, 16' F-F urban).

Parclo Terminal Detail - Alternate entrance and exit ramps which may be used on divided or undivided crossroad.

This layout is applicable for the crossroad passing over or under the freeway.

The dimensions and standards used on this guide are typical of a rural situation. In urban areas, appropriate urban standard guides for speed change lanes, C-D roads and ramps should be used.

Where unusual physical conditions prevail, this standard may be modified.

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
 STANDARD DESIGN GUIDE FOR  
 CLOVERLEAF TYPE  
 INTERCHANGE  
 THIS DRAWING TO BE USED AS A GUIDE FOR DESIGNERS

|                          |  |                 |
|--------------------------|--|-----------------|
| CHECKED                  | <i>R. A. Riatti</i><br>ENGINEER OF GEOMETRICS            | 7-25-68<br>DATE |
| RECOMMENDED FOR APPROVAL | <i>H. H. Cooper</i><br>TRAFFIC AND SAFETY DIVISION       | 7-25-68<br>DATE |
| RECOMMENDED FOR APPROVAL | <i>M. J. Jones</i><br>ENGINEER OF BRIDGE AND ROAD DESIGN | 8-23-68<br>DATE |
| RECOMMENDED FOR APPROVAL | <i>W. A. Sawyer</i><br>CONSTRUCTION DIVISION             | 8/26/68<br>DATE |
| RECOMMENDED FOR APPROVAL | <i>John P. Woodford</i><br>CHIEF BUREAU OF OPERATIONS    | 8/26/68<br>DATE |

DEPARTMENT OF STATE HIGHWAYS APPROVAL  
 APPROVED HENRIK E. STAFSETH STATE HIGHWAY DIRECTOR  
 BY *John P. Woodford* DEPUTY STATE HIGHWAY DIRECTOR 8/26/68 DATE  
 DRAWN BY L.E.S. CHECKED BY A.A.L. TRACED BY L.E.S. APP'VD B.P.R.

APPENDIX

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I-196 @ Coloma Road  
West Terminal

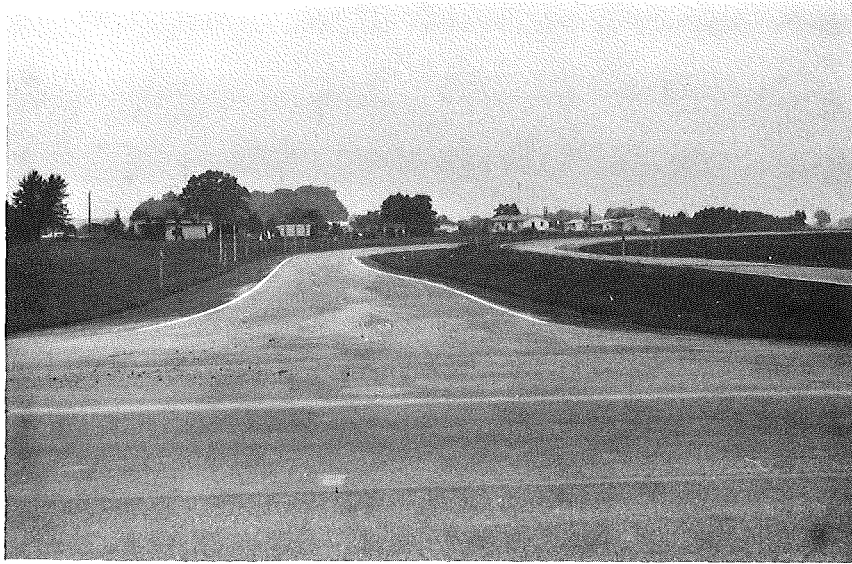


Photo 1

Before Reconstruction

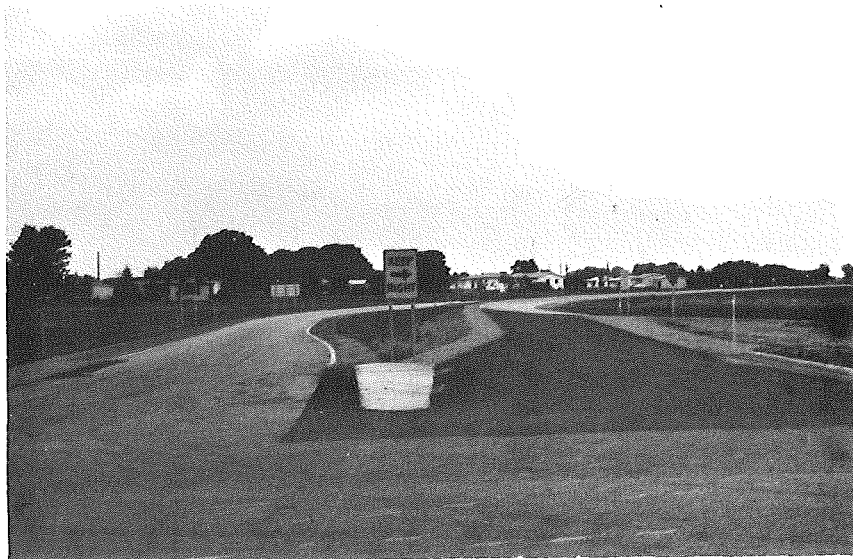


Photo 2

After Reconstruction



I-196 @ Coloma Road  
East Terminal

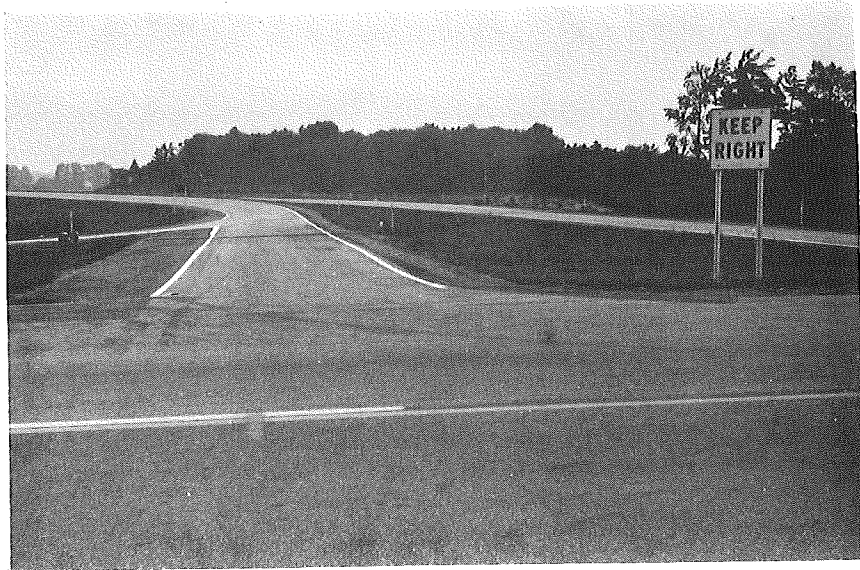


Photo 3

Before Reconstruction

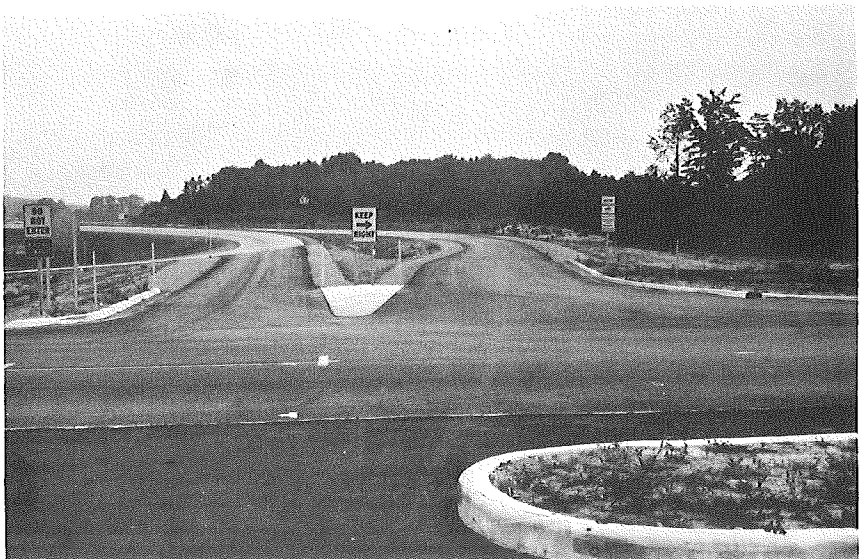


Photo 4

After Reconstruction

I-196 @ Coloma Road  
West Terminal

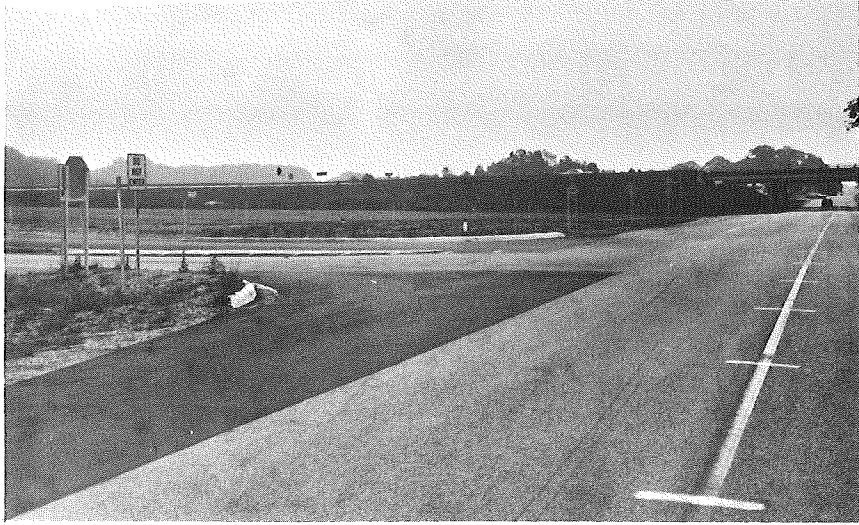


Photo 5

Before Sign Changes

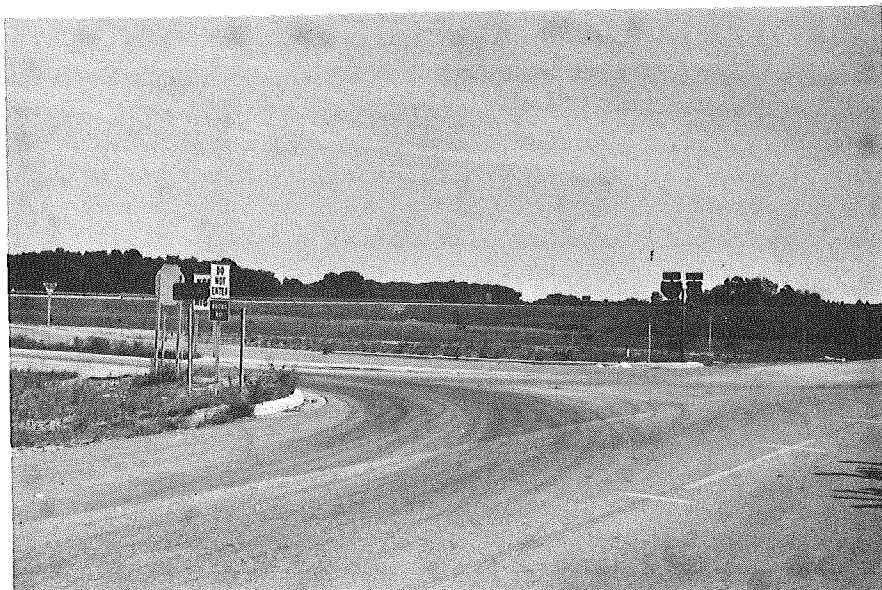


Photo 6

After Sign Changes