GEOMETRIC DESIGN CRITERIA

OHIO DEPARTMENT OF HIGHWAYS

BUREAU OF LOCATION & DESIGN

MAY 1, 1964

NOTES FOR CLASS I ENTRANCE & EXIT TERMINALS

A. GENERAL

1. Class I Terminals are intended for use on all Rural Interstate Highways. They will be used on such other Limited Access facilities as may be recommended by the Engineer of Location and Design.

B. EXIT TERMINAL

1. Exit Curve Dc_1 shall be 1°-30' where the mainline is on tangent alignment. Where the mainline is on a curving alignment, the maximum differential between Dc_1 and the mainline curve shall normally be 1°-30. This differential, however, may vary by as much as one degree in order to avoid a tangent exit alignment.

2. The 800' deceleration lane length may be reduced to 600' if such reduction would eliminate the need for bridge widening.

3. When Ramp Curve Dc_2 does not exceed 8°, Exit Curve Dc_1 may be compounded directly with Dc_2 at a PCC 100' beyond the nose. When Dc_2 does exceed 8°, a 200' spiral should be placed between Dc_1 and Dc_2 and the beginning of the spiral (CS) should be at the exit nose.

C. ENTRANCE TERMINAL

1. The acceleration lane shall be a uniform taper (48:1) relative to the main pavement edge for either tangent or curving alignment.

2. The right edge of the 300' pacing area shall be a rearward extension of the right edge of the acceleration lane (i.e. on a 48:1 taper relative to the mainline).

3. When Ramp Curve Dc_3 does not exceed 8°, the PT shall be at the beginning of the 300' pacing area. When Dc_3 does exceed 8°, a 200' spiral shall be placed between Dc_3 and the pacing area.

4. The Type 7 Curb shall begin where the ramp pavement edge is approximately 40' from the mainline pavement edge.

D. RAMP WIDTH

1. Normally single lane ramps will have a width (w) of 16'. However, if it is necessary to introduce a ramp whose radius is less than 200', the width (w) must be increased to 18'.

E. PAVED BERM

1. If the paved (stabilized) berm is less than 8' in width along the mainline, this lesser width shall be used along the speed change lanes.

2. If the mainline paved (stabilized) berm beyond the exit nose is less than 10', the paved berm shall be reduced from 10' at the end of the paved apron (100' beyond the exit nose) to the normal width on a 25:1 taper.

3. The 10' to 20' variable width paved berm of the entrance terminal shall be sloped for 10' as required for mainline design (usually 1/2 in./ft.) except for the last 100' (approx.) at the curb nose which may vary. The remaining paved berm width may slope (1 in./ft. maximum) toward or away from the Type 8 curb as required for proper terminal grading.

F. SUPERELEVATION

1. At Class I Terminals, superelevation shall be developed using the following guide lines:

   (a) The rate of superelevation at the entrance and exit nose shall be selected on the basis of a design speed at the nose of 20 mph lower than the design speed of the mainline.

   (b) All transverse changes or breaks in superelevation shall be made at joint lines (See Joint Detail Drawings). In the case of bituminous pavement, the superelevation breaks should occur in the same locations as they would in concrete pavement.

   (c) The transverse breaks in superelevation cross-slope shall not exceed a differential of .032 ft/ft at the mainline pavement edge or .050 ft/ft at other locations. If a double break occurs on longitudinal joints less than 6' apart, it shall not exceed a total differential of .032 ft/ft if adjacent to the mainline or .050 ft/ft elsewhere.

   (d) The rate of rotation of a superelevated ramp pavement, or speed change lane pavement shall not exceed .050 ft/ft per station.

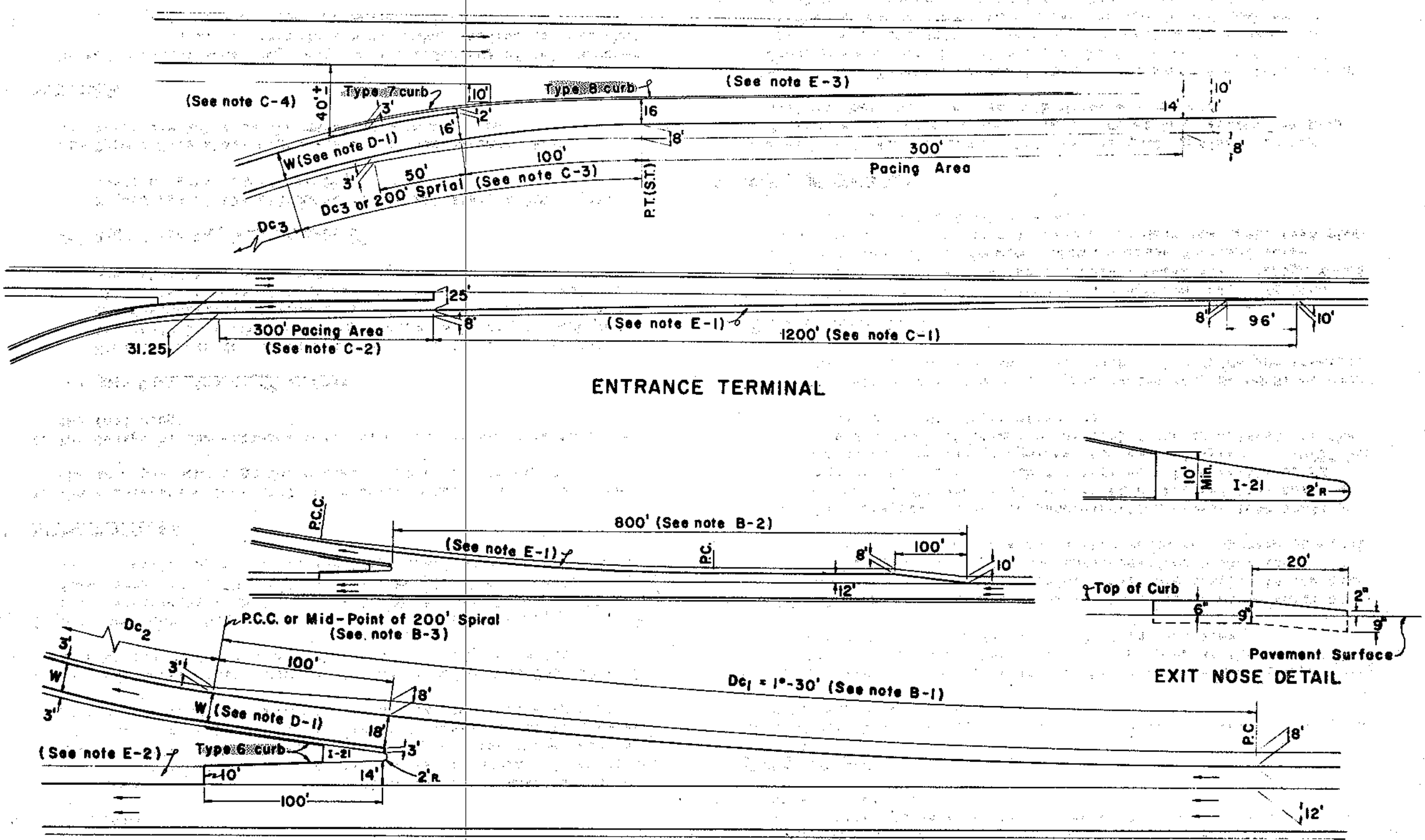
G. CREST VERTICAL CURVES

1. Where an exit terminal is located on a mainline crest vertical curve, this mainline curve should have a K=750 for a design speed of 80 mph and 480 for 70 mph. Where a crest vertical curve occurs on an exit ramp at or near the nose, this ramp curve should have a K value of 150. (K times algebraic difference of grades equals vertical curve length).

H. LEFT SIDE TERMINALS

1. A Left Side Exit Terminal shall be designed similarly to the drawing shown but of opposite hand. Paved berm widths and transitions shall be in accord with Notes E-1 and E-2.

a. A Left Side Entrance Terminal shall be designed similarly to the drawing shown here but of opposite hand. However, the curb clearance on the left of the mainline shall be 5' from the edge of the through pavement to the face of the Type 8 Curb and the acceleration taper shall be 60:1. Paved berm widths and transitions shall be in accord with Notes E-1 and E-2.



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OHIO DEPARTMENT OF HIGHWAYS
Bureau of Location & Design

GEOMETRIC DESIGN CRITERIA

CLASS I ENTRANCE
& EXIT TERMINALS

Drawing No.
Revisions
Appr. R.N. Ricketts Date 5-1-64

NOTES FOR CLASS II ENTRANCE & EXIT TERMINALS

A. GENERAL

1. Class II Terminals are intended for use on Urban Interstate Highways and all other limited access facilities where the use of Class I is not designated or required.

B. EXIT TERMINAL

1. Exit Curve Dc_1 shall be 4^o-00' maximum where the mainline is on tangent alignment. Where the mainline is on curving alignment the maximum differential between Dc_1 and the mainline curve shall normally not exceed 4^o. This differential, however, may vary by as much as one degree in order to avoid a tangent exit alignment.

2. The 800' deceleration lane length may be reduced to 600' if such a reduction would eliminate the need for bridge widening.

3. When Ramp Curve Dc_2 does not exceed 8^o, Exit Curve Dc_1 may be compounded directly with Dc_2 at a PCC 100' beyond the nose. When Dc_3 does exceed 8^o, a 200' spiral should be placed between Dc_1 and Dc_2 and the beginning of the spiral (CS) should be at the exit nose.

C. ENTRANCE TERMINAL

1. The acceleration lane shall be a uniform taper (40:1) relative to the main pavement edge for either tangent or curving alignment.

2. The design of the entrance terminal curvature shall be based on the following:

   (a) Ramp Curve Dc_3 of 8^o of Less

   When the mainline is on a tangent or a curve to the right, Dc_4 shall be a 200' long simple curve of a degree such that the differential between it and the mainline will not exceed 4^o. When the mainline is on a curve to the left a 200' tangent shall be substituted for Dc_4.

   (b) Ramp Curve Dc_3 Greater than 8^o

   Regardless of the alignment of the mainline, a 200' spiral shall be substituted for Dc_4.

3. The Type 7 Curb shall begin where the ramp pavement edge is approximately 40' from the mainline pavement edge.

D. RAMP WIDTH

1. Normally single lane ramps will have a width (w) of 16'. However, if it is necessary to introduce a ramp whose radius is less than 200', the width (w) must be increased to 18'.

E. PAVED BERM

1. If the paved (stabilized) berm is less than 8' in width along the mainline, this lesser width shall be used along the speed change lanes.

2. When the mainline paved (stabilized) berm beyond the exit nose is less than 10', the paved berm shall be reduced from 10' at the end of the paved apron (100' beyond the exit nose) to the normal width on a 25:1 taper.

F. SUPERELEVATION

1. At Class II Terminals, superelevation shall be developed using the following guide lines:

   (a) The rate of superelevation at the entrance and exit nose shall be selected on the basis of a design speed at the nose of 20 mph lower than the design speed of the mainline.

   (b) All transverse changes or breaks in superelevation shall be made at joint lines (See Joint Detail Drawings). In the case of bituminous pavement, the superelevation breaks should occur in the same location as they would in concrete pavement.

   (c) The transverse breaks in superelevation cross-slope shall not exceed a differential of .032 ft/ft at the mainline pavement edge or .050 ft/ft at other locations. If a double break occurs on longitudinal joints less than 6' apart, it shall not exceed a total differential of .032 ft/ft if adjacent to the mainline or .050 ft/ft elsewhere.

   (d) The rate of rotation of a superelevated ramp pavement or speed change lane pavement shall not exceed .050 ft/ft per station.

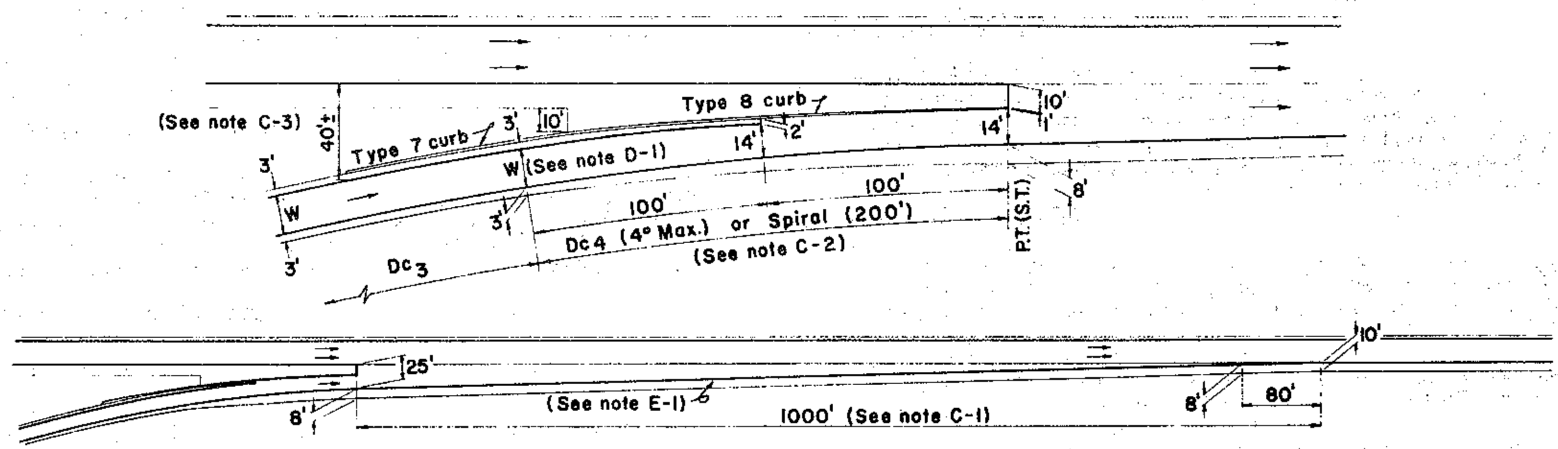
G. CREST VERTICAL CURVES

1. Where an exit terminal is located on a mainline crest vertical curve, this mainline curve should have a K=480 for a design speed of 70 mph and 300 for 60 mph. Where a crest vertical curve occurs on an entrance or exit ramp at or near the nose, this ramp curve should have a K value of 100.

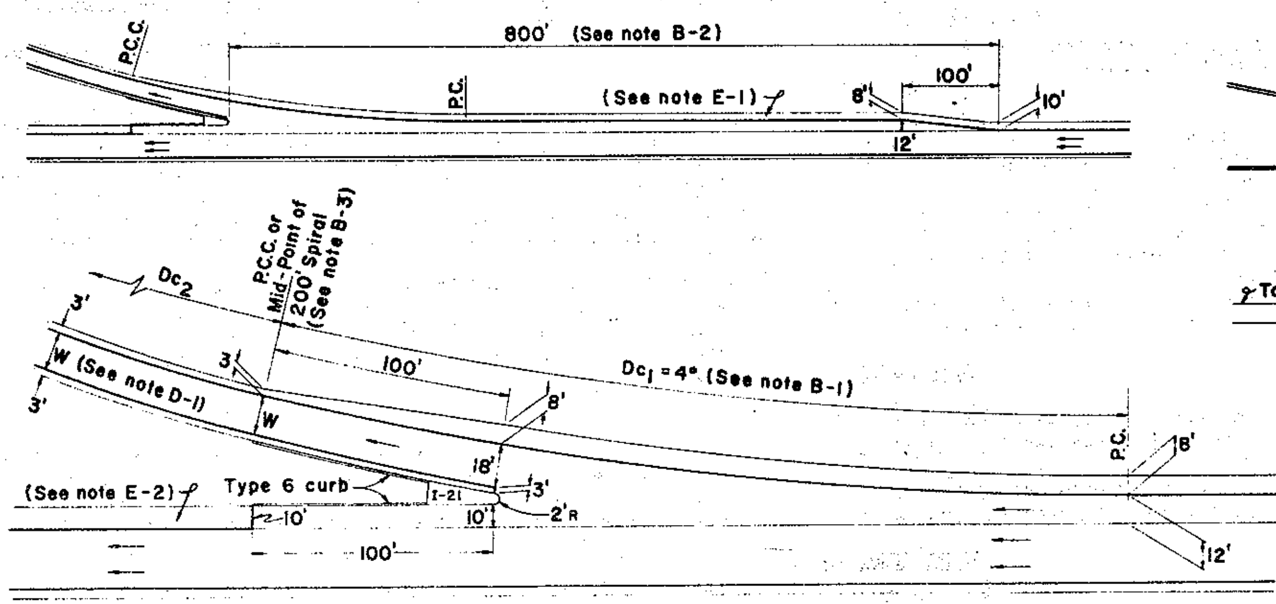
H. LEFT SIDE TERMINALS

1. A Left Side Exit Terminal shall be designed similarly to the drawing shown but of opposite hand. Paved berm widths and transitions shall be in accord with Notes E-1 and E-2.

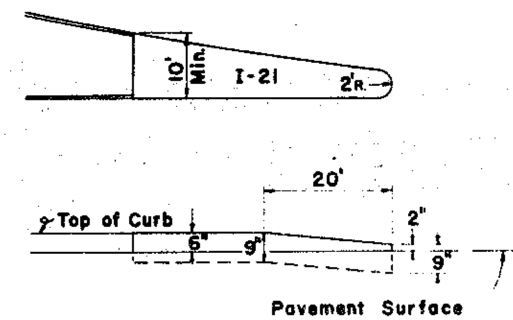
2. A Left Side Entrance Terminal shall be designed similarly to the drawing shown here but of opposite hand. However, the curb clearance on the left of the mainline shall be 5' from the edge of the through pavement to the face of the Type 8 Curb and the acceleration taper shall be 50:1. Paved berm widths and transitions shall be in accord with Notes E-1 and E-2.



ENTRANCE TERMINAL



EXIT TERMINAL



EXIT NOSE DETAIL

OHIO DEPARTMENT OF HIGHWAYS Bureau of Location & Design
GEOMETRIC DESIGN CRITERIA
CLASS II ENTRANCE & EXIT TERMINALS
Drawing No. / Revisions
Appr. [signature] Date 5-1-64

NOTES FOR CLASS III ENTRANCE & EXIT TERMINALS

A. GENERAL

1. Class III Terminals are intended for use on highways which have little or no access control excepting through an interchange area. Many of the features of Class III Terminals are applicable to a terminal of one ramp with another ramp in a freeway interchange.

B. EXIT TERMINALS: TYPE A & TYPE B

1. Type A shall normally be used on highways (including off system highways) having design speeds of 50 or 60 mph, however, Type B may be used where substantial savings in bridge or right of way cost would result. Type B shall normally be used on highways having design speeds of 40 mph or less.

2. The curve differential between the through roadway and exit curve Dc_1 may vary from a minimum of 4^o to the maximum allowable differential as shown in column 3 of Table A.

3. Exit curve Dc_1 may be either compounded or spiraled into ramp curve Dc_2. To determine the treatment between Dc_1 and Dc_2 Table B shall be used.

C. ENTRANCE TERMINALS: TYPE A & TYPE B

1. Type A is preferred and shall normally be used, however, when a ramp enters as an added lane or as a combined acceleration-deceleration lane Type B may be used if its use would result in a substantial savings in cost (i.e. reduced bridge width).

2. The acceleration lane of Type A shall be a uniform taper relative to the through pavement edge for either tangent or curving alignment. A 40:1 taper shall be used for design speeds of 50 or 60 mph and a 30:1 taper shall be used for design speeds of 40 mph or less.

3. The curve differential between the through roadway and entrance curve Dc_5 of Type B shall be 4^o.

4. The design of the entrance terminal shall be based on the following:

   (a) <u>Ramp Curve Dc_3 of 8^o or Less</u>

   When the through roadway is on tangent or curve to the right, Dc_4 shall be a 150' long simple curve of a degree such that the differential between it and the through roadway will not exceed 4^o. When the through roadway is on a curve to the left, a 150' tangent shall be substituted for Dc_4.

   (b) <u>Ramp Curve Dc_3 Greater Than 8^o</u>

   A 150' spiral shall be substituted for Dc_4.

5. The Type 7 Curb shall begin where the ramp pavement edge is approximately 40' from the through roadway pavement edge.

D. RAMP WIDTH

1. Normally single lane ramps will have a width (w) of 16'. The width (w) shall be increased to 18' when the ramp radius is less than 200'.

2. When it is necessary to provide curbing on a ramp without paved berms, the curbing shall be offset one foot from the normal pavement edge.

E. PAVED BERM

1. The width of the paved (stabilized) berm along the speed change lane shall be the same as the through roadway.

2. When the through roadway paved (stabilized) berm beyond the exit nose is less than 8', the berm shall be reduced from 8' at the end of the paved apron (100' beyond the exit nose) to the normal width on a 25:1 taper.

3. The Special Detail drawings shall apply when stabilized berm is used in lieu of paved berm or when the through roadway is curbed.

F. SUPERELEVATION

1. At Class III Terminals, superelevation shall be developed using the following guide lines:

   (a) The rate of superelevation at the entrance and exit nose shall be selected by using the speeds listed under column 4 of Table A. To satisfy these superelevation requirements where the through roadway curves to the left it may be necessary to use a degree of curve for Dc_1 less than the maximum shown.

   (b) All transverse changes or breaks in superelevation shall be made at joint lines (see Joint Detail Drawings). In the case of bituminous pavement, the superelevation breaks should occur in the same location as they would in concrete pavement.

   (c) The transverse breaks in superelevation cross-slope shall not exceed a differential of .05 to .06 ft/ft.

   (d) The rate of rotation of a superelevated ramp or speed change lane pavement shall not exceed .05 to .06 ft/ft per station. Values as high as .08 ft/ft may be used on 30 mph or lower design speed ramps.

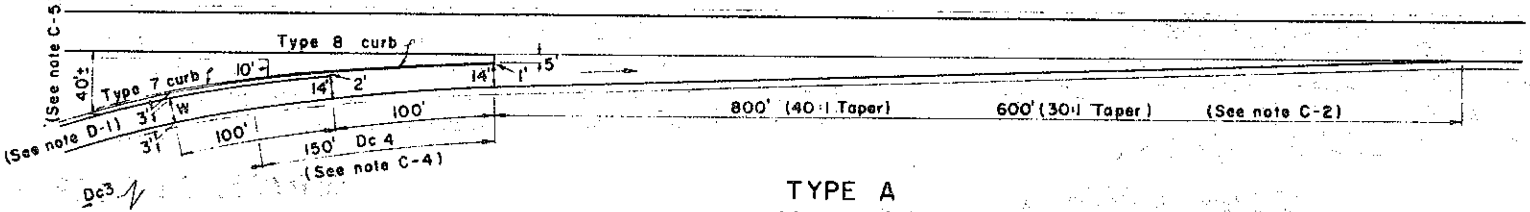
G. CREST VERTICAL CURVES

1. When an exit terminal is located on a through roadway crest vertical curve, this curve should have a K value as shown in column 2 of Table A. When a crest vertical curve occurs on an exit or entrance ramp at or near the nose, this ramp curve should have a K value (based on 3.75' to 6") for a nose speed as shown in column 4 of Table A.

H. LEFT SIDE TERMINALS

1. Left side entrance and exits shall be designed similarly to the drawings shown but of opposite hand.

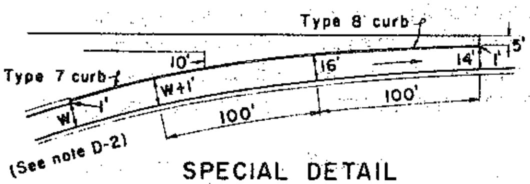
ENTRANCE TERMINALS



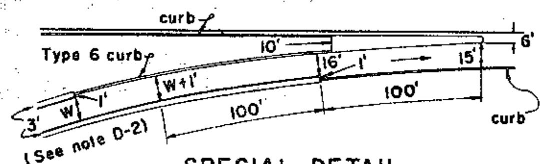
TYPE A
(See note C-1)

TABLE A

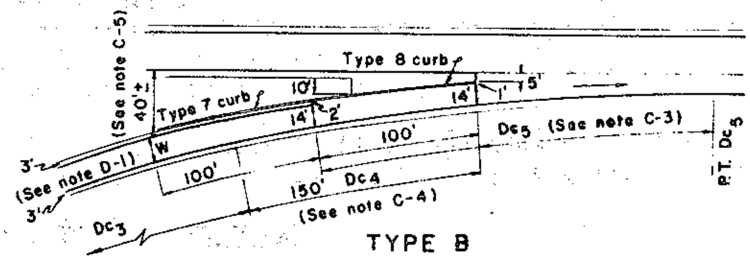
THRU ROADWAY DESIGN SPEED COL.(1)	THRU ROADWAY K COL.(2)	Dc_1 Max. CURVE COL.(3)	NOSE DESIGN SPEED COL.(4)
60	300	6°	40
50	160	8°	35
40	100	13°	30
30	55	25°	25



SPECIAL DETAIL
For Stabilized Berm
(See note E-3)

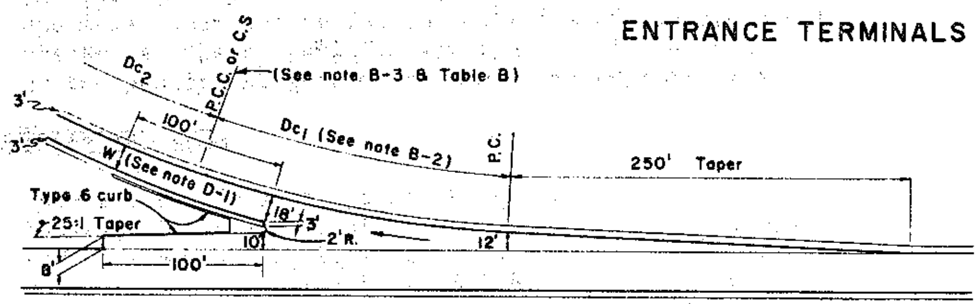


SPECIAL DETAIL
Thru Roadway Curbed
(See note E-3)

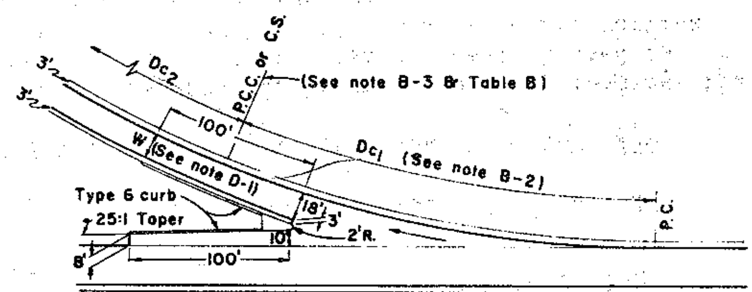


TYPE B
(See note C-1)

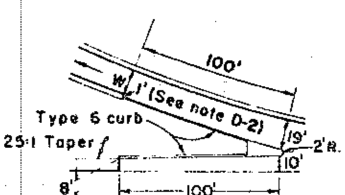
EXIT TERMINALS



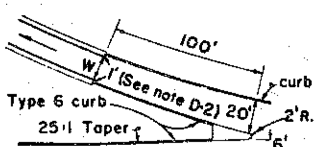
TYPE A
(See note B-1)



TYPE B
(See note B-1)



SPECIAL DETAIL
For Stabilized Berm
(See note E-3)

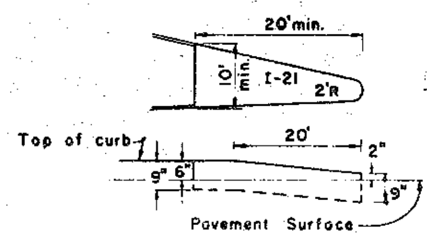


SPECIAL DETAIL
Thru Roadway Curbed
(See note E-3)

TABLE B

Location of P.C.C. or C.S and
Spiral Requirments Between Dc_1 & Dc_2

THRU ROADWAY DESIGN SPEED	$Dc_2 < Dc_1$ LOC OF P.C.C.	$Dc_2 < Dc_1$ L_s	$Dc_2 < 18.5°$ LOC OF P.C.C.	$Dc_2 < 18.5°$ L_s	18.6° to 24.8° LOC. OF P.C.C. OR C.S.	18.6° to 24.8° L_s	24.9° & OVER LOC. OF P.C.C. OR C.S	24.9° & OVER L_s
60	AT NOSE	0	100' Beyond Nose	0	AT NOSE	200'	AT NOSE	200'
50	AT NOSE	0	75' Beyond Nose	0	AT NOSE	150'	AT NOSE	150'
40	AT NOSE	0	AT NOSE	0	AT NOSE	0	AT NOSE	150'
30	AT NOSE	0	AT NOSE	0	AT NOSE	0	AT NOSE	0



EXIT NOSE DETAIL

OHIO DEPARTMENT OF HIGHWAYS
Bureau of Location & Design
GEOMETRIC DESIGN CRITERIA

CLASS III ENTRANCE
& EXIT TERMINALS

Drawing No.
Revisions
Appr. [signature] Date 3-1-64

NOTES FOR CONVERGING ROADWAYS

A. GENERAL

1. CONVERGING ROADWAYS as used herein are defined as separate and nearly parallel roadways which combine into a single contiguous roadway having a greater number of lanes beyond the nose than the number of lanes on either approach roadway. (Class I, II and III Entrance Terminals should be used in lieu of Converging Roadway drawings when applicable).

2. Class I and II Converging Roadways should be used when either or both of the Converging Roadways are mainline roadways of an expressway or freeway. Class III should be used at the convergence of directional ramps within an interchange or at the convergence of interchange ramps with non-limited access roads or streets. In general, Class III is applicable at all locations other than those requiring the use of Class I or II.

B. PREFERENTIAL FLOW

1. On the Converging Roadway drawing, one roadway in each design is labeled PREFERENTIAL FLOW. This indicates the more important of the two approaching traffic flows. In selecting the preferential flow a designer must consider the effect of traffic volumes, number of lanes, sign route continuity and importance, vehicle speeds and roadway alignment.

2. From the TYPICAL EXAMPLES, it can be noted that the lanes carrying the preferential flow are given the higher design treatment. When it is necessary to reduce the number of converging lanes or where an angular change in direction must occur, the design should favor the preferential flow.

C. HORIZONTAL CURVATURE

1. Horizontal curves of roadways approaching the terminal nose should conform to mainline roadway criteria in the case of mainline roadways and to ramp entrance terminal criteria in the case of ramps.

D. CREST VERTICAL CURVES

1. Crest vertical curves on constant-width roadways approaching the merging nose should be designed to provide non-passing sight distance consistent with the design speed of the roadways.

2. Crest vertical curves from the merging nose forward to a point where pavement convergence ceases should be somewhat flatter than required for non-passing sight distance. These flatter vertical curves are also applicable to the converging portion of an approaching roadway where the number of lanes is being reduced in advance of the nose. The following "K" values are recommended.

Design Speed, MPH	30	40	50	60	70	80
"K" Value	55	100	160	300	480	750

3. When design speeds differ on approaching roadways the higher of the two design speeds shall be used in selecting the proper "K" value for the crest vertical curve beyond the merging nose.

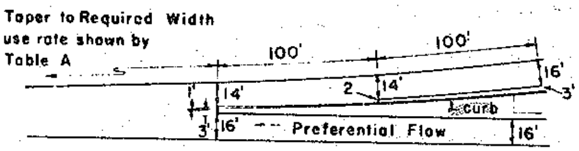
E. SUPERELEVATION & JOINT LOCATION

1. Reference shall be made to the Class I, II, and III Terminal designs for superelevation requirements.

2. Longitudinal joints should be located so that they will conincide with and define the lane lines. Reference should be made to standard joint drawings for type and location.

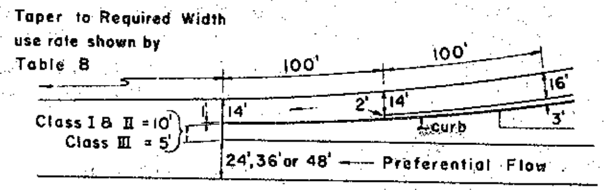
F. TYPICAL EXAMPLES

1. The TYPICAL EXAMPLES shown on the drawing are representative of the more common converging roadway situations. Other converging roadway combinations will be encountered and can be designed with the CONVERGING ROADWAY criteria.



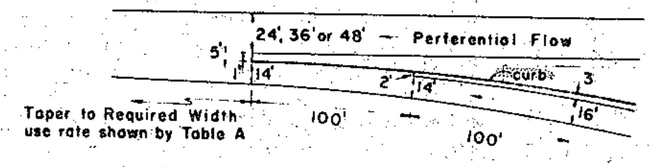
SINGLE LANE CONVERGING WITH SINGLE LANE

Preferential Flow on Left *



SINGLE LANE CONVERGING WITH MULTI-LANE

Preferential Flow on Left



SINGLE LANE CONVERGING WITH MULTI-LANE

Preferential Flow on Right

*NOTE

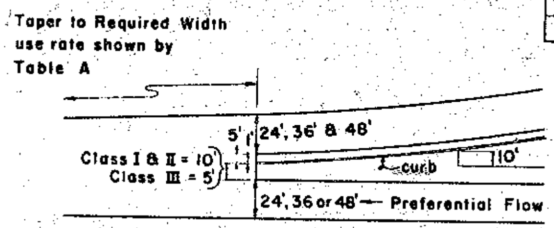
If the preferential flow occurs on the right rather than the left, the design should be of opposite hand.

TABLE A

Design Speed	Taper Ratio Class I	Class II	Class III
80	60:1	—	—
70	60:1	50:1	—
60	—	50:1	40:1
50	—	—	40:1
40	—	—	30:1
30	—	—	30:1

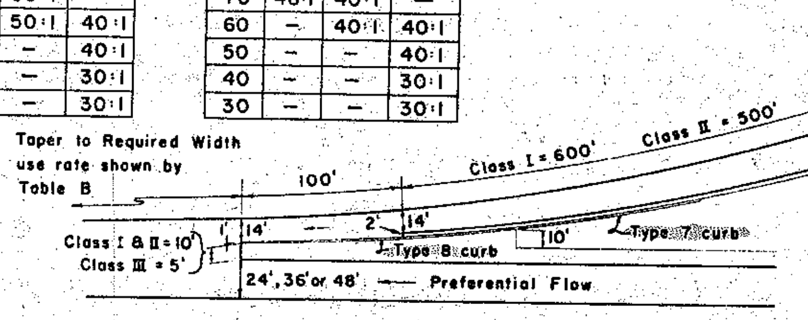
TABLE B

Design Speed	Taper Ratio Class I	Class II	Class III
80	48:1	—	—
70	48:1	40:1	—
60	—	40:1	40:1
50	—	—	40:1
40	—	—	30:1
30	—	—	30:1



MULTI-LANE CONVERGING WITH MULTI-LANE

Preferential Flow on Left *



TWO-LANE ROADWAY REDUCED TO SINGLE LANE PRIOR TO MERGING NOSE

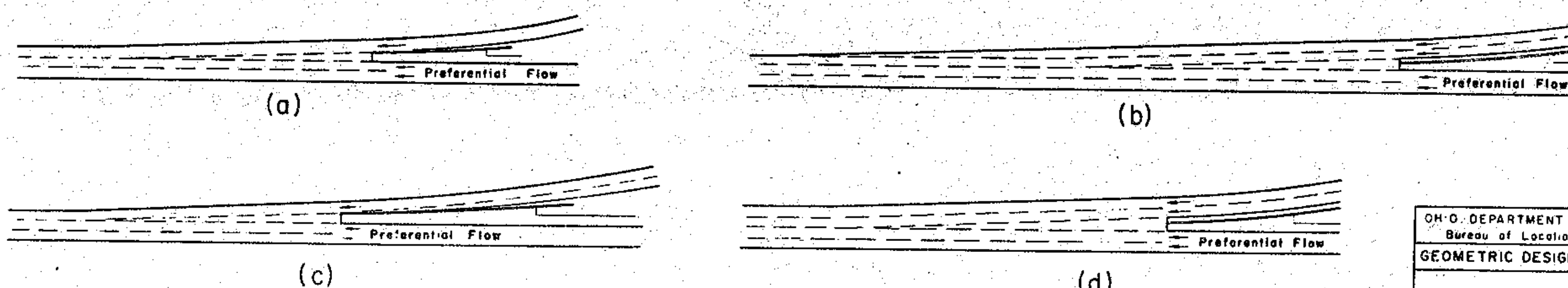
Preferential Flow on Left **

**NOTE

If the Preferential Flow is on the right, the entrance terminal shall be designed similarly to the drawing shown but of opposite hand.

The nose offset should be 5' for all classes of Design and Table A shall be used for taper ratio in lieu of Table B.

TERMINAL DETAILS



TYPICAL EXAMPLES

(NOT TO SCALE)

OHIO DEPARTMENT OF HIGHWAYS
Bureau of Location & Design

GEOMETRIC DESIGN CRITERIA

CONVERGING ROADWAYS

Drawing No. | Revisions

Appr. [signature] Date 5-1-64

NOTES FOR DIVERGING ROADWAYS

A. GENERAL

1. A Diverging Roadway as used herein is defined as a single roadway which branches or forks into two separate roadways without the use of a speed change lane.

2. Class I and II Diverging Roadways should be used when either or both of the Diverging Roadways are mainline roadways of an expressway or freeway. Class III Diverging Roadways should be used at the divergence of directional ramps within an interchange or at the divergence of ramps with non-limited access roads or streets. In general, Class III is applicable at all locations other than those requiring Class I or II.

B. LANE BALANCE

1. Normally the number of lanes on either roadway beyond the diverging nose will be less than the number of lanes on the approach roadway. The total number of lanes beyond the nose will be equal to or one greater than the number of lanes approaching the nose.

2. When it is necessary to design diverging roadways which do not meet the lane balance stated above (i.e., a two lane roadway branching into two, two lane roadways) the design should provide the number of lanes desired for the preferential flow and comply with required lane balance at the nose (approach lanes plus one). The subordinate flow roadway can be widened to the desired number of lanes a short distance beyond the nose.

3. An alternate method to solve a lane balance problem is to add an extra lane to the approach roadway starting at a 12' width and 1000' in advance of the diverging nose and using a 0' to 12' taper of length "L" as listed in Table A for the approach roadway class and design speed. This treatment is particularly appropriate where the approach roadway is planned for future widening.

C. TERMINAL DESIGN

1. The design of Diverging Roadway Terminals is determined by the class and the design speed of the approach roadway and is based on the required neutral gore length "L" and the required nose offset "C".

2. Table A lists length "L" and offset "C" for various design speeds and diverging roadway classes. The "C" dimensions shall be exact but the "L" dimensions may vary slightly from the Table A value. TYPICALS A and B are shown on the drawing to depict the gore area dimensions.

3. The design of the curbed diverging nose shall be similar to the exit nose details of Class I, II or III terminals except that paved berm is not used on either side of the nose.

4. When a 16' lane width is used following the diverging nose the nose offset "C" includes 4' of the 16' lane width.

D. HORIZONTAL CURVATURE

1. Table B lists recommended values for the curve differential between the outer pavement edges of the diverging roadways. These values apply only when the alignment between the diverging nose and the P.C. of the diverging curvature is on tangent or simple curvature. Three examples of diverging roadways are shown on the drawing.

2. When compounded or spiraled curvature is used in the diverging area it will be necessary to design diverging roadway alignments individually to provide the proper "L" and "C" for the approach roadway Class and design speed. Any lane combination can be designed from Table A and TYPICALS A and B by adding one or more lanes to one or both sides of TYPICAL A or adding one or more lanes to both sides of TYPICAL B.

E. CREST VERTICAL CURVES

1. When a diverging nose is located on a crest vertical curve, this vertical curve shall be designed using the design speed of the approach roadway and a K value as listed in Table A. (K times algebraic difference of grades equals vertical curve length).

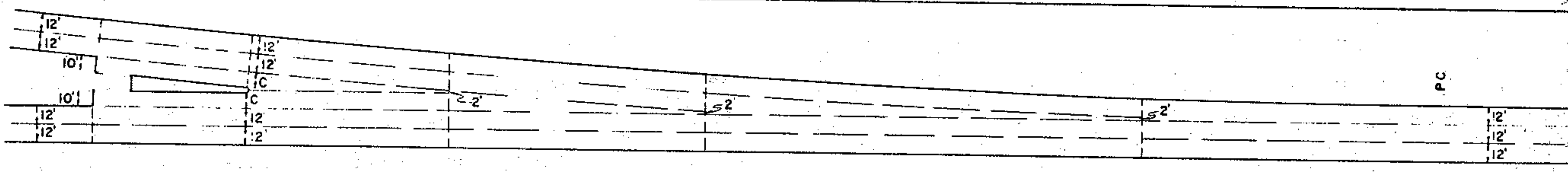
F. PAVED BERM

1. A 25:1 taper shall be used on the berm to taper from the width at the end of the paved apron (100' beyond the nose) to the normal berm width of the roadways following the diverging nose.

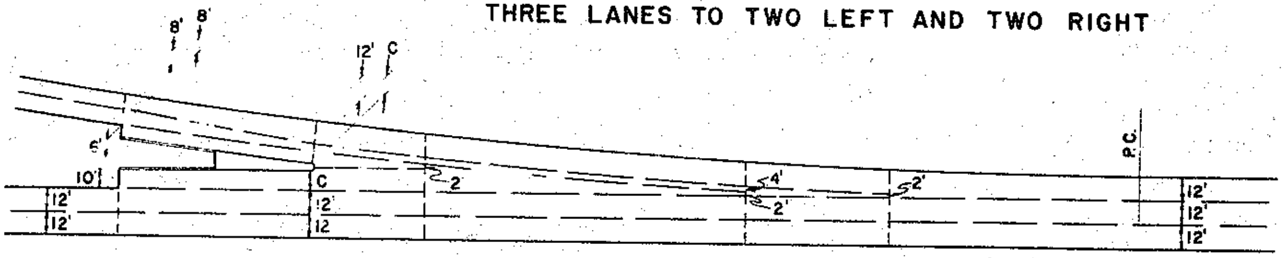
G. SUPERELEVATION & JOINT LOCATION

1. The superelevation rate will be based on the design speed of the approach roadway. Reference should be made to Class I, II and III Terminal design for other superelevation requirements.

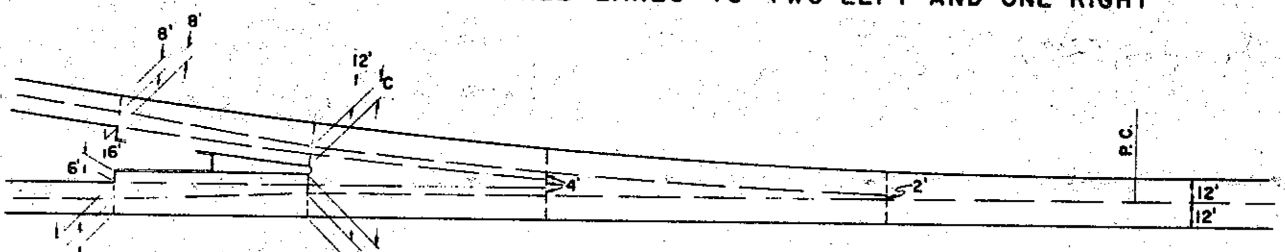
2. Longitudinal joints should be located so that they will define the lane lines. Reference should be made to standard joint drawings for type and location. The joints in the gore area shall be located to facilitate superelevation and pavement grading.



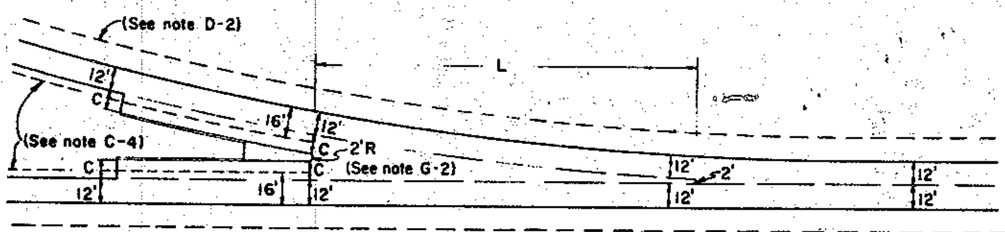
THREE LANES TO TWO LEFT AND TWO RIGHT



THREE LANES TO TWO LEFT AND ONE RIGHT

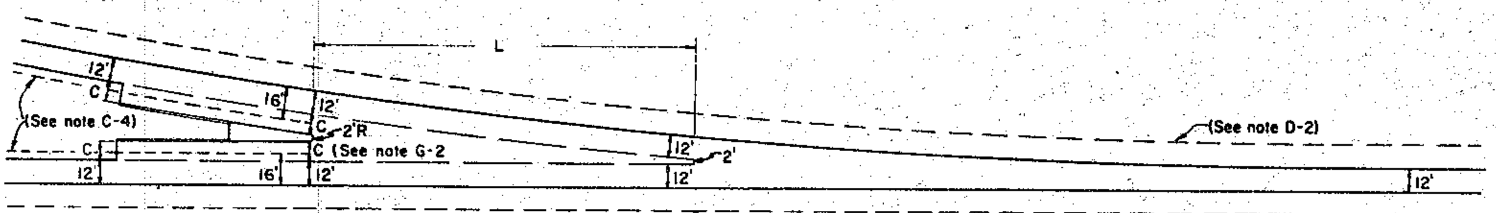


TWO LANES TO ONE LEFT AND ONE RIGHT



TYPICAL A

TOTAL NUMBER OF LANES BEYOND NOSE EQUALS APPROACH LANES



TYPICAL B

TOTAL NUMBER OF LANES BEYOND NOSE IS ONE GREATER THAN APPROACH LANES

TABLE A

Design Speed	"L" Gore Length (ft.)			"C" * Nose Offset (ft)			Min K
	I	II	III	I	II	III	
80	525			14			750
70	450	350		14	10		480
60		300	250		10	10	300
50			200			10	160
40			150			10	100
30			100			10	55

* C dimension includes 4' of a 16' lane (See note C-4)

TABLE B

RECOMMENDED DIVERGING CURVATURE (See note D-1)

Design Speed of Approaching Roadway	DIVERGING CURVATURE — Total Lanes Beyond Diverging Nose Equals: Approach Lanes			Approach Lanes + 1		
	Class I	Class II	Class III	Class I	Class II	Class III
80	0°-45'			0°-20'		
70	1°-00'	1°-00'		0°-30'	0°-30'	
60		1°-30'	2°-15'		0°-40'	1°-00'
50			3°-30'			1°-30'
40			6°-30'			2°30'
30			12°-00'			6°-00'

OHIO DEPARTMENT OF HIGHWAYS
Bureau of Location & Design

GEOMETRIC DESIGN CRITERIA

DIVERGING ROADWAYS

Drawing No. | Revisions
Appr. [signature] Date 5-1-64

PAVEMENT JOINT DETAIL NOTES
For Entrance & Exit Terminals

A. GENERAL

1. The drawing for PAVEMENT JOINT DETAILS For Entrance and Exit Terminals is intended to serve as a guide in the selection of "joint types" and "joint locations" when Class I, II or III Terminals are to be constructed of Portland Cement Concrete.

B. TRANSVERSE JOINTS

1. The transverse joints shown are termed "control joints". Their location is fixed in accordance with the transverse dimensions shown. ~~Transverse joints not shown on these drawings shall be spaced uniformly between the "control joints" not to exceed the standard spacing.~~

2. All transverse joints shall be in a straight line and continuous through the mainline pavement and the speed change lane, with the exception of the joint at the exit nose which shall be radial in the ramp lane.

C. LONGITUDINAL JOINTS

1. The longitudinal joints in the terminal area and along the speed change lanes shall be of the type and at the location shown on the drawing.

2. When ramp curbing is used with Class III Terminals, the longitudinal ramp joint shall be established at a distance of W/2 + 1' from the face of the curb. (W = width of ramp if uncurbed).

D. THREE & FOUR LANE DIRECTIONAL PAVEMENTS

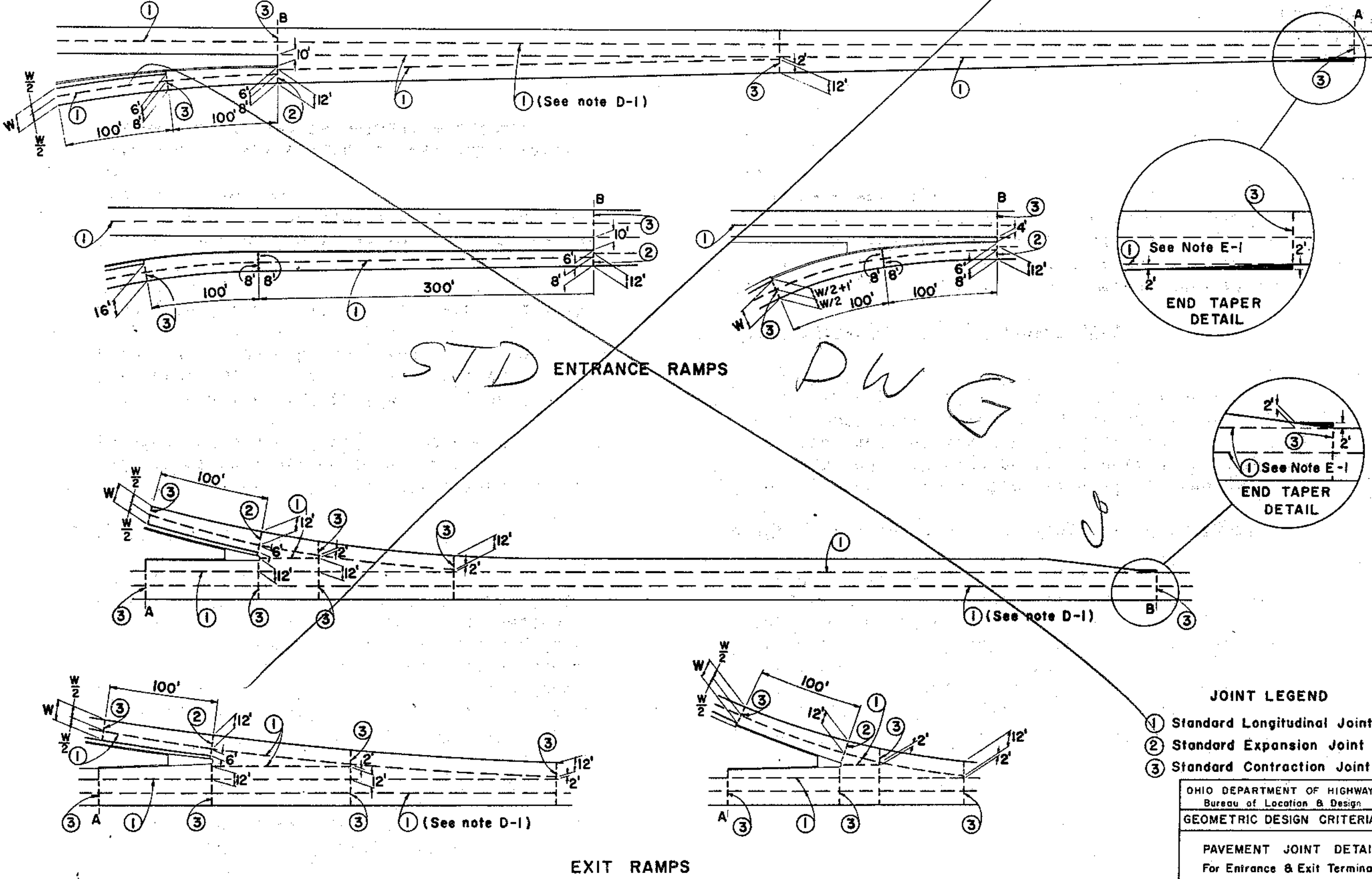
1. When a mainline pavement is to be constructed as three directional lanes, all three of these lanes shall be tied together by a "Standard Longitudinal Joint" except when adjacent to a ramp terminal (and speed change lane). In such instances the longitudinal joint which is located 24' from the median edge will change to a "Key Joint Without Tiebars" between points A and B as shown on the drawing.

2. When a mainline pavement is to be constructed as four directional lanes, the longitudinal joint which is located 24' from the median edge (the center joint) shall be constructed as a "Key Joint Without Tiebars" while the remaining two joints on either side shall be constructed as "Standard Longitudinal Joints". The Joint between the mainline pavement and the terminal (and speed change lane) pavement shall also be a "Standard Longitudinal Joint" as shown on the drawing.

E. END TAPER DETAILS

1. The shaded area shown in the END TAPER DETAILS shall be constructed of concrete pavement to an elevation one half inch lower than the adjacent pavement and surfaced with T-31 using No. 6 aggregate as the maximum size. The shaded area shall be paid for as full depth T-71 and the surface treatment shall be paid for as T-31.

PAVEMENT JOINT DETAILS
For Entrance & Exit Terminals



JOINT LEGEND

1. Standard Longitudinal Joint
2. Standard Expansion Joint
3. Standard Contraction Joint

OHIO DEPARTMENT OF HIGHWAYS Bureau of Location & Design
GEOMETRIC DESIGN CRITERIA
PAVEMENT JOINT DETAILS For Entrance & Exit Terminals
Drawing No. / Revisions
Appr. [signature] Date 5-1 64

PAVEMENT JOINT DETAIL NOTES
For At-Grade Intersections

A. GENERAL

1. The drawing for PAVEMENT JOINT DETAILS For At-Grade Intersections is intended to serve as a guide in the selection of "joint types" and "joint locations" for at-grade intersections which are to be constructed of Portland Cement Concrete. These intersection joint designs supersede Section E-410.50 of the Manual of Location and Design.

B. INTERSECTION RETURNS

1. The use of Detail B is required when the return is being constructed against an existing pavement or a new bituminous pavement.

2. Either Detail A or Detail B may be used when the return is adjacent to a concurrently constructed concrete highway and a note indicating this option should be shown on the plans. Pavement quantities shall be calculated and paid for as Detail A.

3. The use of Detail C is appropriate on the interior (next to freeway) returns of diamond ramp intersections.

4. Detail A is appropriate for all other situations not covered by Details B and C.

5. The shaded area shown in Detail B shall be constructed of concrete pavement to an elevation one half inch lower than the adjacent pavement and surfaced with T-31 using No. 6 aggregate as the maximum size. The shaded area of Detail B shall be paid for as full depth T-71 and the surface treatment shall be paid for as T-31.

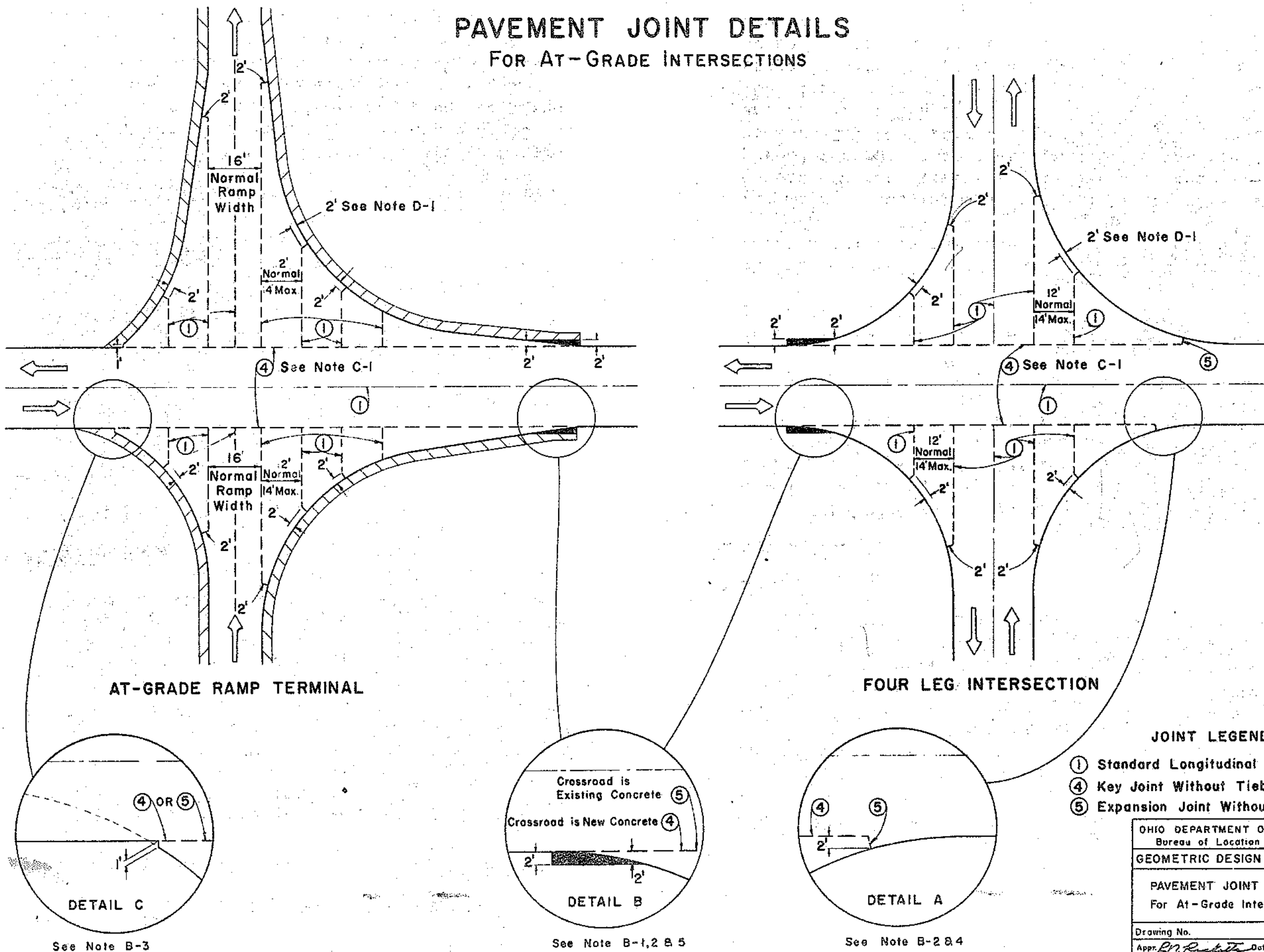
C. JOINT BETWEEN HIGHWAY AND INTERSECTION PAVEMENT

1. A key joint without tiebars will be used at the highway edge through an intersection when the highway and intersecting road (or ramp) are of new concrete. No joint need be specified when the highway is existing or new bituminous material.

D. JOINT INTERSECTION OF PAVEMENT EDGE

1. Where a joint intersects a pavement edge or an untied joint at an angle less than 70°, the last two feet of the joint shall be located on a radial line or at 90° to the intersected joint or pavement edge.

PAVEMENT JOINT DETAILS
For At-Grade Intersections



JOINT LEGEND

1. Standard Longitudinal Joint
4. Key Joint Without Tiebars
5. Expansion Joint Without Dowels

OHIO DEPARTMENT OF HIGHWAYS Bureau of Location & Design
GEOMETRIC DESIGN CRITERIA
PAVEMENT JOINT DETAILS For At-Grade Intersections
Drawing No. — Revisions
Appr. R.N. Ricketts — Date 5-1-64

NOTES FOR UNCURBED INTERSECTIONS

A. APPROACH RADII

1. The radius (R) shown on the Uncurbed Intersection drawing shall normally be 50'.

2. Radii larger than 50', or a radius and taper, or a three centered curve should be considered at intersections, such as two state highways, where the design must accommodate semi-trailer truck turning movements. The stop approach design should permit a legal stop sign placement.

3. Radii less than 50' (minimum 35') may be used at low volume intersecting roads on 50 mph or lower design speed projects as appropriate for the volume and character of turning vehicles.

B. APPROACH WIDTH

1. Normally use 24' pavement width at radii ends.

2. An approach pavement shall be at least 20' wide at the radii ends on roads less than 20' wide but the width shall be 24' if future widening is anticipated.

3. The pavement width shall be tapered back to the existing pavement width on a 10:1 taper if adjacent to the radii ends.

C. INTERSECTION ANGLES

1. Intersection angles of 70° to 90° are to be provided on relocated highways. An angle of 60° is satisfactory if right of way is to be purchased for a future grade separation and the smaller angle will avoid reconstruction of the intersecting road. It may be desirable to locate the intersection so the separation structure can be constructed in the future without disrupting the intersection operation.

2. Intersection angles of 60° to 90° are satisfactory on salvage type projects and 50° may be used if in the quadrant favoring the stopped vehicle driver's visibility (intersecting road on a left forward skew). The normal 50' intersection radii are not usually appropriate for these smaller angle intersections and a special design must be made. Refer to AASHO Geometric Design Policy.

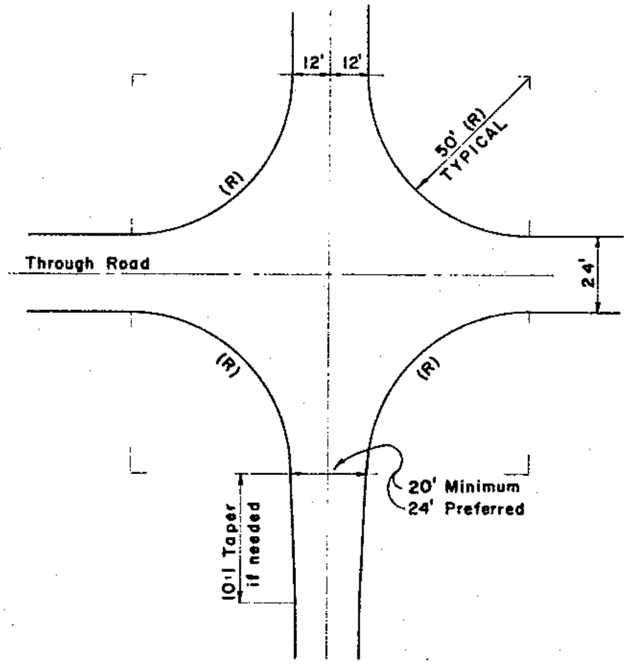
D. MEDIAN CROSSINGS

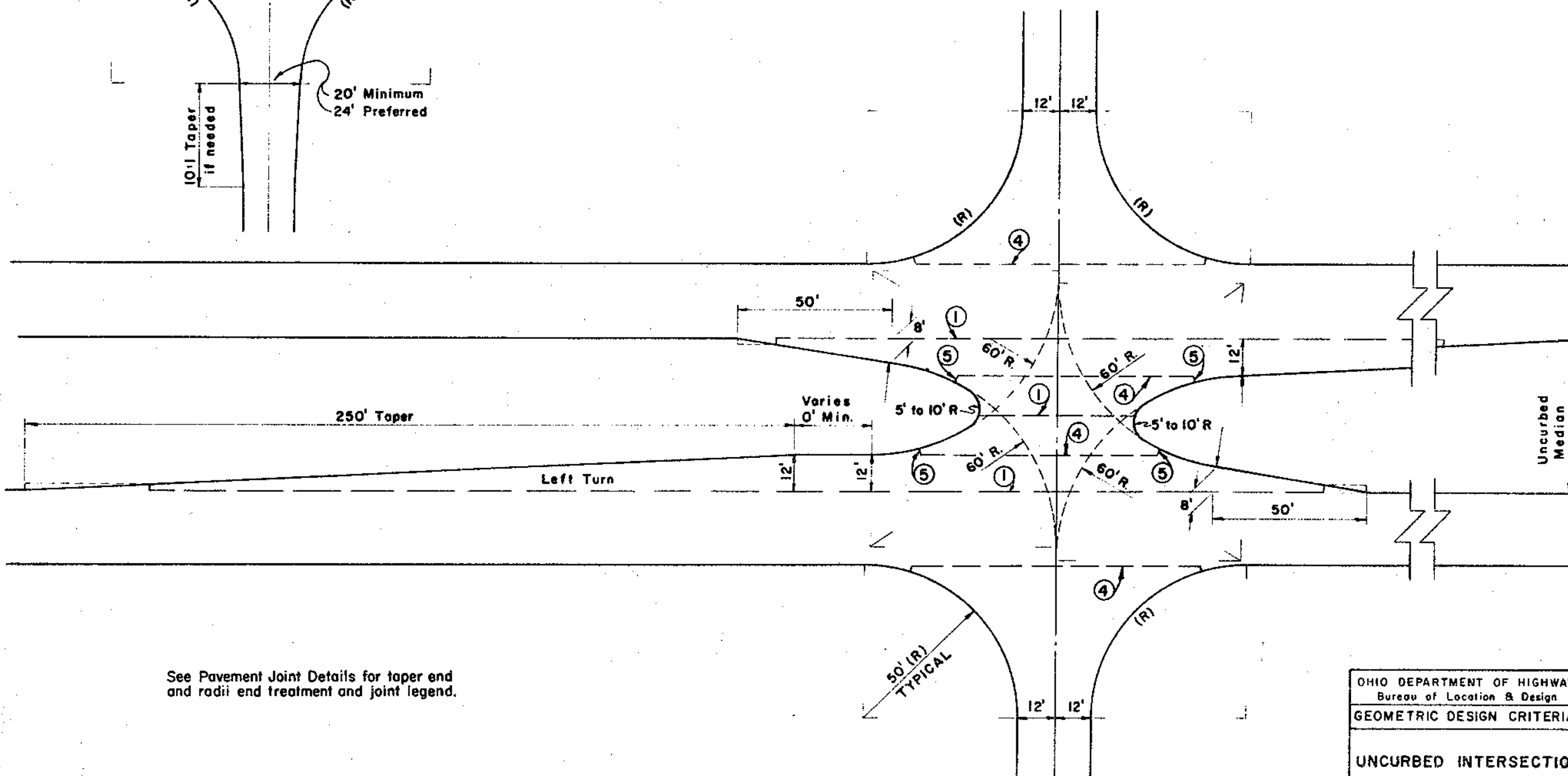
1. A 250' taper (0' to 12' wide) is a required part of a median crossing at all public highway intersections. It is adequate **for** storage of left turn vehicle volumes of 30 DDHV or less and no length of uniform 12' width left turn lane is required. For volumes greater than 30 DDHV, a length of 12' lane shall be provided at the end of the taper as shown below.

Left Turn Vol.(DDHV)	31-60	61-90	91-120	121-150
12' Wide Lane Length	50'	75'	100'	125'

2. The minimum median crossing width is 40' measured perpendicular to the intersecting road centerline.

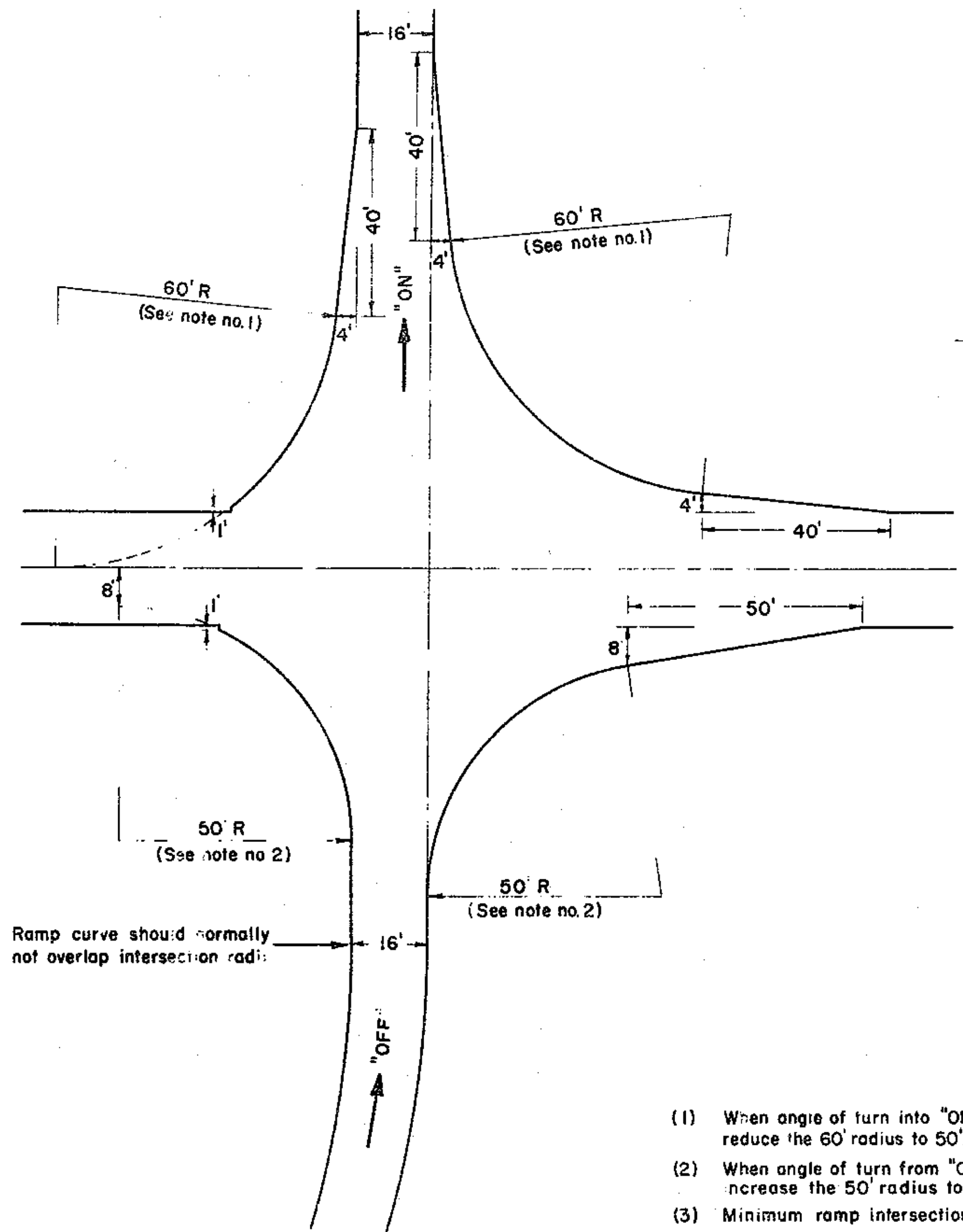
3. The median crossing design shown is for wide, uncurbed medians without signalization. For narrow curbed medians (often used on diamond interchange crossroads) the taper will usually be 150' long and the 12' width for storage should be at least 100' long or longer as required for traffic volumes. Projects with 70 mph design speed and a 16' to 20' curbed median should use a 250' median left turn lane taper.

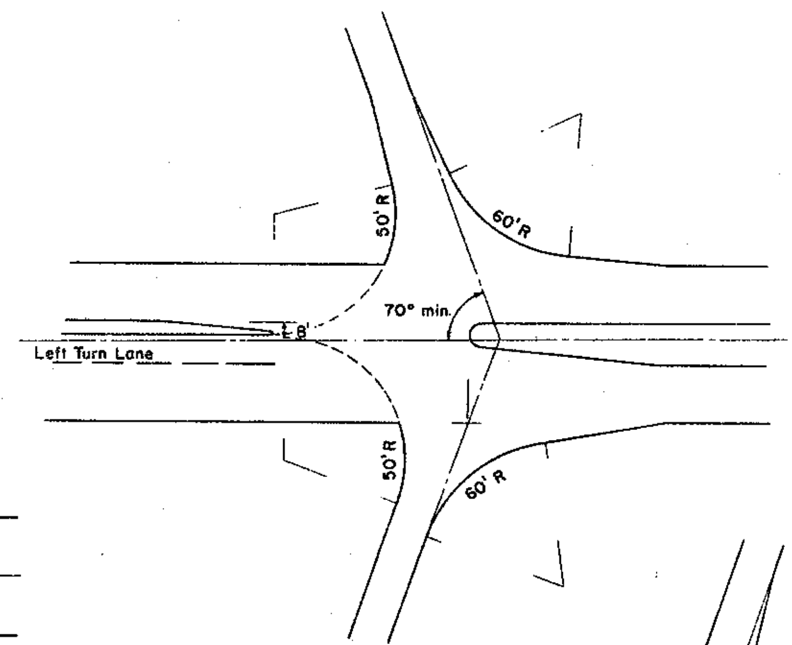


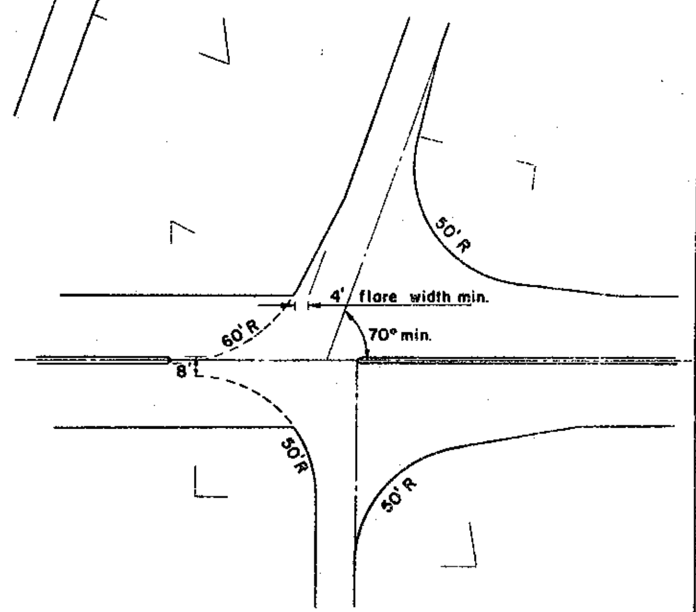


See Pavement Joint Details for taper end and radii end treatment and joint legend.

OHIO DEPARTMENT OF HIGHWAYS Bureau of Location & Design
GEOMETRIC DESIGN CRITERIA
UNCURBED INTERSECTION
Drawing No. — Revisions
Date 5-1-64







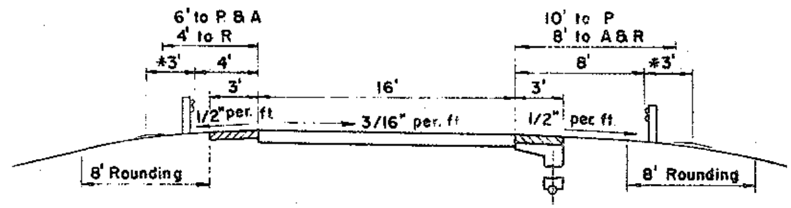
(1) When angle of turn into "ON" ramp is 100° or greater reduce the 60' radius to 50'.

(2) When angle of turn from "OFF" ramp is 80° or less increase the 50' radius to 60'.

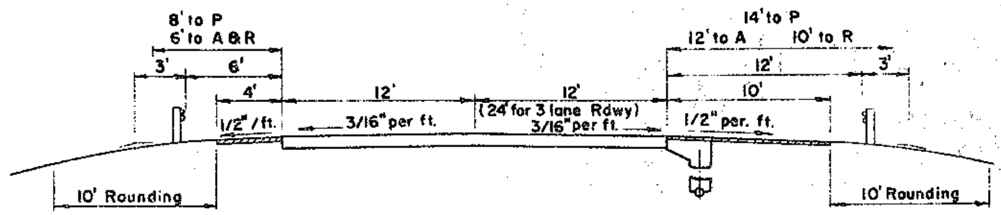
(3) Minimum ramp intersection angle with crossroad is 70°.

(4) This standard ramp intersection is for uncurbed crossroads. Curbed intersection returns may be reduced to accomodate the design vehicle minimum turning path.

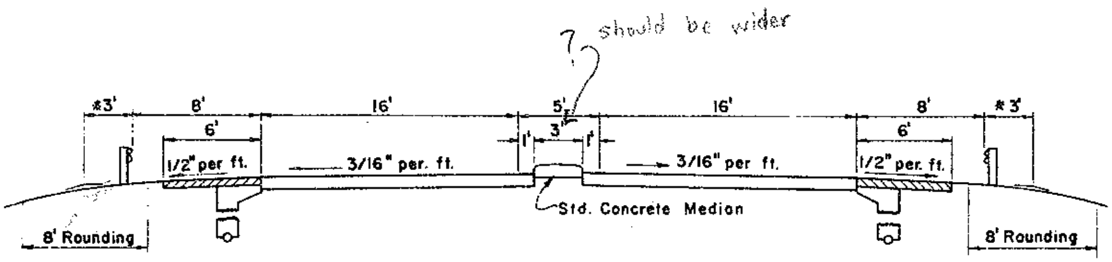
OHIO DEPARTMENT OF HIGHWAYS Bureau of Location & Design	
GEOMETRIC DESIGN CRITERIA	
UNCURBED RAMP INTERSECTION	
Drawing No.	Revisions
Appr. R.M. Ricketts Date 5-1-64	



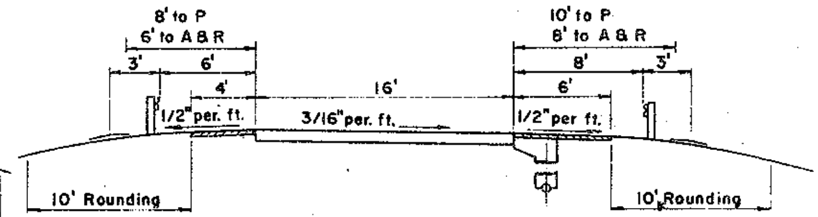
STANDARD RAMP SECTION



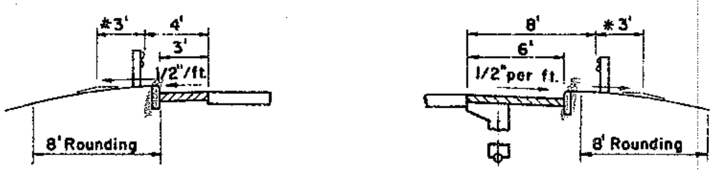
TWO LANE DIRECTIONAL ROADWAY



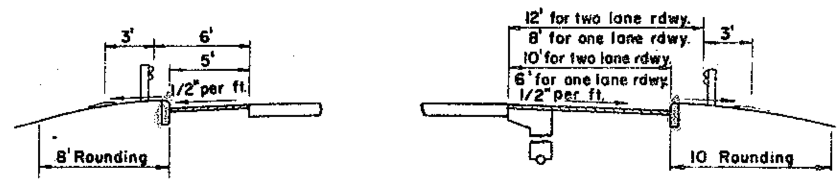
STANDARD TWO WAY RAMP SECTION



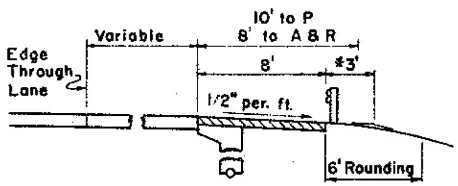
ONE LANE DIRECTIONAL ROADWAY



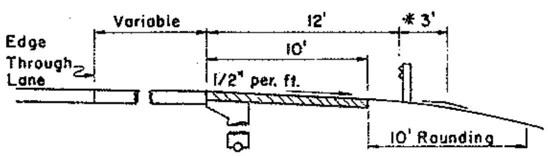
RAMP CURB DETAILS



DIRECTIONAL ROADWAY CURB DETAILS



SPEED CHANGE LANE



COMBINED ACCELERATION - DECELERATION LANE
(Same as mainline shoulder)

NOTES

1. Standard ramp pavement width is 16'. Use 18' when inside pavement edge radius is less than 200'.
2. Any design criteria not shown shall be the same as the mainline.
3. A directional roadway is a turning roadway of a directional interchange or a separate roadway carrying mainline traffic.
   A diamond ramp, a loop ramp and a ramp carrying the complimentary return movement of a loop ramp are considered ramps, not directional roadways.

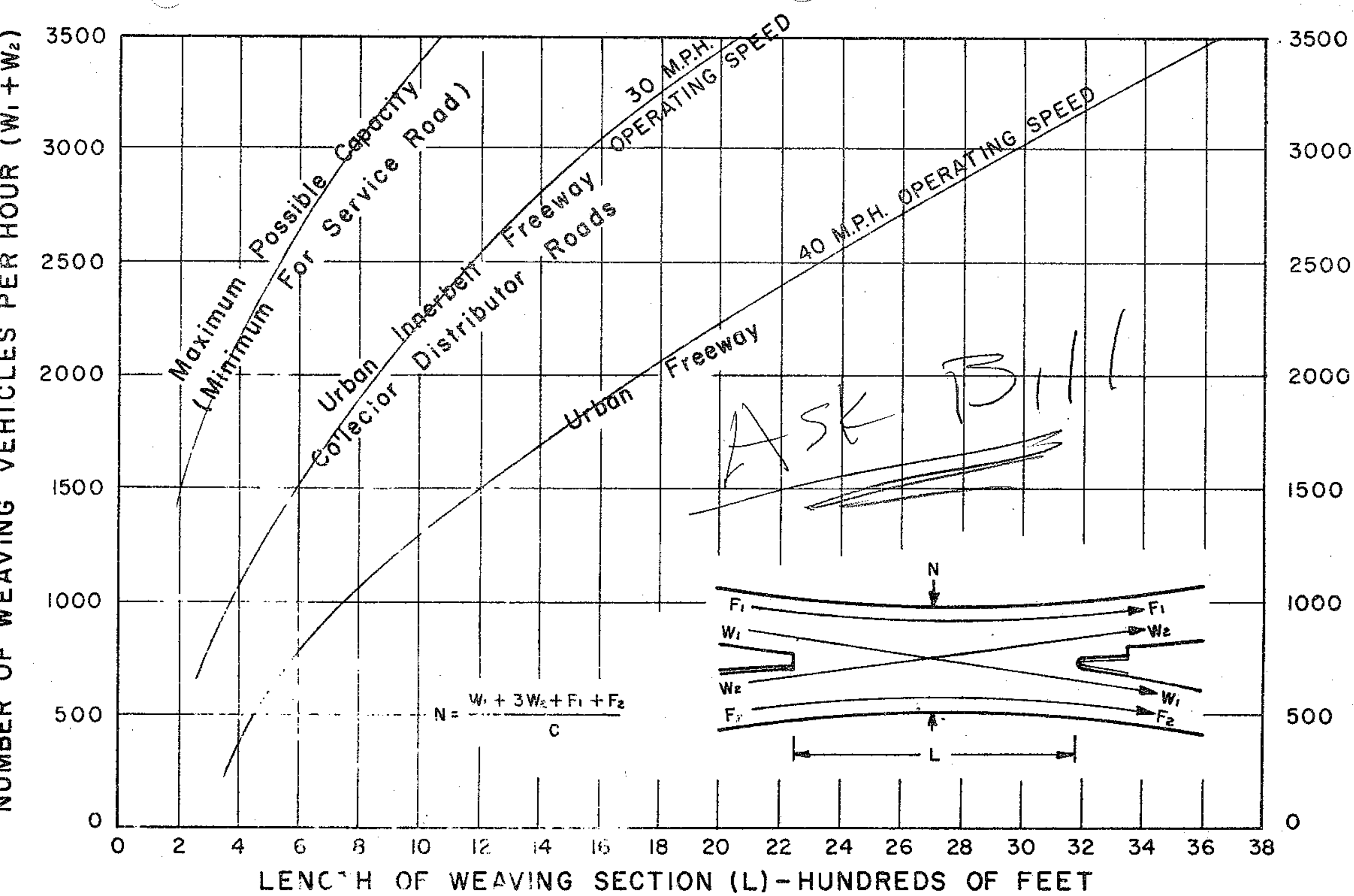
* 4. Reduce to 2' if mainline guard rail is located 2' from shoulder edge.

P = bridge pier face
A = bridge abutment face
R = bridge parapet wall or face of railing

OHIO DEPARTMENT OF HIGHWAYS
Bureau of Location & Design
GEOMETRIC DESIGN CRITERIA

INTERCHANGE RAMP
TYPICAL SECTIONS

Drawing No. | Revisions
Appr. [signature] Date 5164



Note added 5-1-64
This data is based on HRB 167 which has curves to be used with terminal nose widths of about 6'. This chart is a modification of HRB 167 curves to be applicable to the large Class I & II terminal offsets. For Class III terminal, reduce these 30 & 40 mph curves distances 65' & 90' respectively

N = Number of lanes
W_1 = V.P.H. in the larger weaving movement
W_2 = V.P.H. in the smaller weaving movement
F_1 and F_2 = V.P.H. in outer flows

C = Normal uninterrupted – flow capacity for approach and exit roadways in vehicles per lane per hour

$$3W_2 = \left[\frac{2(\text{required weaving length from chart})}{\text{actual length}} + 1\right] W_2$$

IN GENERAL WHEN AN OUTER FLOW EXCEEDS 600 PASSENGER CARS PER HOUR, THE SECTION SHOULD BE WIDE ENOUGH TO PROVIDE A SEPARATE LANE FOR THIS MOVEMENT

Redistributed 5-1-64

BUREAU OF L. & D.
OHIO DEPT. OF HWY.

WEAVING SECTION

Date 6-12-61

May 1, 1964

INTERSECTION SIGHT DISTANCE CRITERIA

A. GENERAL

1. "Intersection Sight Distance" as used herein is defined as the length of unobstructed visibility between a waiting vehicle on a "stop" sign approach and a target vehicle moving on the through roadway.

2. All unsignalized at-grade intersections must be designed to provide adequate intersection sight distance. This includes all three-leg, four-leg, and multi-leg intersections as well as the at-grade intersection elements of diamond and other type interchanges.

B. CONDITIONS AND DIMENSIONS AFFECTING INTERSECTION SIGHT DISTANCE

1. All intersections should be designed to provide the length of intersection sight distance recommended in Table I. The length of required sight distance varies with the design speed of the through roadway.

2. In Diagram A, the effect of horizontal obstructions such as a building or a bridge are shown.

3. In Diagram B, the effect of vertical obstructions such as a simple crest vertical curve or a crest vertical curve in conjunction with a bridge curb are shown.

4. Diagram C indicates the various dimensions which control intersection sight distance. These dimensions should be used by the designer when a graphical solution is required.

C. DESIGN APPLICATION AT CONVENTIONAL TWO-WAY INTERSECTIONS

1. The distance which must be provided between a fixed obstruction and the intersection can best be determined by solving the horizontal sight distance component graphically.

2. The vertical sight distance component has been solved by Graph I and the minimum required length of crest vertical curve can be read directly from the graph.

3. When the through roadway is on a crest vertical curve in the intersection area, the guard rail along the through roadway should be flared to 15' at the intersection in accordance with the flare ratio.

D. DESIGN APPLICATION AT DIAMOND INTERCHANGES

1. The restriction of intersection sight distance from the at-grade terminals of diamond "off" ramps is usually the result of interference of a bridge pier when the crossroad is carried under the expressway or by both a bridge railing and a crest vertical curve when the crossroad is carried over the expressway. Usually the sight distance restriction is to the driver's left.

2. When the crossroad is either over or under the expressway, the required design may be determined graphically in the same manner as a conventional intersection. However, since the same restrictions occur at most diamond interchanges, Tables II & III and Graphs I & II have been prepared to simplify the design.

3. When the crossroad is over the expressway and:

   (a) on a crest vertical curve, Table II gives the distance required between the end of the bridge railing and the "off" ramp intersection to satisfy the left horizontal sight distance requirements. Graph II gives the minimum length of crest vertical curve required (considering curb interference) to satisfy the left vertical sight distance requirements.

   (b) on a tangent grade, the line of sight will normally pass over the bridge railing but only a small part of the target vehicle can be seen. Therefore, it is desirable to use Table II to locate the intersection but a minimum distance of 165' for rural locations may be used if the project cost can be substantially reduced.

   (c) on a sag vertical curve, it is possible to see over the bridge railing to satisfy horizontal and vertical sight distance components.

4. When the crossroad is under the expressway, Table III gives the minimum distance required between the closest bridge pier and the "off" ramp intersection to satisfy the left horizontal sight distance requirements. Normally there is no restriction to the vertical sight distance component when the crossroad is under the expressway due to the absence of a crest vertical curve. If a crest vertical curve does occur, the proper curve length can be selected from Graph I.

5. Although the intersection sight distance on the driver's right at a diamond interchange "off" ramp is usually adequate, each case should be checked.

6. When the crossroad is either over or under the expressway and is on a horizontal curve, Tables II and III are not applicable, and a graphical solution must be used instead.

7. When the crossroad is on a crest vertical curve in the intersection area the guard rail along the crossroad should be flared to 15' at the "off" ramp intersection in accordance with the flare ratio shown in Table I.

E. <u>DESIGN APPLICATION AT OTHER INTERCHANGE TYPES</u>

1. Intersection sight distance at other interchange types may be designed by using the appropriate methods from the design application of both conventional intersections and diamond interchanges.

F. <u>SPECIAL CIRCUMSTANCES</u>

1. When, because of right of way or other valid considerations, the cost of design could be substantially reduced, the values for intersection sight distance shown in Table I may be reduced up to 15%. Each situation, however, should be individually justified.

INTERSECTION SIGHT DISTANCE

TABLE I

INTERSECTION SIGHT DISTANCE

DESIGN SPEED	INTERSECTION SIGHT DISTANCE REQUIRED	GUARDRAIL FLARE RATIO
70	900	45:1
60	775	40:1
50	650	35:1
40	525	30:1
35	450	25:1
30	375	25:1

GRAPH I

LENGTH OF CREST VERTICAL CURVE
WHEN LINE OF SIGHT IS TANGENT TO PAVEMENT SURFACE

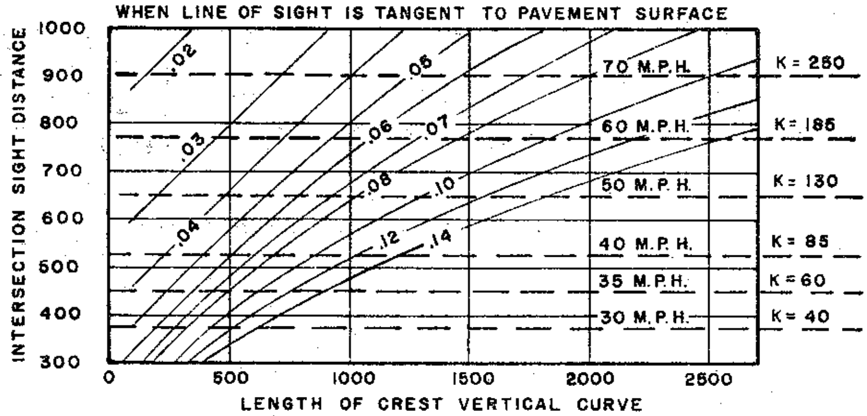


TABLE II

DISTANCE FROM RAMP TO BRIDGE
WHEN LINE OF SIGHT CLEARS BRIDGE RAIL

DESIGN SPEED	CLEARANCE FROM EDGE OF THRU LANE TO FACE OF PARAPET		
	10'	5'-3"	4'-3"
70	215	420	460
60	185	360	400
50	155	300	335
40	125	245	270
35	105	210	230
30	90	175	190

GRAPH II

LENGTH OF CREST VERTICAL CURVE
WHEN LINE OF SIGHT IS TANGENT TO TOP OF BRIDGE CURB

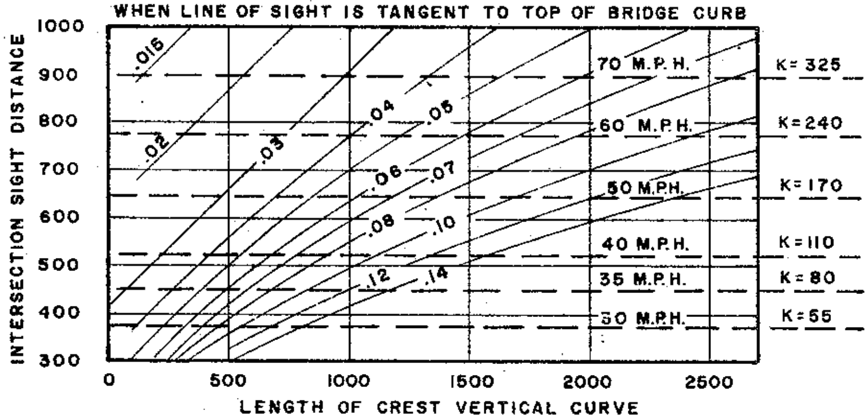


TABLE III

DISTANCE FROM RAMP TO BRIDGE
WHEN LINE OF SIGHT CLEARS BRIDGE PIER

DESIGN SPEED	CLEARANCE FROM EDGE OF THRU LANE TO FACE OF PIER			
	6'	8'	10'	12'
70	385	300	215	130
60	330	260	185	110
50	280	215	155	90
40	225	175	125	75
35	190	150	105	65
30	160	125	90	55