Chapter Forty-seven

RURAL TWO-LANE/MULTILANE STATE HIGHWAYS (New Construction/Reconstruction)

BUREAU OF DESIGN AND ENVIRONMENT MANUAL

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Chapter Forty-seven
RURAL TWO-LANE/MULTILANE STATE HIGHWAYS
(New Construction/Reconstruction)

Table of Contents

Section				Page
47-1	GENERAL			47-1.1
47-2	TWO-LANE HIGHWAYS			47-2.1
	47-2.01	General		47-2.1
	47-2.02	Typical Sections		47-2.1
	47-2.03	Passing Sight Distance		47-2.1
		47-2.03(a)	Design Derivation	47-2.1
		47-2.03(b)	Applications	47-2.7
	47-2.04	Passing Lanes		47-2.7
		47-2.04(a)	General	47-2.7
		47-2.04(b)	Warrants	47-2.8
		47-2.04(c)	Design	47-2.8
	47-2.05	Two-Way, Left-Turn Lanes (TWLTL)		47-2.12
	47-2.06	Tables of Design Criteria		47-2.12
47-3	MULTILANE HIGHWAYS			47-3.1
	47-3.01	General		47-3.1
	47-3.02	Design Speed		47-3.1
	47-3.03	Typical Sections		47-3.1
	47-3.04	Tables of Design Criteria		47-3.2
47-4	REFERENCES			47-4.1

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Chapter Forty-seven

RURAL TWO-LANE/MULTILANE STATE HIGHWAYS (New Construction/Reconstruction)

Chapter 47 provides guidance in the design of rural two-lane principal arterials, multilane minor arterials, two-lane minor arterials, and collectors on the State highway system. Information that is also applicable to these facilities is included in the following chapters:

- Chapter 11 discusses the procedures for determining the facility location.
- Chapter 14 discusses intersection design studies.
- Chapters 31, 32, 33, 34, and 39 provide guidance on geometric design elements that are also applicable to these facilities.
- Chapter 35 provides guidelines for access control along interchange crossroads and intersections. It also discusses the procedures for preparing access control plans.
- Chapter 36 provides information on the design of intersections including left- and right-turn lanes, channelization, and intersection sight distance.
- Chapter 38 provides guidelines on roadside safety issues.
- Chapter 45 discusses the procedures for designing expressways.

47-1 GENERAL

Construction of new two-lane State highways, full reconstruction of long segments of existing two-lane State highways, or new construction of rural multilane State highways without access control are no longer common highway designs in Illinois. Instead, existing two-lane highways are more commonly improved using 3R guidelines (Chapter 49) or upgraded to a four-lane expressway design with partial access control (Chapter 45).

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47-2 TWO-LANE HIGHWAYS

47-2.01 General

The minimum design for a State route is a two-lane, two-way highway. In some areas of the State, the two-lane highway system carries a large portion of the rural traffic. Many of these highways are located near major urbanized areas and are experiencing rapid growth in traffic.

The following describes some of the more common situations where new construction or reconstruction projects might be proposed for a two-lane highway improvement:

- realigning of an existing low-speed horizontal curve;
- raising the profile gradeline of a roadway to remedy flooding problems;
- providing a bypass around a small community;
- modifying the vertical profile or improving an intersection to enhance safety;
- upgrading a major route (i.e., arterial or collector) approaching an urbanized area where the current ADT is 5000 or greater, and where there is a small probability of traffic growth warranting four lanes in 20 years; and/or
- increasing passing opportunities to break up platoons and to reduce delay.

47-2.02 Typical Sections

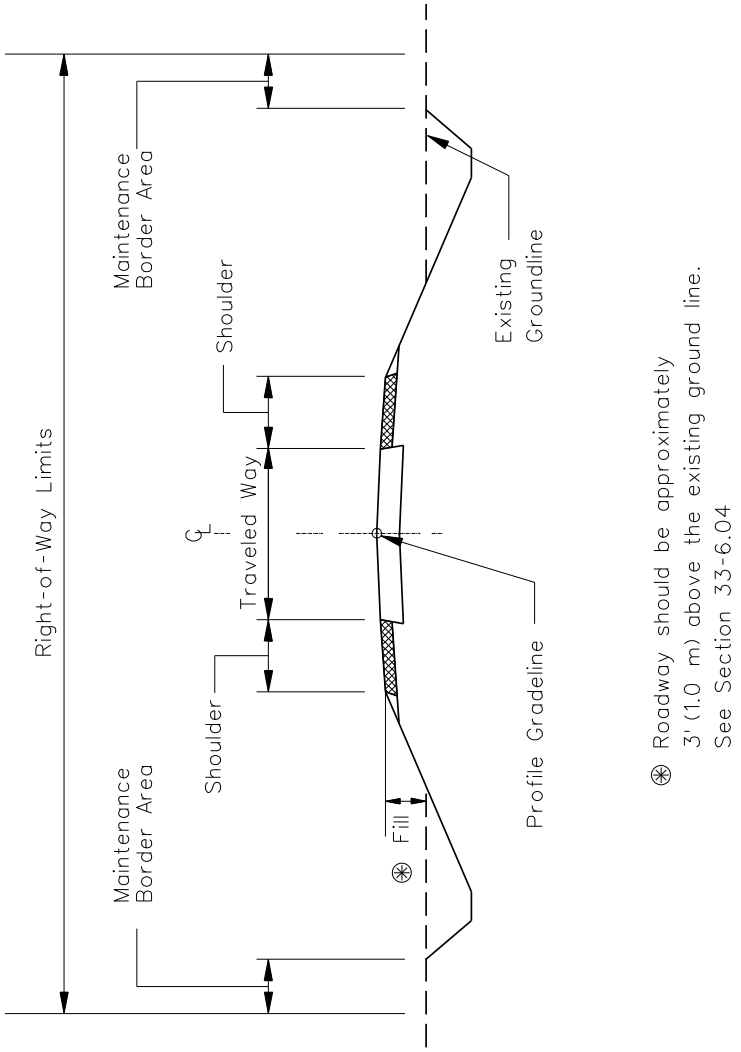
Figures 47-2.A and 47-2.B illustrate typical schematic cross sections for two-lane highways. The tables in Section 47-2.06 provide the minimum criteria for lane widths, shoulder widths, and other cross section elements that should be used on rural two-lane highways.

47-2.03 Passing Sight Distance

47-2.03(a) Design Derivation

Passing sight distance considerations are limited to two-lane, two-way highways. On these facilities, vehicles may overtake slower moving vehicles, and the passing maneuver must be accomplished on a lane used by opposing traffic.

The minimum passing sight distance for two-lane highways is determined from the sum of four distances as illustrated in Figure 47-2.C. Figure 47-2.D and the following provides the basic assumptions used to develop passing sight distance values for design:



TYPICAL TANGENT SECTION FOR RURAL TWO-LANE HIGHWAYS

Figure 47-2.A

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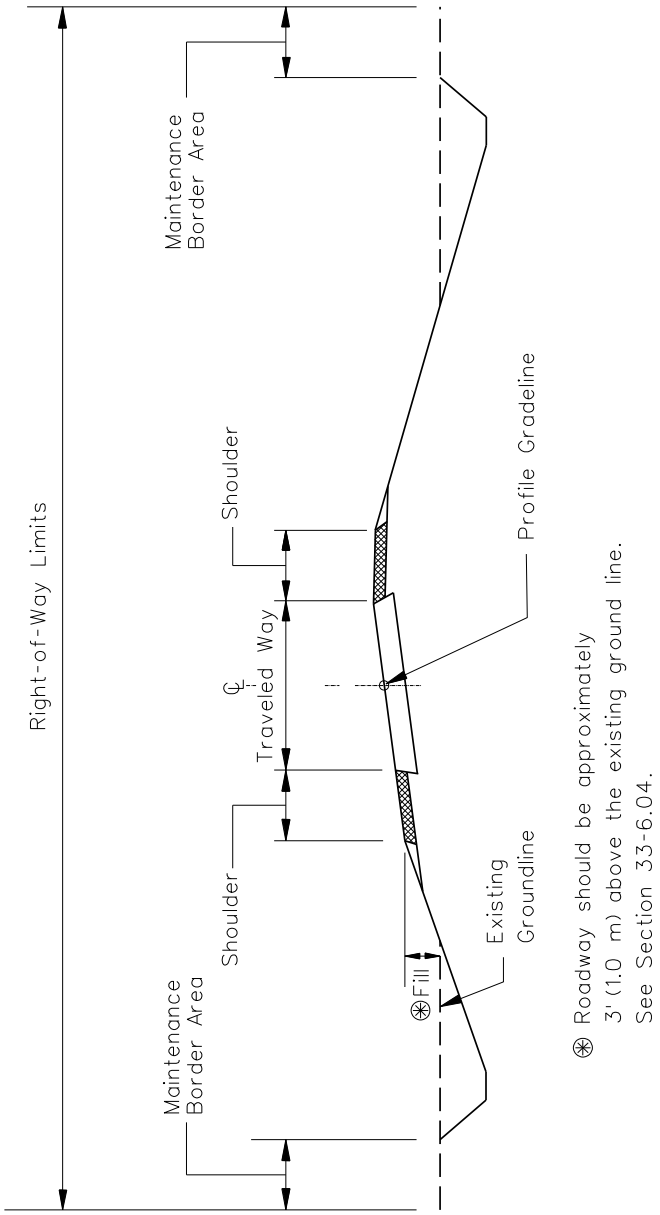
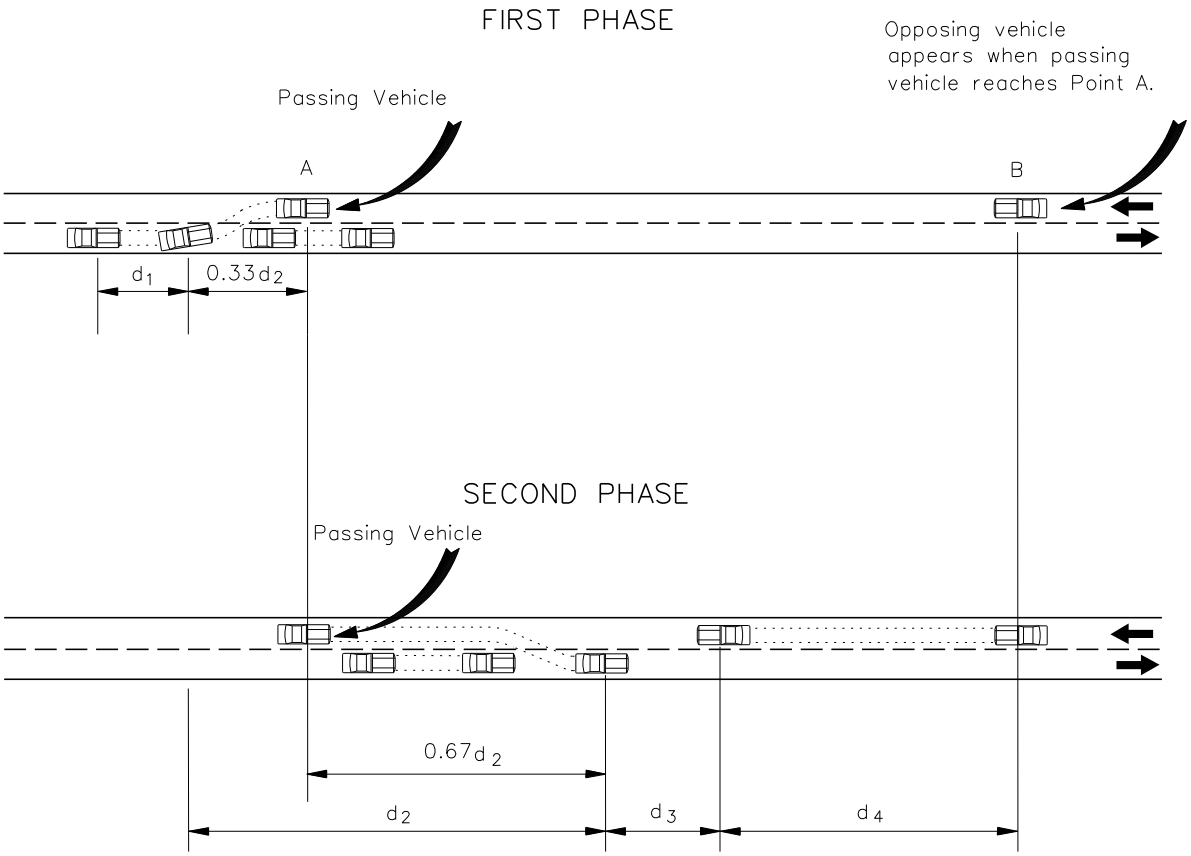


TYPICAL SECTION FOR SUPERELEVATED RURAL TWO-LANE HIGHWAYS

Figure 47-2.B



Note: The Illinois MUTCD definition for passing sight distance uses only the second phase of signing and pavement markings distances.

ELEMENTS OF PASSING DISTANCE
(Two-Lane Highways)

Figure 47-2.C

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US Customary					Metric				
Design Speed (mph)	Assumed Speeds (mph)		Passing Sight Distance (ft)		Design Speed (km/h)	Assumed Speeds (km/h)		Passing Sight Distance (m)	
	Passed Vehicle	Passing Vehicle	Calculated	Rounded for Design		Passed Vehicle	Passing Vehicle	Calculated	Rounded for Design
20	18	28	706	710	30	29	44	200	200
25	22	32	897	900	40	36	51	266	270
30	26	36	1088	1090	50	44	59	341	345
35	30	40	1279	1280	60	51	66	407	410
40	34	44	1470	1470	70	59	74	482	485
45	37	47	1625	1625	80	65	80	538	540
50	41	51	1832	1835	90	73	88	613	615
55	44	54	1984	1985	100	79	94	670	670
60	47	57	2133	2135	110	85	100	727	730
65	50	60	2281	2285					
70	54	64	2479	2480					

Note: See Figure 33-4.D for K-values for passing sight distances for passenger cars on crest vertical curves.

MINIMUM DESIGN PASSING SIGHT DISTANCE
(Assumes Entire Maneuver is Completed)

Figure 47-2.D

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1. Initial Maneuver Distance (d_1). This is the distance traversed during the perception and reaction time and during the initial acceleration to the point of encroachment on the left lane. For the initial maneuver, the overtaken vehicle is assumed to be traveling at a uniform speed, and the passing vehicle is accelerating at a rate from 1.41 mph/sec to 1.47 mph/sec (2.25 km/h/sec to 2.37 km/h/sec). The average speed of the passing vehicle is assumed to be 10 mph (15 km/h) greater than the overtaken vehicle. Use Equation 47-2.1 to determine d_1:

$$d_1 = 1.47t_1\left(v - m + \frac{at_1}{2}\right) \qquad \text{(US Customary) Equation 47-2.1}$$

$$d_1 = \frac{t_1}{3.6}\left(v - m + \frac{at_1}{2}\right) \qquad \text{(Metric) Equation 47-2.1}$$

where:

t_1 = time of initial maneuver, sec
a = average acceleration, mph/sec (km/h/sec)
v = average speed of passing vehicle, mph (km/h)
m = difference in speed of passed vehicle and passing vehicle, mph (km/h)

2. Distance of Passing Vehicle in Left Lane (d_2). This is the distance traveled by the passing vehicle while it occupies the left lane. Use Equation 47-2.2 to determine d_2:

$$d_2 = 1.47\ vt_2 \qquad \text{(US Customary) Equation 47-2.2}$$

$$d_2 = \frac{vt_2}{3.6} \qquad \text{(Metric) Equation 47-2.2}$$

where:

t_2 = time passing vehicle occupies the left lane, sec
v = average speed of passing vehicle, mph (km/h)

3. Clearance Distance (d_3). This is the distance between the passing vehicle at the end of its maneuver and the opposing vehicle. Based on various studies, this clearance distance at the end of the passing maneuver is assumed to be between 100 ft and 250 ft (30 m and 75 m).

4. Opposing Vehicle Distance (d_4). This is the distance traversed by an opposing vehicle during the time the passing vehicle occupies the left lane. As shown in Figure 47-2.C, the opposing vehicle appears after approximately one-third of the passing maneuver (d_2) has been accomplished. The opposing vehicle is assumed to be traveling at the same speed as the passing vehicle. Therefore, $d_4 = 0.67\ d_2$.

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47-2.03(b) Applications

Figure 47-2.D shows the minimum passing sight distance for design on two-lane, two-way highways. These distances allow the passing vehicle to safely complete the entire passing maneuver. These values are not the same as those values presented in the *Illinois MUTCD* for the placement of no-passing zone stripes. The *Illinois MUTCD* values are based on different operational assumptions (i.e., distance for the passing vehicle to abort the passing maneuver). The designer should also realize that the highway capacity adjustment in the *Highway Capacity Manual* for two-lane, two-way highways is based on the *Illinois MUTCD* criteria for marking no-passing zones. It is not based on the percent of passing sight distance as calculated from the AASHTO *A Policy on Geometric Design of Highways and Streets* and shown in Figure 47-2.D.

On rural new construction/reconstruction projects, the designer should attempt to provide passing sight distance over the length of the project consistent with the percentages shown in Figure 47-2.E. In determining the percentages, each passing sight distance segment should be greater than 800 ft (240 m). It is generally not cost effective to make significant improvements to the horizontal and vertical alignment solely to increase the available passing sight distance.

Appreciable upgrades can increase the sight distances required for safe passing maneuvers. Where these upgrades are encountered in the design of the project, take this into account when selecting the appropriate passing sight distances.

Passing sight distance is measured from a 3.5 ft (1080 mm) height of eye to a 3.5 ft (1080 mm) height of object. Figure 47-2.D presents the K-values for crest vertical curves based on passing sight distances and these eye and object heights. This 3.5 ft (1080 mm) height of object allows 9 in (225 mm) of a typical passenger car to be seen by the opposing driver.

47-2.04 Passing Lanes

47-2.04(a) General

Passing lanes are defined as short added lanes which are provided in one or both directions of travel on a two-lane, two-way highway to improve passing opportunities. They present a relatively low-cost type of improvement for traffic operations by breaking up traffic platoons and reducing delay on facilities with inadequate passing opportunities.

Terrain	Minimum Percent Passing Sight Distance		
	Arterials	Collectors	Local
Level	60%	50%	40%
Rolling	40%	30%	20%

GUIDELINES FOR PERCENT PASSING DISTANCE
(Rural)
Figure 47-2.E

Truck-climbing lanes are one type of passing lane used on steep grades to provide passenger cars with an opportunity to pass slow-moving vehicles. The warrant and design criteria for truck-climbing lanes are discussed in Chapter 33. Procedures for developing the climbing lane capacity analysis are also shown in Chapter 33.

Passing lanes may serve to improve safety on a segment of two-lane highway. Three-lane roadways may be considered an intermediate solution to the ultimate expansion to a four-lane highway. The various methods of providing the third lane are shown in Figure 47-2.F.

47-2.04(b) Warrants

Passing lanes other than truck-climbing lanes may be warranted on two-lane facilities where passing opportunities are not adequate. Passing lanes also may be warranted, based on an engineering study that includes judgment, operational experience, and a capacity analysis. The use of a passing lane will be determined on a case-by-case basis. For more information on passing lane warrants, see the FHWA publication *Low Cost Methods for Improving Traffic Operations on Two-Lane Roads*, Report No. FHWA-IP-87-2.

47-2.04(c) Design

1. Capacity Analysis. *Low Cost Methods for Improving Traffic Operations on Two-Lane Roads* presents approximate adjustments that can be made to the capacity methodology in the *Highway Capacity Manual*. These adjustments can be used to estimate the level-of-service benefits from adding passing lanes to two-lane facilities.

2. Spacing. When passing lanes are provided to improve the overall traffic operations over a length of roadway, they should be constructed systematically at regular intervals. Typical spacing for passing lanes may range from 3 miles to 10 miles (5 km to 15 km). Actual spacing of passing lanes will depend on the traffic volumes, right-of-way availability, and existing passing opportunities.

3. Location. When determining where to locate passing lanes, the designer should consider the following factors:

    a. Costs. Locate passing lanes to minimize costs. Rough terrain will generally increase the costs for construction of passing lanes.

    b. Appearance. The passing lane location should appear logical to the driver. The value of passing lanes is more obvious to the driver at locations where passing sight distances are restricted or where opposing volumes are significant.

    c. Horizontal Alignment. Avoid locating passing lanes on highway sections with low-speed horizontal curves.

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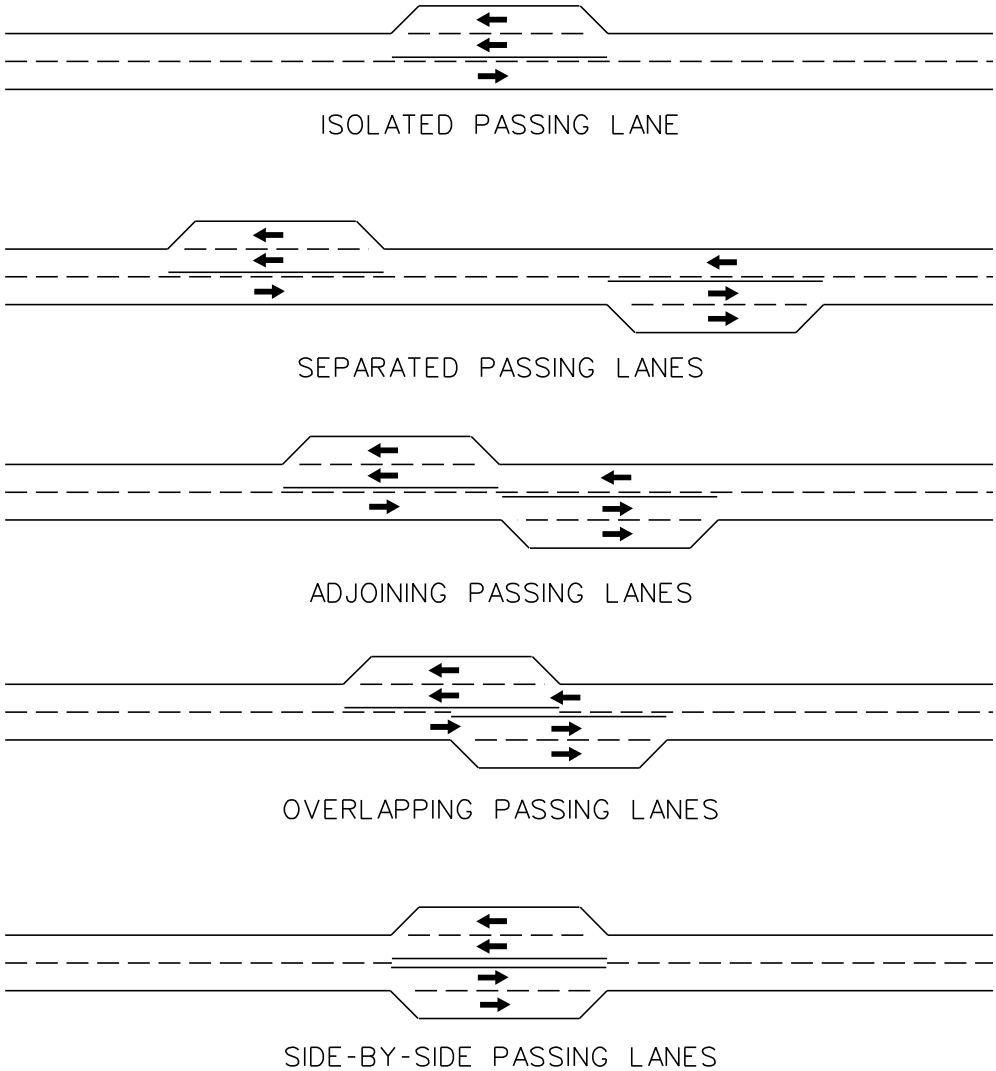

TYPICAL CONFIGURATIONS FOR PASSING LANES

Figure 47-2.F

d. Vertical Alignment. Where practical, construct passing lanes on a sustained upgrade. The upgrade will generally cause a greater speed differential between slow moving vehicles and passing vehicles. However, passing lanes in level terrain still should be considered where the demand for passing opportunities exceeds supply.

e. Sight Distance. Locate the passing lane where there will be adequate sight distance to both the entrance and exit tapers of the additional lane. Because of sight distance concerns, do not locate exit tapers just beyond a crest vertical curve.

f. Intersections. Use special care when designing passing lanes through intersections and high-volume commercial entrances.

g. Structures. Avoid placing passing lanes where structures (e.g., large culverts, bridges) will restrict the overall width of the traveled way, passing lane, and shoulders.

h. Alternative Configurations. See Figure 47-2.F for various configurations of passing lanes.

4. Widths. Passing lane widths should be the same width as the adjacent travel lane width. Paved shoulder widths next to the passing lane should be a minimum of 4 ft (1.2 m).

5. Tapers. Design passing lanes by providing an additional lane to the right side of the traveled way; see Figure 47-2.G. Develop the additional lane with an entrance taper of 25:1. For the exit taper, the most commonly used taper rate is 50:1. However, where a location warrants an extended length of taper, the following equation may be used:

$$L = WS \qquad \text{(US Customary) Equation 47-2.3}$$

$$L = 0.6WS \qquad \text{(Metric) Equation 47-2.3}$$

where:

L = length of taper, ft (m)
W = width of passing lane, ft (m)
S = design speed, mph (km/h)

6. Length. The length of the passing lane will be determined by traffic volumes, length of the platoon, location of major intersections, geometrics, and distances between successive passing opportunities. The optimal length of passing lanes is usually between ½ mile and 1 mile (1 km and 1.5 km). At a minimum, passing lanes should not be less than 1000 ft (300 m) long. On the other hand, passing lane lengths greater than 1 mile (1.5 km) tend to have diminishing reductions in platooning per unit length.

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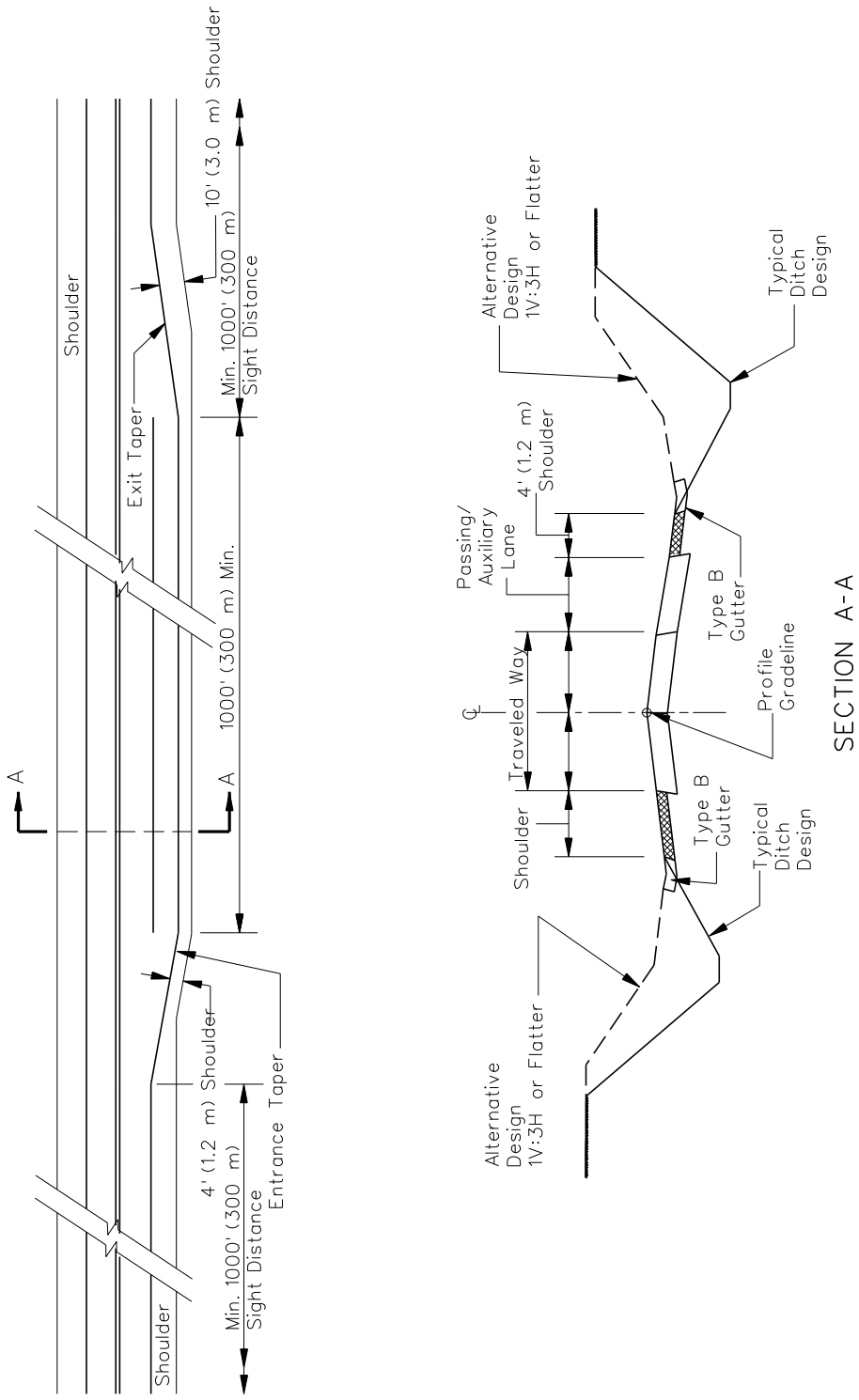

Note: For final signing and pavement markings, contact the Bureau of Operations.

TYPICAL DESIGN LAYOUT FOR ONE DIRECTION PASSING LANE

Figure 47-2.G

7. Typical Design Layout. Figure 47-2.G illustrates a typical design for a passing lane in one direction. Advance signing is necessary to indicate to drivers that passing opportunities exist ahead (e.g., PASSING LANE 1/2 MILES AHEAD). Coordinate the final signing and pavement marking placement with the Bureau of Operations.

8. Typical Sections. Figure 47-2.G illustrates a cross section design for one directional passing lanes and Figure 47-2.H illustrates side-by-side passing lanes.

9. Four-Lane Sections. Short segments of a four-lane cross section, designated as side-by-side passing lanes in Figure 47-2.F, may be constructed along a two-lane highway to break up platoons, to provide the desired frequency of safe passing zones, and to eliminate interference from low-speed vehicles. These sections may be advantageous in rolling terrain, where the alignment is winding, or where the profile includes critical grades in both directions. The decision to use a short four-lane segment, as compared to using a three-lane option, should be based on long-range planning objectives for the facility, the availability of right-of-way, the existing cross section, topography, and the desire to reduce platooning and passing problems.

   Provide sufficient sight distance (e.g., 1000 ft (300 m)) in the transition area from the two-lane section to the four-lane section to allow a driver to anticipate the passing opportunity. Four-lane sections of 1 mile to 1.5 miles (1.5 km to 2.5 km) in length are usually sufficient to dissipate most queues formed by slow vehicles and terrain conditions.

47-2.05 Two-Way, Left-Turn Lanes (TWLTL)

TWLTL may be appropriate at isolated rural locations, where the highway is transitioning into a suburban or urban area having sizable left-turn volumes, or where there are several closely spaced driveways. Rural facilities will typically consist of a three-lane cross section illustrated in Figure 47-2.I. For posted speeds greater than 45 mph, exercise caution in designing the TWLTL. See Sections 48-4 and 34-3 for TWLTL design criteria.

47-2.06 Tables of Design Criteria

Figures 47-2.J through 47-2.L present the Department's design criteria for rural two-lane principal arterials, two-lane minor arterials, and two-lane collectors. Note that Figures 47-2.J, 47-2.K, and 47-2.L also provide criteria for existing design elements allowed to remain in place. The designer should realize that some of the cross section elements included in the figures (e.g., TWLTL) are not automatically warranted in the project design. The values in the figures only apply after the decision has been made to include the element in the highway cross section.

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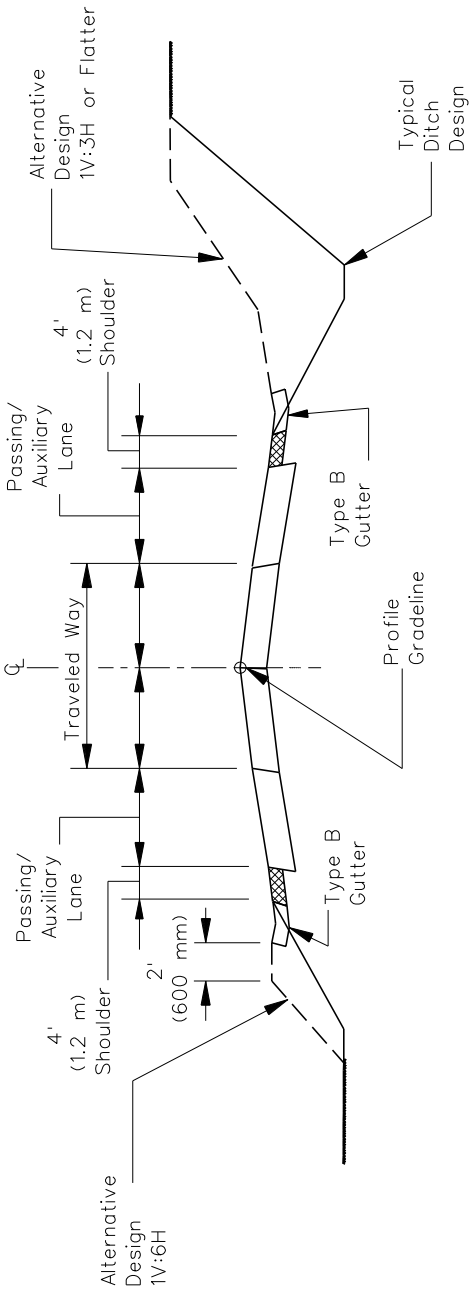
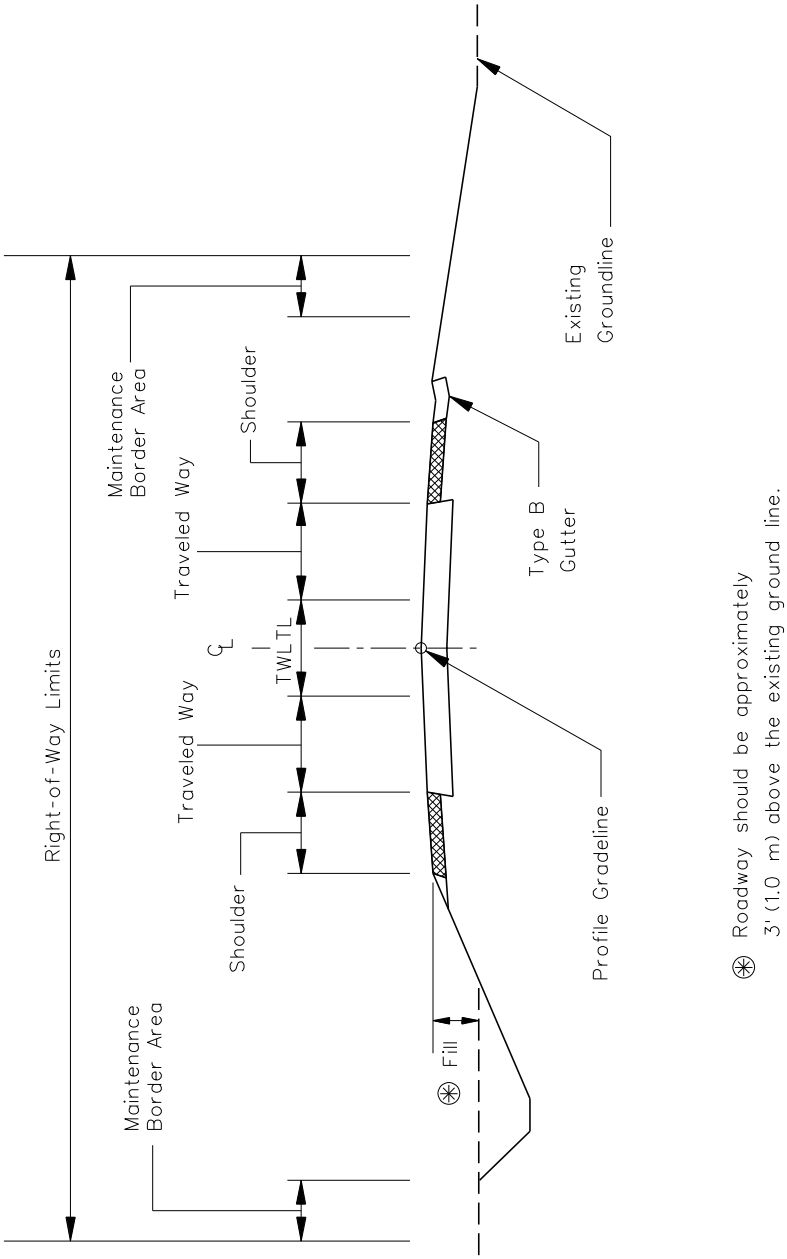


TYPICAL SECTION FOR FOUR-LANE PASSING SEGMENT

Figure 47-2.H



Roadway should be approximately 3' (1.0 m) above the existing ground line. See Section 33-6.04.

TYPICALRURAL SECTION WITH TWLTL

Figure 47-2.I

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Design Element				Manual Section	New Construction/Reconstruction Two-Way DHV: Under 650 (2)	Elements to Remain-In-Place (1) Two-Way DHV: Under 600 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	70 mph (**3a**)	60 mph (**3b**)
	Access Control			35-1	Controlled by Regulation (**4**)	Controlled by Regulation
	Level of Service			31-4.04	B	B
Cross Section Elements	*Traveled Way Width			34-2.01	24′	22′
	*Shoulder Width	Total Width		34-2.02	10′	8′
		Paved			10′	8′
	Auxiliary Lanes	Lane Width		34-2.03	12′	11′
		Shoulder Width			4′ (Paved)	4′ (Paved)
	Flush/TWLTL Widths			34-3.03	14′	12′
	Cross Slope	*Travel Lane		34-2.01	3/16″/ft (**5**)	3/16″/ft (**5**)
		Shoulder		34-2.02	1/2″/ft	1/2″/ft to 3/4″ ft
	Clear Zone			38-3	(**6**)	(**6**)
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		4′ (**7**)	2′-0″ (**7**)
			Back Slope		1V:3H (**8**)	1V:3H (**8**)
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:6H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	HS-20	N/A
		*Clear Roadway Width (**10**)		39-6	44′	N/A
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	N/A	HS-20
		*Clear Roadway Width (**11**)		39-6	N/A	38′ - 40′
	*Vertical Clearance (Arterial Under) (**12a**)	New and Replaced Overpassing Bridges		39-4	16′-6″ (**12b**)	
		Existing Overpassing Bridges			16′-0″	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 17′-3″(**12b**)″	
	*Vertical Clearance (Arterial over Railroad)			39-4.06	23′-0″	

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE PRINCIPAL ARTERIALS
(New Construction/Reconstruction)
(US Customary)

Figure 47-2.J

Design Element				Manual Section	New Construction/Reconstruction Two-Way DHV: Under 650 (2)	Elements to Remain-In-Place (1) Two-Way DHV: Under 600 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	110 km/h (**3a**)	100 km/h (**3b**)
	Access Control			35-1	Controlled by Regulation (**4**)	Controlled by Regulation
	Level of Service			31-4.04	B	B
Cross Section Elements	*Traveled Way Width			34-2.01	7.2 m	6.6 m
	*Shoulder Width	Total Width		34-2.02	3.0 m	2.4 m
		Paved			3.0 m	2.4 m
	Auxiliary Lanes	Lane Width		34-2.03	3.6 m	3.3 m
		Shoulder Width			1.2 m (Paved)	1.2 m (Paved)
	Flush/TWLTL Widths			34-3.03	4.2 m	3.6 m
	Cross Slope	*Travel Lane		34-2.01	1.5% (**5**)	1.5% (**5**)
		Shoulder		34-2.02	4%	4% to 6%
	Clear Zone			38-3	(**6**)	(**6**)
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		1.2 m (**7**)	600 mm (**7**)
			Back Slope		1V:3H (**8**)	1V:3H (**8**)
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:6H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	MS-18	N/A
		*Clear Roadway Width (**10**)		39-6	13.2 m	N/A
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	N/A	MS-18
		*Clear Roadway Width (**11**)		39-6	N/A	11.4 m – 12.0 m
	*Vertical Clearance (Arterial Under) (**12a**)	New and Replaced Overpassing Bridges		39-4	5.0 m (**12b**)	
		Existing Overpassing Bridges			4.9 m	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 5.25 m (**12b**)	
	*Vertical Clearance (Arterial over Railroad)			39-4.06	7.0 m	

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE PRINCIPAL ARTERIALS
(New Construction/Reconstruction)
(Metric)

Figure 47-2.J

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(1) Design Criteria. The criteria in this column are the minimum cross-section elements allowed to remain in place provided it is cost effective and the safety record is satisfactory.

(2) Traffic Volumes. The design hourly volumes (DHV) assumes base conditions (except for 8% heavy vehicles) and a PHF = 1 for LOS shown. Adjust these values according to the actual factors.

(3) Design Speed.

a. In rolling terrain, a minimum design speed of 60 mph (100 km/h) may be considered with study and justification.
b. To determine the minimum design speed allowed to remain in place, see Section 45-2.02.

(4) Access Control. For bypass routes on new alignment, design the roadway with partial access control.

(5) Cross Slopes. Cross slopes for auxiliary lanes should be 1/16″/ft (0.5%) greater than the adjacent travel lane.

(6) Clear Zone. The clear zone will vary according to design speed, traffic volumes, side slopes, and horizontal curvature.

(7) Ditch Bottom Width. Provide a wider outside ditch bottom where detention storage of storm water is a consideration.

(8) Back Slope. Where the height of cut exceeds 10 ft (3 m), consider using a 1V:2H back slope beyond the clear zone. Also, for heights of cut greater than 30 ft (9 m), consider the use of benching.

(9) Fill Slope. For fill heights greater than 30 ft (9 m), use a 1V:2H uniform slope with a roadside barrier. Also, for heights greater than 30 ft (9 m), consider the use of benching.

(10) New and Reconstructed Bridge Widths. Clear roadway bridge widths are measured from face to face of parapets or rails. Bridge widths are normally defined as the sum of the approach traveled way width and the width of the paved shoulders. See Figure 39-6.A.

(11) Existing Bridge Widths to Remain in Place. Clear roadway bridge widths measured face to face of parapets or rails. Implies elements allowed to remain in place without a design exception when cost effective and when safety record is satisfactory. See Figure 39-6.A.

(12) Vertical Clearance (Arterial Under).

a. The clearance must be available over the traveled way and any paved shoulders.
b. Table value includes an additional allowance for future overlays.

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE PRINCIPAL ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 47-2.J

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Design Element				Manual Section	New Construction/Reconstruction Two-Way DHV: Under 1050 (2)	Elements to Remain-In-Place (1) Two-Way DHV: Under 975 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	60 mph (**3a**)	60 mph (**3b**)
	Access Control			35-1	Controlled by Regulation (**4**)	Controlled by Regulation
	Level of Service			31-4.04	C	C
Cross Section Elements	*Traveled Way Width			34-2.01	24′	22′
	*Shoulder Width	Total Width		34-2.02	10′	8′
		Paved			4′	4′
	Auxiliary Lanes	Lane Width		34-2.03	12′	11′
		Shoulder Width			4′ (Paved)	4′ (Paved)
	Flush/TWLTL Widths			34-3.03	14′	12′
	Cross Slope	*Travel Lane		34-2.01	3/16″/ft (**5a**)	3/16″/ft (**5**)
		Shoulder		34-2.02	1/2″/ft (**5b**)	1/2″/ft to 3/4″ ft (**5b**)
	Clear Zone			38-3	(**6**)	(**6**)
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		4′ (**7**)	2′-0″ (**7**)
			Back Slope		1V:3H (**8**)	1V:3H (**8**)
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:6H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	HS-20	N/A
		*Clear Roadway Width (**10**)		39-6	32′	N/A
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	N/A	HS-20
		*Clear Roadway Width (**11**)		39-6	N/A	30′ - 32′
	*Vertical Clearance (Arterial Under) (**12a**)	New and Replaced Overpassing Bridges		39-4	16′-6″ (**12b**)	
		Existing Overpassing Bridges			16′-0″	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 17′-3″(**12b**)	
	*Vertical Clearance (Arterial over Railroad)			39-4.06	23′-0″	

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE MINOR ARTERIALS
(New Construction/Reconstruction)
(US Customary)

Figure 47-2.K

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Design Element				Manual Section	New Construction/Reconstruction Two-Way DHV: Under 1050 (2)	Elements to Remain-In-Place (1) Two-Way DHV: Under 975 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	100 km/h (**3a**)	100 km/h (**3b**)
	Access Control			35-1	Controlled by Regulation (**4**)	Controlled by Regulation
	Level of Service			31-4.04	C	C
Cross Section Elements	*Traveled Way Width			34-2.01	7.2 m	6.6 m
	*Shoulder Width	Total Width		34-2.02	3.0 m	2.4 m
		Paved			1.2 m	1.2 m
	Auxiliary Lanes	Lane Width		34-2.03	3.6 m	3.3 m
		Shoulder Width			1.2 m (Paved)	1.2 m (Paved)
	Flush/TWLTL Widths			34-3.03	4.2 m	3.6 m
	Cross Slope	*Travel Lane		34-2.01	1.5% (**5a**)	1.5% (**5a**)
		Shoulder		34-2.02	4% (**5b**)	4% to 6% (**5b**)
	Clear Zone			38-3	(**6**)	(**6**)
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Width		1.2 m (**7**)	500 mm (**7**)
			Back Slope		1V:3H (**8**)	1V:3H (**8**)
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:6H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	MS-18	N/A
		*Clear Roadway Width (**10**)		39-6	9.6 m	N/A
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	N/A	MS-18
		*Clear Roadway Width (**11**)		39-6	N/A	9.0 m – 9.6 m
	*Vertical Clearance (Arterial Under) (**12a**)	New and Replaced Overpassing Bridges		39-4	5.0 m (**12b**)	
		Existing Overpassing Bridges			4.9 m	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 5.25 m (**12b**)	
	*Vertical Clearance (Arterial over Railroad)			39-4.06	7.0 m	

* Controlling design criteria (see Section 31-8)

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE MINOR ARTERIALS
(New Construction/Reconstruction)
(Metric)

Figure 47-2.K

(1) Design Criteria. The criteria in this column are the minimum cross-section elements allowed to remain in place provided it is cost effective and the safety record is satisfactory.

(2) Traffic Volumes. The design hourly volumes (DHV) assumes base conditions (Except for 8% heavy vehicles) and a PHF =1 for LOS shown. Adjust these values according to the actual factors.

(3) Design Speed.

a. In rolling terrain, a minimum design speed of 55 mph (90 km/h) may be considered with study and justification.
b. To determine the minimum design speed allowed to remain in place, see Section 45-2.02.

(4) Access Control. For bypass routes on new alignment, design the roadway with partial access control.

(5) Cross Slopes.

a. Traveled Way. Cross slopes for auxiliary lanes should be 1/6″/ft (0.5%) greater than the adjacent travel lane.
b. Shoulder. Where an aggregate shoulder is part of the shoulder width, slope the aggregate portion of the shoulder at 3/4″/ft (6%).

(6) Clear Zone. The clear zone will vary according to design speed, traffic volumes, side slopes, and horizontal curvature.

(7) Ditch Bottom Width. Provide a wider outside ditch bottom where detention storage of storm water is a consideration.

(8) Back Slope. Where the height of cut exceeds 10 ft (3 m), consider using a 1V:2H back slope beyond the clear zone. Also, for heights of cut greater than 30 ft (9 m), consider the use of benching.

(9) Fill Slope. For fill heights greater than 30 ft (9 m), use a 1V:2H uniform slope with a roadside barrier. Also, for heights greater than 30 ft (9 m), consider the use of benching.

(10) New and Reconstructed Bridge Widths. Clear roadway bridge widths are measured from face to face of parapets or rails. Bridge widths are normally defined as the sum of the approach traveled way width and the width of the paved shoulders. See Figure 39-6.A.

(11) Existing Bridge Widths to Remain in Place. Clear roadway bridge widths measured face to face of parapets or rails. Implies elements allowed to remain in place without a design exception when cost effective and when safety record is satisfactory. See Figure 39-6.A.

(12) Vertical Clearance (Arterial Under).

a. The clearance must be available over the traveled way and any paved shoulders.
b. Table value includes an additional allowance for future overlays.

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE MINOR ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 47-2.K

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Design Element				Manual Section	New Construction/Reconstruction Two-Way DHV: Under 1050 (2)	Elements to Remain-In-Place (1) Two-Way DHV: Under 975 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	60 mph (**3a**)	60 mph (**3b**)
	Access Control			35-1	Controlled by Regulation (**4**)	Controlled by Regulation
	Level of Service			31-4.04	C	C
Cross Section Elements	*Traveled Way Width			34-2.01	24′	22′
	*Shoulder Width	Total Width		34-2.02	8′	6′
		Paved			4′	2′
	Auxiliary Lanes	Lane Width		34-2.03	12′	11′
		Shoulder Width			4′ (Paved)	4′ (Paved)
	Flush/TWLTL Widths			34-3.03	14′	12′
	Cross Slope	*Travel Lane		34-2.01	3/16″/ft (**5a**)	3/16″/ft (**5a**)
		Shoulder		34-2.02	1/2″/ft (**5b**)	1/2″/ft to 3/4″/ft (**5b**)
	Clear Zone			38-3	(**6**)	(**6**)
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		4′ (**7**)	2′-0″ (**7**)
			Back Slope		1V:3H (**8**)	1V:3H (**8**)
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	HS-20	N/A
		*Clear Roadway Width (**10**)		39-6	32′	N/A
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	N/A	HS-20
		*Clear Roadway Width (**11**)		39-6	N/A	30′ - 32′
	*Vertical Clearance (Collector Under) (**12a**)	New and Replaced Overpassing Bridges		39-4	14′-9″ (**12b**)	
		Existing Overpassing Bridges			14′-0″	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 17′-3″(**12b**)	
	*Vertical Clearance (Collector over Railroad)			39-4.06	23′-0″	

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE COLLECTORS
(New Construction/Reconstruction)
(US Customary)

Figure 47-2.L

Design Element				Manual Section	New Construction/Reconstruction Two-Way DHV: Under 1050 (2)	Elements to Remain-In-Place (1) Two-Way DHV: Under 975 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	100 km/h (**3a**)	100 km/h (**3b**)
	Access Control			35-1	Controlled by Regulation (**4**)	Controlled by Regulation
	Level of Service			31-4.04	C	C
Cross Section Elements	*Traveled Way Width			34-2.01	7.2 m	6.6 m
	*Shoulder Width	Total Width		34-2.02	2.4 m	1.8 m
		Paved			1.2 m	600 mm
	Auxiliary Lanes	Lane Width		34-2.03	3.6 m	3.3 m
		Shoulder Width			1.2 m (Paved)	1.2 m (Paved)
	Flush/TWLTL Widths			34-3.03	4.2 m	3.6 m
	Cross Slope	*Travel Lane		34-2.01	1.5% (**5a**)	1.5% (**5a**)
		Shoulder		34-2.02	4% (**5b**)	4% to 6% (**5b**)
	Clear Zone			38-3	(**6**)	(**6**)
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		1.2 m (**7**)	600 mm (**7**)
			Back Slope		1V:3H (**8**)	1V:3H (**8**)
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope (**9**)
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	MS-18	N/A
		*Clear Roadway Width (**10**)		39-6	9.6 m	N/A
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	N/A	MS-18
		*Clear Roadway Width (**11**)		39-6	N/A	9.0 m – 9.6 m
	*Vertical Clearance (Collector Under) (**12a**)	New and Replaced Overpassing Bridges		39-4	4.5 m (**12b**)	
		Existing Overpassing Bridges			4.3 m	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 5.25 m (**12b**)	
	*Vertical Clearance (Collector over Railroad)			39-4.06	7.0 m	

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE COLLECTORS
(New Construction/Reconstruction)
(Metric)

Figure 47-2.L

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(1) Design Criteria. The criteria in this column are the minimum cross-section elements allowed to remain in place provided it is cost effective and the safety record is satisfactory.

(2) Traffic Volumes. The design hourly volumes (DHV) assumes base conditions (except for 8% heavy vehicles) and a PHF = 1 for LOS shown. Adjust these values according to the actual factors.

(3) Design Speed.

a. In rolling terrain, a minimum design speed of 55 mph (90 km/h) may be considered with study and justification.
b. To determine the minimum design speed allowed to remain in place, see Section 45-2.02.

(4) Access Control. For bypass routes on new alignment, design the roadway with partial access control.

(5) Cross Slopes.

a. Traveled Way. Cross slopes for auxiliary lanes should be 1/16″/ft (0.5%) greater than the adjacent travel lane.
b. Shoulder. Where an aggregate shoulder is part of the shoulder width, slope the aggregate portion of the shoulder at 3/4″/ft (6%).

(6) Clear Zone. The clear zone will vary according to design speed, traffic volumes, side slopes, and horizontal curvature.

(7) Ditch Bottom Width. Provide a wider outside ditch bottom where detention storage of storm water is a consideration.

(8) Back Slope. Where the height of cut exceeds 10 ft (3 m), consider using a 1V:2H back slope beyond the clear zone. Also, for heights of cut greater than 30 ft (9 m), consider the use of benching.

(9) Fill Slope. For fill heights greater than 30 ft (9 m), use a 1V:2H uniform slope with a roadside barrier. Also, for heights greater than 30 ft (9 m), consider the use of benching.

(10) New and Reconstructed Bridge Widths. Clear roadway bridge widths are measured from face to face of parapets or rails. Bridge widths are normally defined as the sum of the approach traveled way width and the width of the paved shoulders. See Figure 39-6.A.

(11) Existing Bridge Widths to Remain in Place. Clear roadway bridge widths measured face to face of parapets or rails. Implies elements allowed to remain in place without a design exception when cost effective and when safety record is satisfactory. See Figure 39-6.A.

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(12) Vertical Clearance (Collector Under).

a. The clearance must be available over the traveled way and any paved shoulders.
b. Table value includes an additional allowance for future overlays.

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE COLLECTORS
(New Construction/Reconstruction)

Footnotes for Figure 47-2.L

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Design Element		Manual Section	Design Speed	
			60 mph	70 mph
* Stopping Sight Distance **(1)**		31-3.01	570′	730′
Passing Sight Distance		47-2.03	2135′	2480′
Decision Sight Distance **(2)**		31-3.02	990′	1105′
Intersection Sight Distance **(3)**		36-6	665′	775′
* Minimum Radii	e_{max} = 6%	32-2.03	Desirable: ≥ 3000′ Minimum: 1330′	Desirable: ≥ 3000′ Minimum: 2040′
* Superelevation Rate **(4)**		32-3	e_{max} = 6%	
* Horizontal Sight Distance **(5)**		32-4	**(5)**	
* Vertical Curvature (K-values)	Crest	33-4	151	247
	Sag		136	181
* Maximum Grade **(6)**	Level	33-2.02	New: 3%	
	Rolling		New: 4%	
Minimum Grade		33-2.03	Desirable: 0.5% Minimum: 0.0% (with Special Ditching)	

* Controlling design criteria (see Section 31-8).

(1) Stopping Sight Distance. Table values are for passenger cars on level grade.

(2) Decision Sight Distance. Table values are for the avoidance maneuver (speed/path/direction change).

(3) Intersection Sight Distance. Table values are for passenger cars for assumed conditions described in Figure 36-6.E. See Section 36-6 for trucks.

(4) Superelevation Rate. See Section 32-3 for superelevation rates based on e_{max}, design speed, and radii of horizontal curves. For horizontal curves to remain in place, an e_{max} of 8% may be considered to remain in place. Where a crossroad intersection lies within the limits of a mainline horizontal curve, see Figure 36-1.E for the maximum superelevation rates allowed on the mainline curve.

(5) Horizontal Sight Distance. For a given design speed, the necessary horizontal sight line offset will be determined by the radius of curve and the required sight distance.

(6) Maximum Grade. Grades 1% steeper may be allowed to remain in place for existing roadways.

ALIGNMENT CRITERIA FOR RURAL TWO-LANE HIGHWAYS
(US Customary)

Figure 47-2.M

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Design Element		Manual Section	Design Speed	
			100 km/h	110 km/h
* Stopping Sight Distance **(1)**		31-3.01	185 m	216 m
Passing Sight Distance		47-2.03	670 m	730 m
Decision Sight Distance **(2)**		31-3.02	315 m	330 m
Intersection Sight Distance **(3)**		36-6	209 m	230 m
* Minimum Radii	e_{max} = 6%	32-2.03	Desirable: ≥ 1000 m Minimum: 437 m	Desirable: ≥ 1000 m Minimum: 560 m
* Superelevation Rate **(4)**		32-3	e_{max} = 6%	
* Horizontal Sight Distance **(5)**		32-4	**(5)**	
* Vertical Curvature (K-values)	Crest	33-4	52	71
	Sag		45	54
* Maximum Grade **(6)**	Level	33-2.02	New: 3%	
	Rolling		New: 4%	
Minimum Grade		33-2.03	Desirable: 0.5% Minimum: 0.0% (with Special Ditching)	

* Controlling design criteria (see Section 31-8).

(1) Stopping Sight Distance. Table values are for passenger cars on level grade.

(2) Decision Sight Distance. Table values are for the avoidance maneuver (speed/path/direction change).

(3) Intersection Sight Distance. Table values are for passenger cars for assumed conditions described in Figure 36-6.E. See Section 36-6 for trucks.

(4) Superelevation Rate. See Section 32-3 for superelevation rates based on e_{max}, design speed, and radii of horizontal curves. For horizontal curves to remain in place, an e_{max} of 8% may be considered to remain in place. Where a crossroad intersection lies within the limits of a mainline horizontal curve, see Figure 36-1.E for the maximum superelevation rates allowed on the mainline curve.

(5) Horizontal Sight Distance. For a given design speed, the necessary horizontal sight line offset will be determined by the radius of curve and the required sight distance.

(6) Maximum Grade. Grades 1% steeper may be allowed to remain in place for existing roadways.

ALIGNMENT CRITERIA FOR RURAL TWO-LANE HIGHWAYS
(Metric)

Figure 47-2.M

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47-3 MULTILANE HIGHWAYS

47-3.01 General

New rural four-lane highways with depressed medians and without access control are not a common highway design in Illinois. For construction or reconstruction projects, the following are descriptions of some of the more likely situations where a four-lane highway design might be proposed:

1. SRA Routes. Where rural routes are designated as Strategic Regional Arterials (SRA). See Chapter 46 for the details of SRA design.

2. Suburban Areas. Where highways are located in an open-suburban area, where reconstruction is required to satisfy capacity demands, and where a design speed of 50 mph (80 km/h) is desired. These highways will most likely be classified as either a minor arterial or as a collector route. Chapter 43 discusses open-suburban guidelines, and Chapter 34 provides general cross section information.

3. Passing Lanes. Where passing lanes are needed in both directions on a two-lane highway and right-of-way and topography favor using a four-lane section. Also, more desirable traffic operations can be accomplished by designing a four-lane section which consists of side-by-side passing lanes; see Figure 47-2.F.

47-3.02 Design Speed

The selected design speed depends on the type of proposed project and on the following:

1. Rural SRA. Where an arterial route is designated as a rural SRA, the desirable design speed for new and existing roadways is 60 mph (100 km/h). To determine the minimum elements allowed to remain in place in conjunction with the design speed, see Section 45-2.02.

2. Open Suburban Area. Where a route is proposed for reconstruction in an open-suburban area and a high-speed design is preferred, use a rural-type cross section with a 50 mph (80 km/h) design speed. See Section 34-3.04(c) for the median design details and Figure 47-3.C for other geometric elements.

3. Passing Lanes. Where a two-lane highway requires additional passing opportunities and side-by-side passing lanes are proposed, provide a design speed of 60 mph (100 km/h) or greater. See Section 47-2.04 for design details.

47-3.03 Typical Sections

Figures 47-3.A and 47-3.B illustrate typical schematic cross sections for rural multilane highways. The tables in Section 47-3.04 provide the minimum criteria for lane widths, shoulder widths, median widths, and other cross section elements.

47-3.04 Tables of Design Criteria

Figures 47-3.C and 47-3.D present the Department's design criteria for rural multilane highways. Note that Figure 47-3.C also provides criteria for an existing roadway to remain in place. The designer should realize that some of the cross section elements included in the figures (e.g., flush concrete barrier) are not automatically warranted in the project design. The values in the figures only apply after the decision has been made to include the element in the highway cross section.

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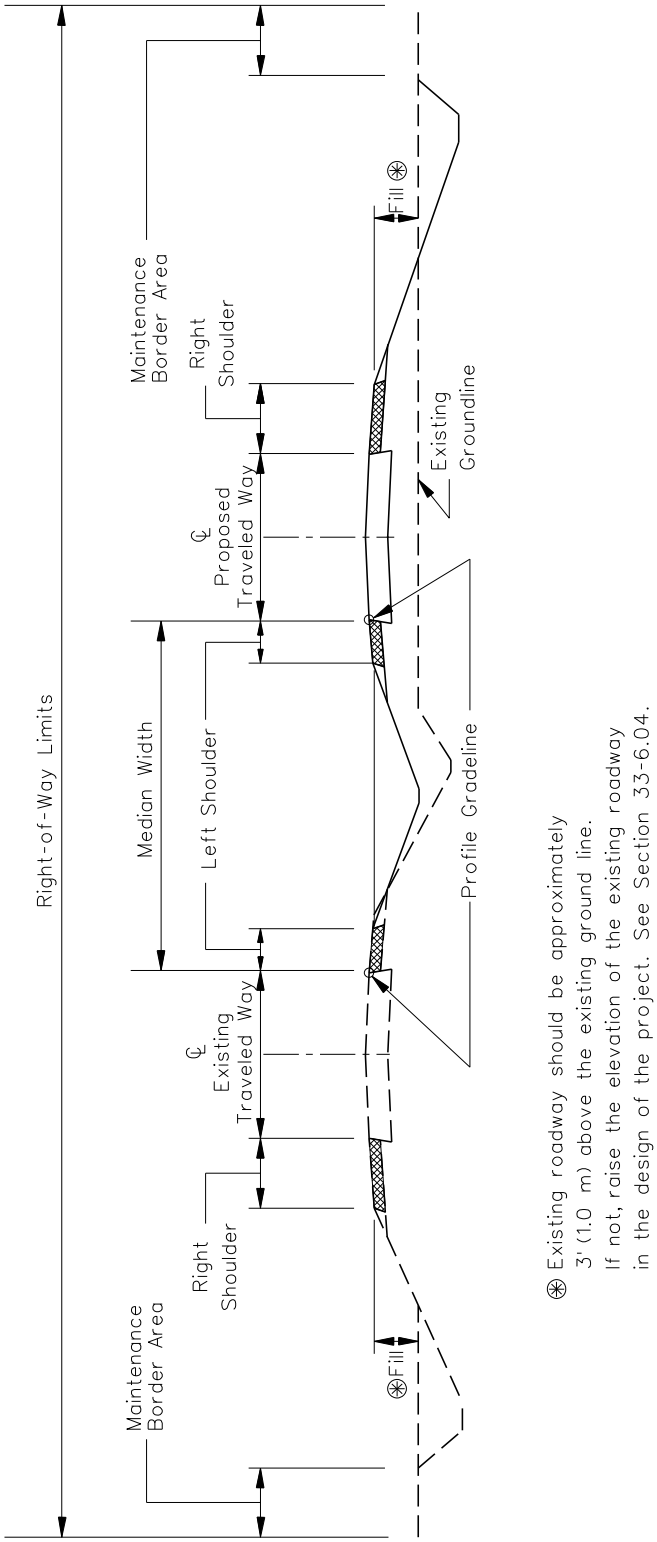
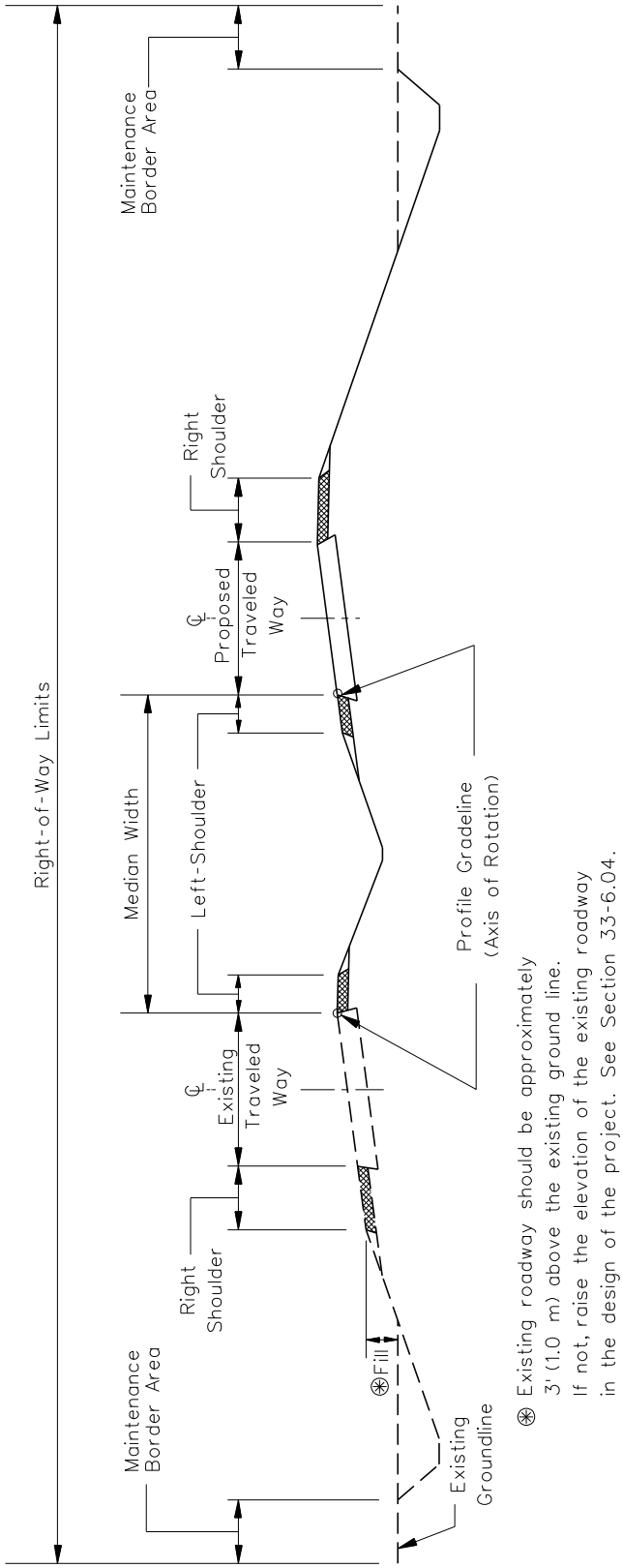


⊛ Existing roadway should be approximately 3' (1.0 m) above the existing ground line. If not, raise the elevation of the existing roadway in the design of the project. See Section 33-6.04.

Note: See Figure 45-2.C for design of flush medians with concrete barrier.

TYPICAL TANGENT SECTION FOR RURAL MULTILANE HIGHWAYS (Depressed Median)

Figure 47-3.A



Note: See Figure 45-2.F for design of flush medians with concrete barrier.

TYPICAL SECTION FOR SUPERELEVATED RURAL MULTILANE HIGHWAYS (Depressed Median)

Figure 47-3.B

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Design Element				Manual Section	New Lanes (1a) One-Way DHV: Under 2525 (2)	Existing Lanes (1b) One-Way DHV: Under 2375 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	50 mph or 60 mph	50 mph or 60 mph **(3)**
	Access Control			35-1	Controlled by Regulation **(4)**	Controlled by Regulation **(4)**
	Level of Service			31-4.04	C	C
Cross Section Elements	*Traveled Way Width			34-2.01	2 @ 24′	2 @ 22′
	Shoulder Width	Right	Total Width	34-2.02	10′	8′
			Paved		Minimum 8′	8′
		Left	Total Width		6′ **(5)**	4′
			Paved		4′	4′
	Auxiliary Lanes	Lane Width		34-2.03	12′	11′
		Shoulder Width			4′ (Paved)	4′ (Paved)
	Cross Slope	*Travel Lane		34-2.01	3/16″/ft for lanes adjacent to crown **(6)**	3/16″/ft for lanes adjacent to crown **(6)**
		Shoulder		34-2.02	1/2″/ft	1/2″/ft to 3/4″/ft
	Median Width	Depressed		34-3	Desirable: 50′ Minimum: 44′ **(7a)**	Minimum: 40′ **(7b)**
		Flush (Concrete Barrier)			22′ **(8)**	Minimum: 20′ **(8)**
	Clear Zone			38-3	**(9)**	**(9)**
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		4′ **(10)**	2′-0″ **(10)**
			Back Slope		1V:3H **(11)**	1V:3H **(11)**
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope **(12)**	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope **(12)**
	Median Slopes	Depressed		34-3	1V:6H to 1V:5H	1V:5H
		Flush			1/2″/ft	1/2″/ft
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	HS-20	HS-20
		*Clear Roadway Width **(13)**		39-6	36′	36′
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	HS-20	HS-20
		*Clear Roadway Width **(14a)**		39-6	36′ with 24′ Traveled Way (**14b**)	34′ with 22′ Traveled Way **(14b)**
	*Vertical Clearance (Arterial Under) **(15a)**	New and Replaced Overpassing Bridges **(15b)**		39-4	16′-6″	
		Existing Overpassing Bridges			16′-0″	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 17′-3″ **(15b)** Existing: 16′-9″	
	*Vertical Clearance (Arterial over Railroad)			39-4.06	23′-0″	

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR RURAL FOUR-LANE MINOR ARTERIALS
(New Construction/Reconstruction)
(US Customary)

Figure 47-3.C

Design Element				Manual Section	New Lanes (1a) One-Way DHV: Under 2525 (2)	Existing Lanes (1b) One-Way DHV: Under 2375 (2)
Design Controls	Design Forecast Year			31-4.02	20 Years	20 Years
	*Design Speed			31-2	80 km/h or 100 km/h	80 km/h or 100 km/h **(3)**
	Access Control			35-1	Controlled by Regulation **(4)**	Controlled by Regulation **(4)**
	Level of Service			31-4.04	C	C
Cross Section Elements	*Traveled Way Width			34-2.01	2 @ 7.2 m	2 @ 6.6 m
	Shoulder Width	Right	Total Width	34-2.02	3.0 m	2.4 m
			Paved		Minimum 2.4 m	2.4 m
		Left	Total Width		1.8 m **(5)**	1.2 m
			Paved		1.2 m	1.2 m
	Auxiliary Lanes	Lane Width		34-2.03	3.6 m	3.3 m
		Shoulder Width			1.2 m (Paved)	1.2 m (Paved)
	Cross Slope	*Travel Lane		34-2.01	1.5% for lanes adjacent to crown **(6)**	1.5% for lanes adjacent to crown **(6)**
		Shoulder		34-2.02	4%	4% to 6%
	Median Width	Depressed		34-3	Desirable: 15 m Minimum: 13.2 m **(7a)**	Minimum: 12 m **(7b)**
		Flush (Concrete Barrier)			7.0 m **(8)**	Minimum: 6.0 m **(8)**
	Clear Zone			38-3	**(9)**	**(9)**
Roadway Slopes	Side Slopes	Cut Section	Front Slope	34-4.03	1V:6H	1V:4H
			Ditch Bottom Width		1.2 m **(10)**	600 mm **(10)**
			Back Slope		1V:3H **(11)**	1V:3H **(11)**
		Rock Cut		34-4.05	—	—
		Fill Section		34-4.02	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope **(12)**	1V:4H to Clear Zone; 1V:3H max. to Toe of Slope **(12)**
	Median Slopes	Depressed		34-3	1V:6H to 1V:5H	1V:5H
		Flush			4%	4%
Bridges	New and Reconstructed Bridges	*Structural Capacity		N/A	MS-18	MS-18
		*Clear Roadway Width **(13)**		39-6	10.8 m	10.8 m
	Existing Bridges to Remain in Place	*Structural Capacity		N/A	MS-18	MS-18
		*Clear Roadway Width **(14a)**		39-6	10.8 m with 7.2 m Traveled Way **(14b)**	10.2 m with 6.6 m Traveled Way **(14b)**
	*Vertical Clearance (Arterial Under) **(15a)**	New and Replaced Overpassing Bridges **(15b)**		39-4	5.0 m	
		Existing Overpassing Bridges			4.9 m	
		Overhead Signs/ Pedestrian Bridges		33-5	New: 5.25 m **(15b)** Existing: 1.5 m	
	*Vertical Clearance (Arterial over Railroad)			39-4.06	7.0 m	

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR RURAL FOUR-LANE MINOR ARTERIALS
(New Construction/Reconstruction)
(Metric)

Figure 47-3.C

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(1) Design Criteria:

a. When upgrading an existing two-lane highway to a four-lane facility, use the criteria in the new lanes column for the design of the new roadway and median.
b. The criteria in this column are the minimum cross-section elements allowed to remain in place for reconstruction of an existing roadway provided it is cost effective and safety record is satisfactory.

(2) Traffic Volumes. The design hourly volumes (DHV) assumes base conditions (except for 8% heavy vehicles) and a PHF = 1.0. Adjust these values using local factors.

(3) Design Speed. To determine the minimum design speed allowed to remain, see Section 45-2.02.

(4) Access Control. Investigate and consider providing partial access control; see Sections 45-2.06 through 45-2.09. Bypasses around a community should be fully access controlled if the installation of traffic signals is likely at any intersection during the 20-year design period.

(5) Shoulder Width (Left). In most cases, left shoulders should be 6 ft (1.8 m) wide. This allows for the use of 1V:6H slopes in the median. However, if the 20-year level of service approaches Level C, then consider a 8 ft (2.4 m) wide left shoulder, and decrease the median slopes to 1V:5H.

(6) Travel Lane Cross Slope. For each additional lane away from the crown lanes, increase the cross slope by 1/16″/ft (0.5%) per additional lane up to a maximum of 5/16″/ft (2.5%).

(7) Depressed Median Width.

a. Median width based on 1V:5H median slopes, 2 ft (600 mm) ditch width, 3 ft (900 mm) ditch depth, and 6 ft (1.8 m) left shoulders.
b. Median width based on 1V:5H median slopes, existing 2 ft (600 mm) ditch width, 3 ft (900 mm) ditch depth, and 4 ft (1.2 m) left shoulders..

(8) Flush Median Width. Only use flush medians with CMB where right-of-way or topography restricts the use of a depressed median. Consider providing wider medians where required for snow storage.

(9) Clear Zone. The clear zone will vary according to design speed, traffic volumes, side slopes, and horizontal curvature.

(10) Ditch Bottom Width. Provide a wider outside ditch bottom where detention storage of storm water is a consideration.

(11) Back Slope. Where the height of cut exceeds 10 ft (3 m), consider using a 1V:2H back slope beyond the clear zone. Also, for heights greater than 30 ft (9 m), consider the use of benching.

(12) Fill Slope. For fill heights greater than 30 ft (9 m), use a 1V:2H uniform slope with a roadside barrier. Also, for heights greater than 30 ft (9 m), consider the use of benching.

GEOMETRIC DESIGN CRITERIA FOR RURAL FOUR-LANE MINOR ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 47-3.C

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(13) New and Reconstructed Bridge Widths. Clear roadway bridge widths are measured from face to face of parapets or rails. Bridge widths are normally defined as the sum of the approach traveled way width and the width of the paved shoulders. See Figure 39-6.A.

(14) Existing Bridge Widths to Remain in Place:

a. Clear roadway bridge widths measured from face to face of parapets or rails. Implies elements allowed to remain in place without a design exception when cost effective and when safety record is satisfactory. See Figure 39-6A.

b. Bridges with total lengths greater than 250 ft (75 m) or any span longer than 120 ft (36 m) typically should have a clear roadway bridge width of 38 ft (11.4 m) or 40 ft (12.0 m).

(15) Vertical Clearance (Arterial Under).

a. The clearance must be available over the traveled way and any paved shoulder.
b. Table value includes allowance for future overlays.

GEOMETRIC DESIGN CRITERIA FOR RURAL FOUR-LANE MINOR ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 47-3.C
(Continued)

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Design Element		Manual Section	Design Speed	
			50 mph	60 mph
*Stopping Sight Distance **(1)**		31-3.01	425′	570′
Decision Sight Distance **(2)**		31-3.02	750′	990′
Intersection Sight Distance **(3)**		36-6	555′	665′
*Minimum Radii	e_{max} = 6%	32-2.03	Desirable: ≥ 3000′ Minimum: 835′	Desirable: ≥ 3000′ Minimum: 1330′
*Superelevation Rate **(4)**		32-3	e_{max} = 6%	
*Horizontal Sight Distance **(5)**		32-4	**(5)**	
*Vertical Curvature (K-values)	Crest	33-4	84	151
	Sag		96	136
*Maximum Grade **(6)**	Level	33-2.02	New: 6%	New: 3%
	Rolling		New: 7%	New: 4%
Minimum Grade		33-2.03	Des: 0.5% Min: 0.0% (with Special Ditching)	

* Controlling design criteria (see Section 31-8)

(1) Stopping Sight Distance. Table values are for passenger cars on level grade.

(2) Decision Sight Distance. Table values are for the avoidance maneuver (speed/path/direction change).

(3) Intersection Sight Distance. Table values are for passenger cars turning right or left from a stopped condition. A wide median is assumed on the multilane facility for left turns from the crossroad.

(4) Superelevation Rate. See Section 32-3 for superelevation rates based on e_{max}, design speed, and radii of horizontal curves. For horizontal curves to remain in place, an e_{max} of 8% may be considered to remain in place. Where a crossroad intersection lies within the limits of a mainline horizontal curve, see Figure 36-1.E for the maximum superelevation rates allowed on the mainline curve.

(5) Horizontal Sight Distance. For a given design speed, the necessary horizontal sight line offset will be determined by the radius of curve and the required sight distance.

(6) Maximum Grade. Grades 1% steeper may be allowed to remain in place for existing roadways.

ALIGNMENT CRITERIA FOR RURAL FOUR-LANE MINOR ARTERIALS
(US Customary)

Figure 47-3.D

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Design Element		Manual Section	Design Speed	
			80 km/h	100 km/h
* Stopping Sight Distance **(1)**		31-3.01	129 m	185 m
Decision Sight Distance **(2)**		31-3.02	230 m	315 m
Intersection Sight Distance **(3)**		36-6	167 m	209 m
*Minimum Radii	e_{max} = 6%	32-2.03	Desirable: ≥ 1000 m Minimum: 252 m	Desirable: ≥ 1000 m Minimum: 437 m
*Superelevation Rate **(4)**		32-3	e_{max} = 6%	
*Horizontal Sight Distance **(5)**		32-4	**(5)**	
*Vertical Curvature (K-values)	Crest	33-4	26	52
	Sag		30	45
*Maximum Grade **(6)**	Level	33-2.02	New: 6%	New: 3%
	Rolling		New: 7%	New: 4%
Minimum Grade		33-2.03	Des: 0.5% Min: 0.0% (with Special Ditching)	

* Controlling design criteria (see Section 31-8)

(1) Stopping Sight Distance. Table values are for passenger cars on level grade.

(2) Decision Sight Distance. Table values are for the avoidance maneuver (speed/path/direction change).

(3) Intersection Sight Distance. Table values are for passenger cars turning right or left from a stopped condition. A wide median is assumed on the multilane facility for left turns from the crossroad.

(4) Superelevation Rate. See Section 32-3 for superelevation rates based on e_{max}, design speed, and radii of horizontal curves. For horizontal curves to remain in place, an e_{max} of 8% may be considered to remain in place. Where a crossroad intersection lies within the limits of a mainline horizontal curve, see Figure 36-1.E for the maximum superelevation rates allowed on the mainline curve.

(5) Horizontal Sight Distance. For a given design speed, the necessary horizontal sight line offset will be determined by the radius of curve and the required sight distance.

(6) Maximum Grade. Grades 1% steeper may be allowed to remain in place for existing roadways.

ALIGNMENT CRITERIA FOR RURAL FOUR-LANE MINOR ARTERIALS
(Metric)

Figure 47-3.D

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47-4 REFERENCES

1. *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2011.

2. *Low-Cost Methods for Improving Traffic Operations on Two-Lane Roads: Informational Guide*, Report No. FHWA-IP-87-2, FHWA, 1987.

3. *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

4. NCHRP 605 *Passing Sight Distance Criteria*, TRB, 2008.

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