700 Multi-Modal Considerations

Table of Contents

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700 Multi-Modal Considerations

701 RAILROADS

701.1 Background

Ohio is interlaced with a network of railroad systems controlled by a multiplicity of local and state laws and regulations. The complexity of railroad operations and regulations requires that special consideration be given to the location of highways with respect to railroad track, whether it be the intersection of a highway with a railroad, or the location of a highway adjacent to a railroad facility.

701.2 Crossing At-Grade

701.2.1 General

Highways that cross railroad tracks on a common grade should be located to provide for a minimum of interference to highway traffic and the least amount of adjustment of railroad facilities.

Crossings at-grade will not be permitted on freeways. The creation of new grade crossings where none now exist should be avoided and will require railroad and **Court of Common Pleas approval. (Sec. 957.29 et. seq. ORC).**

701.2.2 Railroad Parallel to Highway

When locating a highway parallel to a railroad track, consideration shall be given to the need for space adjacent to railroad tracks for future industrial development. It is desirable to locate the highway a sufficient distance from the railroad to permit rail service to industrial areas without crossing the highway.

Sufficient distance from a railroad to a parallel highway should be provided along crossroads on which traffic must stop before entering the highway, to permit vehicles to stop clear of the railroad track.

701.3 Lateral Clearances

The standard gage of railroad tracks is 4 feet 8 ½ inches. Where two or more tracks are parallel, the normal centerline spacing is 14 feet.

701.3.1 New Construction

Although minimum lateral clearances vary with railroad ownership, clearance from the centerline of the outside track should normally be at least 18 feet. An additional 8 feet of lateral clearance should be provided when a railroad off-track equipment road is located parallel to the tracks.

701.3.2 Reconstruction

The above clearances should be provided when replacing an existing structure when such additional work can be accomplished at a reasonable cost. A horizontal clearance less than the existing clearance will not be permitted.

701.4 Vertical Clearance

701.4.1 New Construction

A minimum of 23 feet between the top of rail and the bottom of an overpassing structure should be provided. This vertical clearance should extend 6 feet on each side of the centerline of the outside tracks. Actual clearance requirements will be determined after the location plan has been submitted.

701.4.2 Reconstruction

Every attempt should be made to increase the minimum vertical clearance to 23 feet when such additional work can be accomplished at a reasonable cost. A vertical clearance less than the existing clearance will not be permitted.

701.4.3 Construction Clearances

Construction clearances should also be considered in the design stages since they could be a factor in the location of certain items such as catch basins, headwalls, etc. A minimum of 9 feet of lateral clearance should be maintained at all times from the centerline of the track during construction unless this is not possible because of existing conditions.

702 SHARED USE PATHS

702.1 General

Shared use paths are multi-use paths designed primarily for use by bicyclists and pedestrians, including those with disabilities, for transportation and recreation purposes. Shared use paths are physically separated from motor vehicle traffic by an open space or barrier. The following sections are based on the AASHTO Guide for the Development of Bicycle Facilities Fourth Edition, the Manual of Uniform Traffic Control (MUTCD), and the FHWA document, Shared Use Path Level of Service Calculator.

702.1.1 Accessibility Requirements for Shared Use Paths

Due to the fact that nearly all shared use paths are used by pedestrians, they fall under the accessibility requirements of the Americans with Disabilities Act (ADA). Paths in the public right of way that function as sidewalks should be designed in accordance with the proposed Public Rights of Way Accessibility Guidelines (PROWAG), or subsequent guidance that may supersede PROWAG in the future.

700 Multi-Modal Considerations

Shared use paths built in independent right of way should meet the draft accessibility guidelines in the Advance Notice of Proposed Rulemaking (ANPRM) on Accessibility Guidelines for Shared Use Paths or any subsequent rulemaking that supersedes the ANPRM.

702.2 Elements of Design

The first step in designing a shared use path is determining the design users. Due to the large percentage of adult bicyclists, they are the basis for most of the design recommendations.

702.2.1 Width and Clearance

The next step in designing a shared use path is determining the cross section. The width of the shared use path should be sufficient to serve the expected volume of users with a facility consistent with guidance for safe operation. The minimum paved width for a two-directional shared use path is 10 feet. Typically, widths range from 10' to 14', with wider widths applicable to areas with high use and/ or a wider variety of user groups. The FHWA document, Shared Use Path Level of Service Calculator can be used in determining the appropriate width of a pathway. Wider paths are advisable in the following situations:

- When there is a significant use by inline skaters, adult tricycles, children, or other users that need more operating width;
- Where the path is used by larger maintenance vehicles;
- On steep grades to provide additional passing area; or
- Through curves to provide more operating space.

Ideally, a graded shoulder width at least 3 to 5 feet wide with a maximum cross slope of 6:1 should be provided on each side of the pathway. At a minimum, a 2 foot graded area with a maximum slope of 6:1 should be provided for clearance from lateral obstructions such as bushes, large rocks, bridge piers, abutments, and poles. See ***Figure 701-1*** for a typical cross section of a two-way shared use path.
Where paths are adjacent to parallel bodies of water or downward slopes of 3:1 or steeper, a wider separation should be considered. A 5 ft. separation from the edge of path pavement to the top of the slope is desirable. Depending on the height of the embankment and condition at the bottom, a physical barrier, such as dense shrubbery, railing or fencing may be needed. Where a recovery area (distance between the edge of the path pavement and the top of the slope) is less than 5 feet, physical barriers or rails are recommended in the following situations (see ***Figure 701-2***):

- Slope 3:1 or greater, with a drop of 6' or greater;
- Slope 3:1 or greater, adjacent to a parallel body of water or other substantial object;
- Slope 2:1 or greater, with a drop of 4' or greater
- Slopes 1:1 or greater, with a drop of 1' or greater.

The barrier or rail should begin prior to, and extend beyond the area of need. The lateral offset of the barrier should be at least 1' from the edge of path. The ends of the barrier should be flared away from the path edge.

It is not desirable to place the pathway in a narrow corridor between two fences for long distances, as this creates personal security issues, prevents users who need help from being seen, prevents path users from leaving the path in an emergency, and impedes emergency response.

Objects shall not overhang or protrude into any portion of a shared use path at or below 8' measured from the finish surface. In some situations, a vertical clearance greater than 8' may be needed to permit passage of maintenance and emergency vehicles.

702.2.2 Shared Use Paths Adjacent to Roadways (Sidepaths)

While it is generally preferable to select path alignments in independent rights-of-way, there are situations where existing roads provide the only corridors available. Sidepaths are specific type of shared use path that run adjacent to the roadway, where right-of-way and other physical constraints dictate. Sidepaths may be considered in addition to on-road bicycle facilities. A sidepath should satisfy the same design criteria as shared use paths in independent right-of-way.

Utilizing or providing a sidewalk as a two-way shared use path is undesirable.

Paths can function along highways for short sections, or for longer sections where there are few street and/or driveway crossings, given appropriate separation between facilities and attention to reducing crashes at junctions. Two-way sidepaths can create operational concerns. These conflicts include:

1. At intersections and driveways, motorists entering or crossing the roadway often will not notice bicyclists approaching from their right, as they do not expect wheeled traffic from this direction. Motorists turning from the roadway onto the cross street may likewise fail to notice bicyclists traveling the opposite direction from the norm.

2. Bicyclists traveling on sidepaths are apt to cross intersections and driveways at unexpected speeds (speeds that are significantly faster than pedestrian speeds). This may increase the likelihood of crashes, especially where sight distance is limited.

3. Motorists waiting to enter the roadway from a driveway or side street may block the sidepath crossing, as drivers pull forward to get an unobstructed view of traffic.

4. Attempts to require bicyclists to yield or stop at each cross street or driveway are inappropriate and are typically not effective.

5. When the sidepath ends, bicyclists traveling in the direction opposed to roadway traffic may continue on the wrong side of the roadway. Similarly, bicyclists approaching a path may travel on the wrong side of the roadway to access the path. Wrong-way travel by bicyclists is a common factor in bicycle-automobile crashes.

6. Depending upon the bicyclist's specific origin and destination, a two-way sidepath on one side of the road may need additional road crossings (and therefore increase exposure); however the sidepath may also reduce the number of road crossings for some bicyclists.

7. Signs posted for roadway users are backwards for contra-flow riders, who cannot see the sign information. The same applies to traffic signal faces that are not oriented to contra-flow users.

8. Because of the proximity of roadway traffic to opposing path traffic, barriers or railings are sometimes needed to keep traffic on the roadway or path from inappropriately encountering each other. These barriers can represent an obstruction to bicyclists and motorists, impair visibility between road and path users, and can complicate path maintenance.

9. Sidepath width is sometimes constrained by fixed objects (such as utility poles, trash can, mailboxes, etc.)

10. Some bicyclists will use the roadway instead of the sidepath because of the operational issues described above. Bicyclists using the roadway may be harassed by motorists who believe bicyclists should use the sidepath.

11. Bicyclists using a sidepath can only make a pedestrian-style left turn, which generally involves yielding to cross traffic twice instead of only once, and thus induces unnecessary delay.

12. Bicyclists on the sidepath, even those going in the same direction, are not within the normal scanning area of drivers turning right or left from the adjacent roadway into a side road or driveway.

13. Even if the number of intersections and driveway crossings is reduced, bicycle-motor vehicle crashes may still occur at the remaining crossings located along the sidepath.

14. Traffic control devices such as signs and markings have not been shown effective at changing road or path user behavior at sidepath intersections or reducing crashes and conflicts.

For these reasons, sidepaths should not be used.

Guidelines for Sidepaths

Although paths in independent rights-of-way are preferred, sidepaths may be considered where one or more of the following conditions exist:

- The adjacent roadway has relatively high-volume and high-speed motor vehicle traffic that might discourage many bicyclists from riding on the roadway, potentially increasing sidewalk riding, and there are no practical alternatives for either improving the roadway or accommodating bicyclists on nearby parallel streets.

- The sidepath is used for a short distance to provide continuity between sections of path in independent rights-of-way, or to connect local streets that are used as bicycle routes.

- The sidepath can be built with few roadway and driveway crossings.

- The sidepath can be terminated at each end onto streets that accommodate bicyclists, onto another path, or in a location that is otherwise bicycle compatible.

In some situations, it may be better to place one-way sidepaths on both sides of the street or highway. Clear directional information is needed if this design is used. This design can reduce some of the concerns associated with a two-way sidepath at driveways and intersections.

A wide separation should be provided between a two-way sidepath and the adjacent roadway. The minimum recommended distance between a path and the roadway curb or edge of travelled way (where there is no curb) is 5 ft. Where a paved shoulder is present, the separation distance begins at the outside edge of shoulder. Where the separation is less than 5 feet, a physical barrier or railing should be provided between the path and the roadway. Such barriers or railings serve to prevent path users from making undesirable or unintended movements from the path to the roadway and to reinforce the concept that the path is an independent facility. The barrier or railing need not be of a size and strength to redirect an errant motorist toward the roadway, unless other conditions indicate the need for a crashworthy barrier. Barriers or railings at the outside of a structure or a steep fill embankment should be a minimum of 42 in. high. Barrier at other locations that serve only to separate the area for motor vehicles from the sidepath should generally have a minimum height equivalent to the height of a standard guardrail.

702.2.3 Design Speed

The next step in shared use path design is to determine the design speed. For most paths in relatively flat areas (grades less than 2 percent), a design speed of 18 mph is generally sufficient, except on inclines where higher speeds can occur.

702.2.4 Horizontal Alignment

After determining the design speed of the shared use path, the horizontal and vertical alignment of the shared use path should be designed. The minimum radius of horizontal curvature for bicyclists can be calculated using two different methods. One method uses "lean angle", and the other method uses superelevation and coefficient of friction. In general, the lean angle method should be used in design. The table below shows minimum radii of curvature for a paved path using a 20-degree lean angle. See the AASHTO Guide for the Development of Bicycle Facilities 2012 Edition for information on calculating the minimum radius based superelevation and coefficient of friction.

US Customary	
Design Speed (mph)	**Minimum Radius (ft)**
12	27
14	36
16	47
18	60
20	74

25	115
30	166

Minimum Radii for Horizontal Curve on Paved Shared Use Path at a 20-degree Lean Angle

702.2.5 Cross Slope

Shared use paths should have a maximum cross slope of 2 percent, to accommodate people with disabilities.

702.2.6 Grade

The maximum grade of a shared use path contained within the roadway right of way shall not exceed the general grade established for the adjacent roadway. Where the shared use path is not contained within the roadway right of way, the maximum grade of the shared shall be 5 per cent.

702.2.7 Stopping Sight Distance

To provide path users with opportunities to see and react to unexpected conditions, shared use paths should be designed with adequate stopping sight distances.

For a crest vertical curve, the height of eye is assumed to be 4.5 ft. and the object height is assumed to be 0 in. to recognize that impediments to bicycle travel exists at pavement level. ***Figure 701-3*** can be used to select the minimum length of vertical curve needed to provide minimum stopping sight distances at various speeds on crest vertical curves.

Figure 701-4 illustrates the horizontal sight distance for a shared use path. The lateral clearance (horizontal sight line offset) is obtained using the table from ***Figure 701-5*** and the proposed horizontal radius of curvature.

Path users typically travel side-by-side on shared use paths. On narrow paths, bicyclists tend to ride near the middle of the path. Lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for path users travelling in opposite directions around the curve.

702.2.8 Surface Structure

The surfaces of shared use paths should be firm, stable, and slip resistant and shall comply with R302.7 of the PROWAG.

Vertical alignment shall be generally planar within shared use path (including curb ramp runs, turning spaces, and gutter areas within shared use path) and surfaces at other elements. Grade breaks shall be flush. Where shared use paths cross rails at grade, the shared use path shall be level and flush with the top of rail at the outer edges of the rails, and the surface between the rails shall be aligned with the top rail.

It is important to maintain a smooth riding surface on shared use paths. Vertical surface discontinuities shall be 0.5 in. maximum. Vertical surface discontinuities between 0.25 in. and 0.5 in. shall be beveled with a slope not steeper than 50 percent. The bevel shall be applied across the entire vertical surface discontinuity.

Utility covers and bicycle compatible grates should be flush with the surface of the pavement on all sides. Horizontal openings in gratings and joints shall not permit passage of a sphere more than 0.5 in. in diameter. Elongated openings in gratings shall be placed so that the long dimension is perpendicular to the dominant direction of travel. Railroad crossings should be smooth and be designed at an angle between 60 and 90 degrees to the direction of travel in order to minimize the possibility of falls. Flangeway gaps at pedestrian at-grade crossings shall be 2.5 in. maximum on non-freight rail track and 3 in. maximum on freight rail track.

702.2.9 Bridges and Underpasses

The receiving clear width on the end of a bridge (from inside of rail or barrier to inside of opposite rail or barrier) should allow 2 ft. of clearance on each side of the shared use path but under constrained conditions may taper to the shared use path width.

Carrying the clear areas across the structures has two advantages. First, the clear width provides a minimum horizontal shy distance from the railing or barrier, and second, it provides needed maneuvering space to avoid conflicts with pedestrians or bicyclists who have stopped on the bridge.

Protective railings, fences, or barriers on either side of a shared use path on a stand-alone structure should be a minimum of 42 in. high. There are some locations where a 48 in. high railing should be considered in order to prevent bicyclists from falling over the railing during a crash. This includes bridges or bridge approaches where high-speed, steep angle impacts between a bicyclists and a railing may occur, such as at a curve at the foot of a long descending grade where the curve radius is less than appropriate for the design speed or anticipated speed.

Openings between horizontal or vertical members on railings should be small enough that a 6 in. sphere cannot pass through them in the lower 27 in. For the portion of railing that is higher than 27 in., openings may be spaced such that an 8 in. sphere cannot pass through them. This is done to prevent children from falling through the openings. Where a bicyclist’s handlebar may come into contact with a railing or barrier, a smooth wide rubrail may be installed at a height of about 36 in. to 44 in. to reduce the likelihood that bicyclist’s handlebar will be caught by the railing.

The structural design of shared use path bridges should be designed in accordance with the AASHTO LRFD Bridge Design Specifications for Design of Pedestrian Bridges.

702.3 Shared Use Path Intersection Design

Shared use path intersection can be at a “new” mid-block location or a sidepath at an existing intersection of two roadways. Both intersection designs should consider the variable speed between the vehicles and path users, the available intersection sight distance and the traffic volumes. The objectives of both designs are:

- Alert the motorists and path users to the crossing

- Communicate who has the obligation to yield to whom
- Enable the motorists and/ or path users to fulfill their obligations

Illumination of the path/ roadway intersection should be considered, especially on unlit paths.
Curb ramps with detectable warnings should be provided at intersections. The curb ramps and detectable warnings should extend the full width of the shared use path.

702.3.1 Design of Mid-Block Crossings

It is preferable for mid-block crossings to intersect the roadway at a 90° angle to minimize the crossing distance and to maximize the intersection sight distance.

Shared use paths are unique in terms of assignment of the right of way, due to the legal responsibility to drivers to yield to pedestrians in crosswalks. Bicyclists approach the intersection at a far greater speed than pedestrians. A stop or yield sign is need to remind the bicyclists who has the legal right of way at crossings.

The least restrictive form of intersection control should be used at shared use path intersections. A common misconception is the routine installation of stop control for the pathway. Per the MUTCD, Stop signs should not be used where Yield signs would be acceptable." Sight triangles should be used in selecting the appropriate control (see ***Figures 701-6 & 701-7***).

Additional traffic control, such as a signal or active warning device, may be needed due to the traffic volumes, vehicular speed or roadway geometry.

702.3.2 Sidepath Intersection Design

The potential issues with sidepaths are discussed in ***Section 702.2.2***, but there are times when they are unavoidable. The following design measures may reduce crashes:

- Reduce the driveway density.
- Reduce the speeds of both the path user and the motorists. Tighter corner radii, median refuge islands, and no free flow right turns are several examples.
- Improve visibility. Keep approaches to intersections and major driveways clear of obstructions such as parked vehicles, landscaping elements and traffic control devices.

At signalized intersections, the following design measures should be considered:

- Prohibit right turn on red.
- Provide a leading pedestrian interval or if the volumes on the path are high, then consider an exclusive phase.
- Allow turning movements on fully protected phases only.

LIST OF FIGURES

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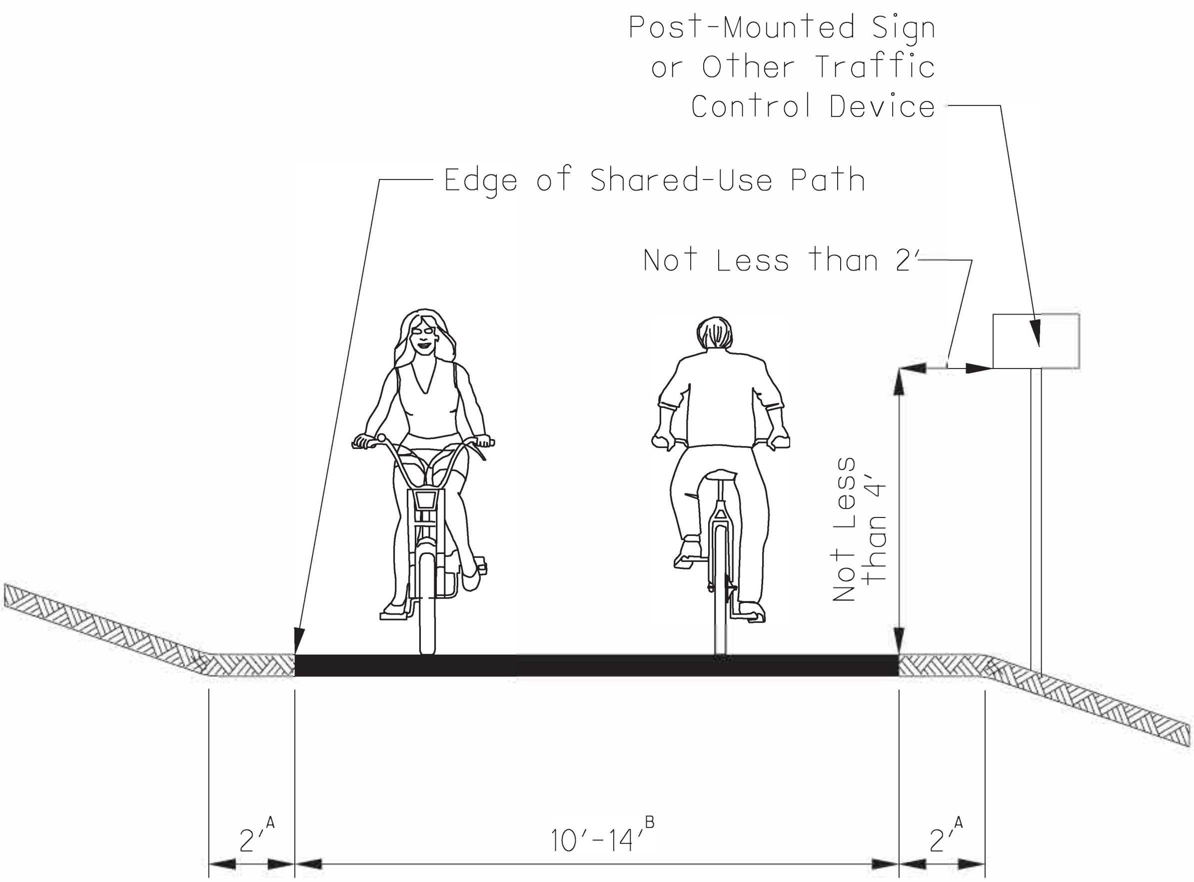
TYPICAL CROSS SECTION OF TWO-WAY. SHARED USE PATH ON INDEPENDENT RIGHT-OF-WAY	701-1
	REFERENCE SECTIONS 702.2.1

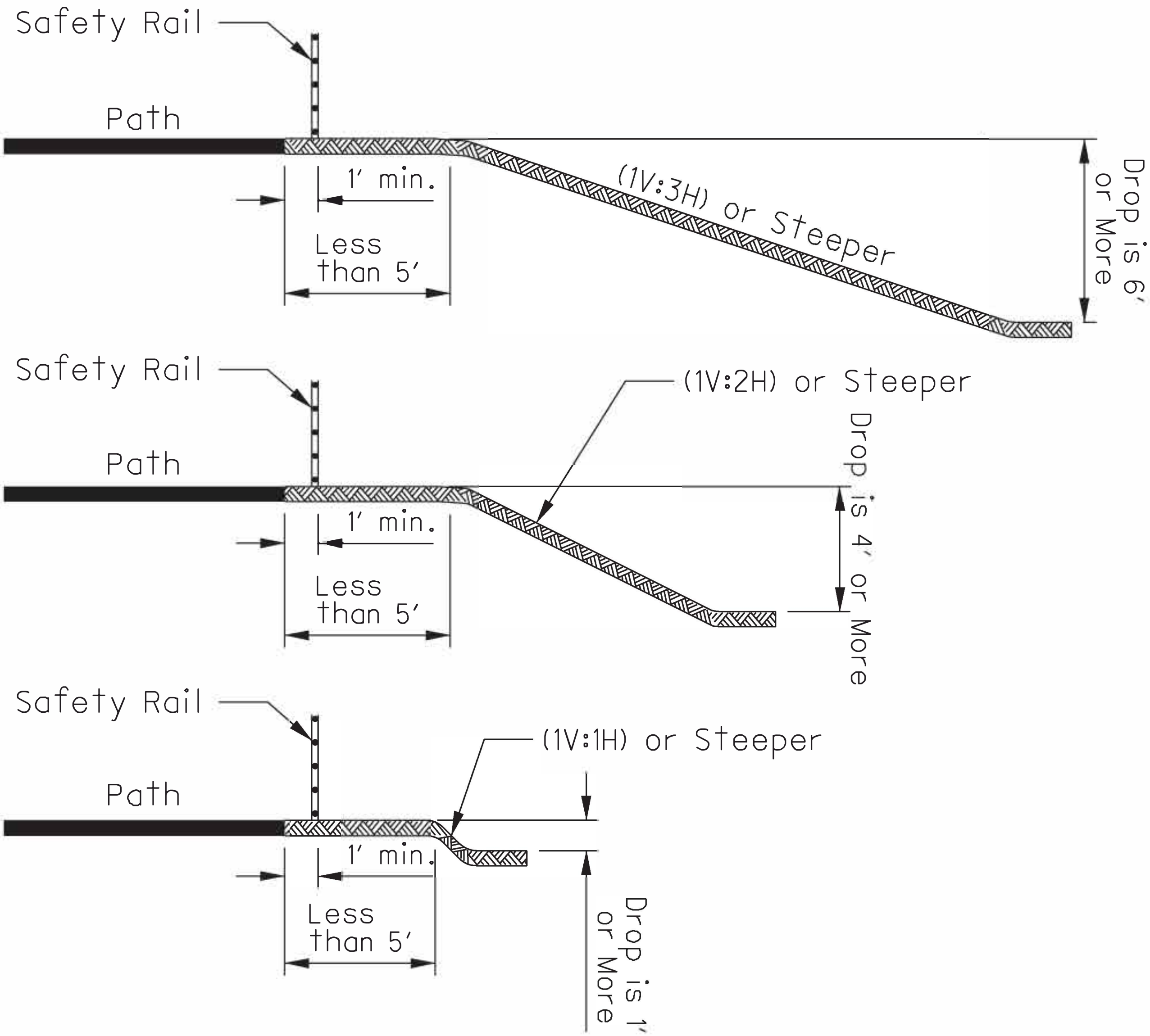


Notes:

A (1V:6H) Maximum Slope (typ.)

B More if necessary to meet anticipated volumes and mix of users, per the FHWA *Shared Use Path Level of Service Calculator*

SAFETY RAIL BETWEEN PATH AND ADJACENT SLOPE	701-2
	REFERENCE SECTIONS 702.2.1



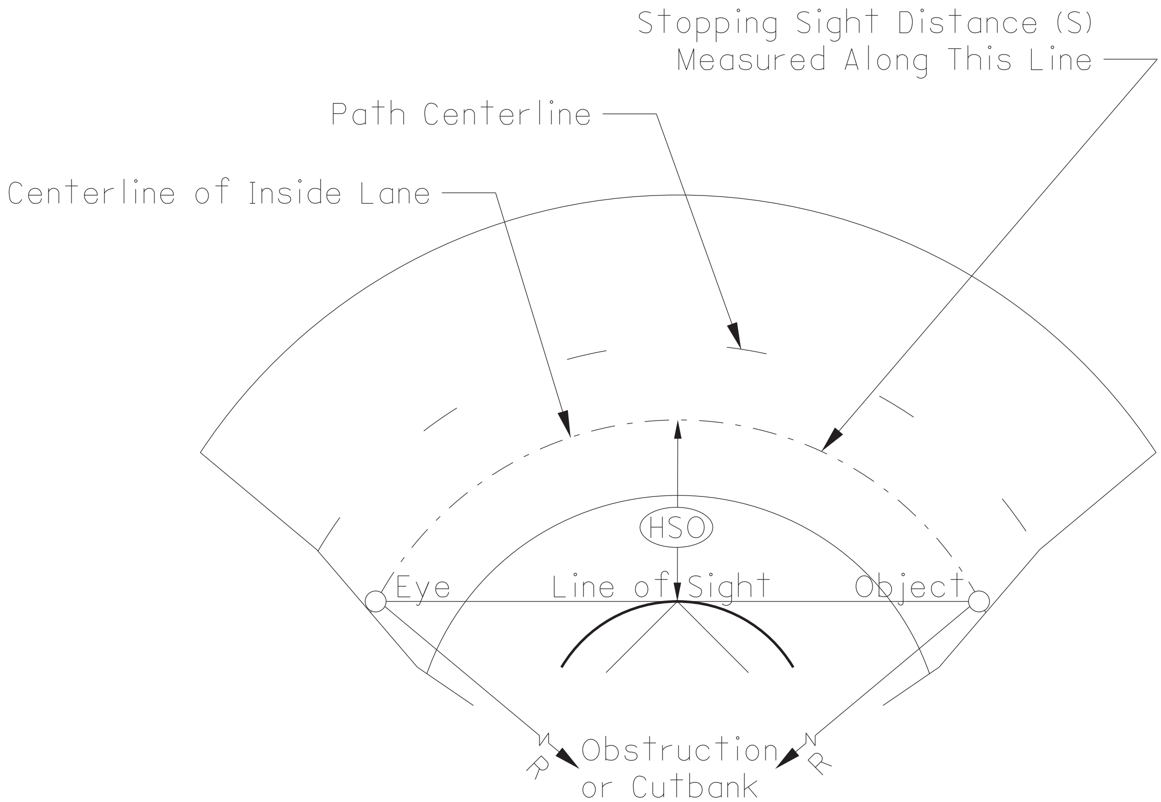
MINIMUM LENGTH OF CREST VERTICAL CURVE BASED ON STOPPING SIGHT DISTANCE

701-3

REFERENCE SECTIONS
309.2.7

A	S = Stopping Sight Distance (ft)														
(%)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300
2												30	70	110	150
3								20	60	100	140	180	220	260	300
4						15	55	95	135	175	215	256	300	348	400
5					20	60	100	140	180	222	269	320	376	436	500
6				10	50	90	130	170	210	267	323	384	451	523	600
7				31	71	111	151	191	231	311	376	448	526	610	700
8			8	48	88	128	168	208	248	356	430	512	601	697	800
9			20	60	100	140	180	220	260	400	484	576	676	784	900
10			30	70	110	150	190	230	270	444	538	640	751	871	1000
11			38	78	118	158	198	238	278	489	592	704	826	958	1100
12		5	45	85	125	165	205	245	285	533	645	768	901	1045	1200
13		11	51	91	131	171	211	251	291	578	699	832	976	1132	1300
14		16	56	96	136	176	216	256	296	622	753	896	1052	1220	1400
15		20	60	100	140	180	220	260	300	667	807	960	1127	1307	1500
16		24	64	104	144	184	224	264	304	711	860	1024	1202	1394	1600
17		27	67	107	147	187	227	267	307	756	914	1088	1277	1481	1700
18		30	70	110	150	190	230	270	310	800	968	1152	1352	1568	1800
19		33	73	113	153	193	233	273	313	844	1022	1216	1427	1655	1900
20		35	75	115	155	195	235	275	315	889	1076	1280	1502	1742	2000
21		37	77	117	157	197	237	277	317	933	1129	1344	1577	1829	2100
22		39	79	119	159	199	239	279	319	978	1183	1408	1652	1916	2200
23		41	81	121	161	201	241	281	321	1022	1237	1472	1728	2004	2300
24	3	43	83	123	163	203	243	283	323	1067	1291	1536	1803	2091	2400
25	4	44	84	124	164	204	244	284	324	1111	1344	1600	1878	2178	2500
Shaded Area Represents S>L Minimum Length of Vertical Curve = 3'															

DIAGRAM ILLUSTRATING COMPONENTS FOR DETERMINING HORIZONTAL SIGHT DISTANCE	701-4
	REFERENCE SECTIONS 309.2.7



$$HSO = R[1-\cos(\frac{28.65S}{R})]$$

$$S = \frac{R}{28.65}[\cos^{-1}(\frac{R-HSO}{R})]$$

Where:

- S = Stopping Sight Distance (ft)
- R = Radius of Centerline of Lane (ft)
- HSO = Horizontal Sightline Offset, Distance from Centerline of Lane to Obstruction (ft)

Note:
- Angle is Expressed in Degrees
- Line of Sight is 2.3′ above Centerline of Inside Lane at Point of Obstruction

MINIMUM LATERAL CLEARANCE (HORIZONTAL SIGHTLINE OFFSET OR HSO) FOR HORIZONTAL CURVES

701-5

REFERENCE SECTIONS
702.2.7

S = Stopping Sight Distance (ft)															
R (ft)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300
25	2.0	7.6	15.9												
50	1.0	3.9	8.7	15.2	23.0	31.9	41.5								
75	0.7	2.7	5.9	10.4	16.1	22.8	30.4	38.8	47.8	57.4	67.2				
95	0.5	2.1	4.7	8.3	12.9	18.3	24.7	31.8	39.5	48.0	56.9	66.3	75.9	85.8	
125	0.4	1.6	3.6	6.3	9.9	14.1	19.1	24.7	31.0	37.9	45.4	53.3	61.7	70.6	79.7
155	0.3	1.3	2.9	5.1	8.0	11.5	15.5	20.2	25.4	31.2	37.4	44.2	51.4	59.1	67.1
175	0.3	1.1	2.6	4.6	7.1	10.2	13.8	18.0	22.6	27.8	33.5	39.6	46.1	53.1	60.5
200	0.3	1.0	2.2	4.0	6.2	8.9	12.1	15.8	19.9	24.5	29.5	34.9	40.8	47.0	53.7
225	0.2	0.9	2.0	3.5	5.5	8.0	10.8	14.1	17.8	21.9	26.4	31.3	36.5	42.2	48.2
250	0.2	0.8	1.8	3.2	5.0	7.2	9.7	12.7	16.0	19.7	23.8	28.3	33.1	38.2	43.7
275	0.2	0.7	1.6	2.9	4.5	6.5	8.9	11.6	14.6	18.0	21.7	25.8	30.2	34.9	39.9
300	0.2	0.7	1.5	2.7	4.2	6.0	8.1	10.6	13.4	16.5	19.9	23.7	27.7	32.1	36.7
350	0.1	0.6	1.3	2.3	3.6	5.1	7.0	9.1	11.5	14.2	17.1	20.4	23.9	27.6	31.7
390	0.1	0.5	1.2	2.1	3.2	4.6	6.3	8.2	10.3	12.8	15.4	18.3	21.5	24.9	28.5
500	0.1	0.4	0.9	1.6	2.5	3.6	4.9	6.4	8.1	10.0	12.1	14.3	16.8	19.5	22.3
565		0.4	0.8	1.4	2.2	3.2	4.3	5.7	7.2	8.8	10.7	12.7	14.9	17.3	19.8
600		0.3	0.8	1.3	2.1	3.0	4.1	5.3	6.7	8.3	10.1	12.0	14.0	16.3	18.7
700		0.3	0.6	1.1	1.8	2.6	3.5	4.6	5.8	7.1	8.6	10.3	12.0	14.0	16.0
800		0.3	0.6	1.0	1.6	2.2	3.1	4.0	5.1	6.2	7.6	9.0	10.5	12.2	14.0
900		0.2	0.5	0.9	1.4	2.0	2.7	3.6	4.5	5.6	6.7	8.0	9.4	10.9	12.5
1000		0.2	0.5	0.8	1.3	1.8	2.4	3.2	4.0	5.0	6.0	7.2	8.4	9.8	11.2

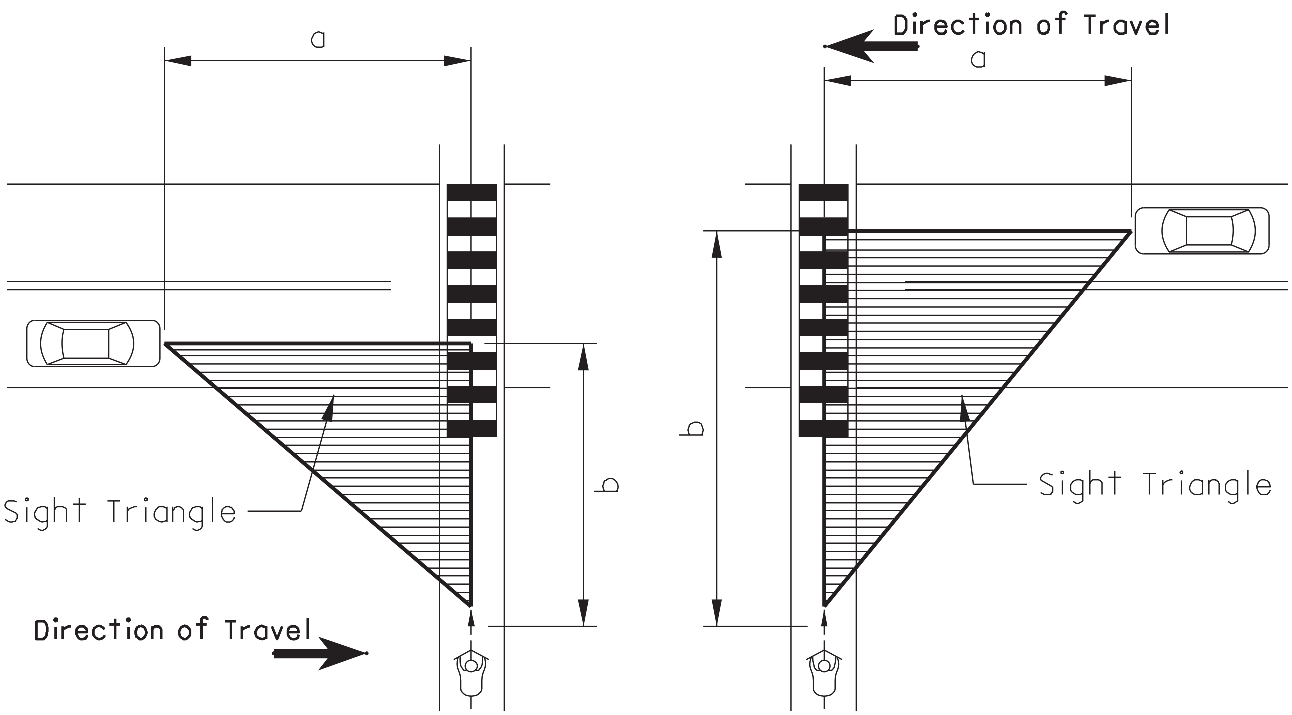
STOPPING SIGHT DISTANCE	701-6
	REFERENCE SECTIONS 702.2.7, 702.3

Bicycle Design Speed (mph)	Stopping Sight Distance (Design Values)						
	No Grade Adjustment	% Down Grade			% Up Grade		
		3	6	9	3	6	9
8	43	46	51	60	41	40	38
10	58	63	71	85	55	52	51
12	75	81	93	113	70	66	64
14	93	102	117	145	86	82	78
16	113	125	145	181	104	98	93
18	134	150	175	221	123	116	110
20	157	176	207	264	144	135	127
25	222	253	301	390	202	187	176
30	298	341	411	539	268	247	231

YIELD SIGHT TRIANGLES

701-7

REFERENCE SECTIONS 702.3



Length of Roadway Leg of Sight Triangle		
$t_a = \frac{S}{1.47V_{path}}$ $t_g = t_a + \frac{w+L_a}{0.278V_{path}}$ $a = 1.47V_{road}t_g$		
where:		
t_g	=	travel time to reach and clear the road (s)
a	=	length of leg sight triangle along the roadway approach (ft)
t_a	=	travel time to reach the road from the decision point for a path user that doesn't stop (s)
w	=	width of the intersection to be crossed (ft)
L_a	=	typical bicycle length = 6 ft
V_{path}	=	design speed of the path (mph)
V_{road}	=	design speed of the road (mph)
S	=	stopping sight distance for the path user traveling at design speed (ft)

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