SECTION A-5-BICYCLE FACILITY GUIDELINES

INTRODUCTION

These guidelines consist of six sections:

A. INTRODUCTION
B. VDOT POLICY ON PARTICIPATION IN THE DEVELOPMENT OF BICYCLE FACILITIES
C. SELECTING ROADWAY DESIGN TREATMENTS TO ACCOMMODATE BICYCLES; this report is recommended for bikeway design
D. VDOT/AASHTO DESIGN GUIDELINES; these include bicycle path design guidelines and minimum bikeway design guidelines
E. AASHTO APPROVED INTERSTATE BICYCLE ROUTES
F. RESOURCES

The Transportation Planning Division will recommend to the road designer the inclusion of a bikeway on a particular project. Discussion will take place at the scoping meeting concerning the expected type of bicyclist that will use the facility and the type of facility to be designed. The types of bicyclist include Group A, advanced; Group B, basic; and Group C, children. Types of facilities include shared lane, paved shoulder, wide outside lane, bicycle lane or bicycle path. The district, locality, Transportation Planning Division and other interested parties will provide input.

In rural and some urban sections of highway with scattered development, it is recommended that the facility be designed for Group A bicyclists. In developed areas near parks, schools, recreation areas, etc., it is recommended that the facility be designed for Group B, C bicyclists. Separate bike paths are recommended in areas where bicyclists are expected to be children, pre-teen or casual recreation riders.

Guidelines in SELECTING ROADWAY DESIGN TREATMENTS TO ACCOMMODATE BICYCLES are recommended as bikeway design criteria, but in no case will a bikeway be designed with criteria less than those contained in the VDOT/AASHTO DESIGN GUIDELINES. Bicycle path design guidelines are available only in the VDOT/AASHTO DESIGN GUIDELINES section.

VDOT POLICY ON PARTICIPATION IN THE DEVELOPMENT OF BICYCLE FACILITIES

The Commonwealth Transportation Board resolution of December 20, 1990 established VDOT's policy on participating in the planning and construction of bicycle facilities. Bicycle facilities can include shared wide highway lanes, paved highway shoulders, bicycle lanes, bicycle paths, multipurpose paths, and other physical improvements to better accommodate bicyclists.

Local governments are encouraged to develop bicycle facilities on a local and regional basis in order to satisfy the need within each geographic area. VDOT's participation in bicycle facilities is principally oriented toward facilities that may be constructed with the roadway improvement as part of the highway construction project.

VDOT will participate in comprehensive bicycle facility planning in the urbanized areas (population greater than 50,000) of Virginia as part of the Continuous, Comprehensive, and Cooperative (3C) transportation planning process. When requested, VDOT may provide technical or financial assistance to all other local governments and Planning District Commissions in developing a comprehensive bicycle facility plan. Bicycle facilities may be constructed for access purposes when the conditions in the **Bicycle Access Facilities** section of this Guideline are met.

VDOT Bicycle Facility Participation Guidelines

VDOT will consider financially participating in the construction of a bicycle facility where all the following conditions are satisfied:

- The bicycle facility will not impair the safety of the bicyclist, motorist, or pedestrian, and is designed to meet current AASHTO guidelines and/or VDOT guidelines.

- The bicycle facility will be accessible to users and will form a segment located and designed pursuant to a comprehensive bicycle plan that has been adopted by the local jurisdiction or is part of the AASHTO approved Interstate Bicycle Route System.

- It is reasonably expected that the bicycle facility will have sufficient use in relation to cost to justify the expenditure of public funds in its construction and maintenance, or the bicycle facility is a significant link in a comprehensive bicycle system that is needed for route continuity.

- VDOT will initiate bicycle facility construction only at the request of the affected local government, with the exception of the AASHTO approved Interstate Bicycle Route System.

- The bicycle facility design plans shall be coordinated with the affected local government and approved by VDOT prior to any official implementation by VDOT.

- The bicycle facility is constructed concurrently with a highway construction project with the exception of the conditions listed in the **Bicycle Access Facilities** and **Existing Roads**, sections of this document.

All proposed highway projects involving major construction or redevelopment along the AASHTO approved Interstate Bicycle Route System should provide the necessary design features to facilitate bicycle travel along those routes.

VDOT may elect not to participate in the construction of a bicycle facility even if all the conditions listed under **VDOT Bicycle Facility Participation Guidelines** are met.

VDOT Funding Guidelines

For a VDOT approved bicycle facility project that is constructed concurrently with a highway project, VDOT may financially participate as follows:

Primary System - In all jurisdictions, except towns under 3,500 population where VDOT maintains the Primary System highways, all additional preliminary engineering, right of way, and half of the construction costs for the bicycle facility may be borne by the Primary System highway construction funds allocated for the Construction District. For the following exceptions, the additional costs may be borne totally by the Primary System funds allocated:

- Towns under 3,500 population
- Relocated Existing Bicycle Facilities
- Paved Shoulders and Shared Roadways where provisions for such are necessary to provide for proper motor vehicle traffic service
- AASHTO Approved Interstate Bicycle Route System

Secondary System - In counties and towns where VDOT maintains the Secondary System highway, all additional preliminary engineering, right of way, and half of the construction costs for the bicycle facility may be borne by the Secondary System highway construction funds allocated for the county. For the following exceptions, the additional costs may be borne totally by the Secondary System funds allocated:

- Relocated Existing Bicycle Facilities
- Paved Shoulders and Shared Roadways for highways functionally classified as Arterials or Collectors where provisions for such are necessary to provide for proper motor vehicle traffic service
- AASHTO Approved Interstate Bicycle Route System

Urban System - In all cities and towns that maintain their own highways, the cost for additional preliminary engineering, right of way, and construction of bicycle facilities may be borne by the Urban System construction funds allocated to the locality with the same local match required by law for construction of the highway project.

AASHTO Approved Interstate Bicycle Route System - For all bicycle projects located along the AASHTO approved Interstate Bicycle Route System on the Primary and Secondary Systems, the additional costs for preliminary engineering, right of way, and construction of the bicycle facility may be borne totally by the funds allocated by law for those systems. The additional costs for the Interstate Bicycle Route System projects on the Urban System may be borne by the urban funds allocated to the locality with the same local match required by law for construction of the highway project.

Bicycle Access Facilities

VDOT may participate in the development of bicycle access facilities to serve public recreational areas and historic sites based on the current Recreational Access Fund Policy.

Existing Roads

In some instances, for route continuity, bicycle facilities may be routed over existing facilities which are not planned for expansion. In these cases, the facilities are an operational feature and usually result in the identification of a bike lane, restriction of parking, or some other physical modification to accommodate bicycle travel. It is necessary for the Transportation Planning Engineer to coordinate with the District Administrator, the District Traffic Engineer, and appropriate Divisions in the Central Office to assure agreement on the method of treatment for a bikeway over an existing route. All the conditions of **VDOT Bicycle Facility Participation Guidelines** and **VDOT Funding Guidelines** need to be met except the bicycle facility is not required to be constructed concurrently with a highway construction project. VDOT's financial participation and funding will be the same as specified in **VDOT Funding Guidelines**.

Major Developments and Site Plans

When bicycle facilities are considered as part of the total development of a property where the road system will be maintained in the future by VDOT and the local government requires bikeways in new developments, the following conditions must be satisfied:

- The bicycle element of the entire plan for the development must be reviewed and approved by the local government prior to final approval by the Transportation Planning Engineer. Appropriate review must be made, and communication regarding the resolution of bicycle facility systems must be carried on between the Resident Engineer, District Traffic Engineer, and the Transportation Planning Engineer.

- Along any roadways identified in the site plan, which will be maintained in the future by VDOT, a bike path may be incorporated into the development parallel to but off of the right of way dedicated for street purposes. The maintenance and the responsibility for operating the bike path would fall on the owner which would be either the locality, the developer, or other entity with the responsibility of maintenance of the common land of the development and not the responsibility of VDOT. The bike path right of way will be exclusive of the road right of way; thus, future changes and/or modifications in the bike path would not be the responsibility of VDOT.

- Bikeways within the VDOT right of way shall be designed to meet AASHTO and VDOT guidelines.

For major developments and site plans where the road system will not be maintained in the future by VDOT, all bicycle facility connections to VDOT maintained facilities shall be subject to review and approval by the District Administrator.

SELECTING ROADWAY DESIGN TREATMENTS TO ACCOMMODATE BICYCLES

This section contains roadway design treatments and widths to accommodate bicycles found in the Federal Highway Administration Report "Selecting Roadway Design Treatments to Accommodate Bicycles", Publication Number FHWA-RD-92-073 January 1994. The controlling feature in the design of every bicycle facility is its location, whether it is on the roadway or on an independent alignment. Five basic types of facilities are described to accommodate bicyclists:

- Shared Lane - Shared motor vehicle/bicycle use of a "standard" width travel lane.

- Wide Outside Lane (or wide curb lane) - An outside travel lane with a width of at least 4.3 meters.

- Bike Lane - A portion of the roadway designated by striping, signing, and/or pavement markings for preferential or exclusive use of bicycles. On urban projects the bike lane width is the distance from the face of the curb to the bike lane stripe. The bike lane stripe will lie at least 1.2 meters from the edge of a gutter pan. On non-curb or non-curb and gutter projects, bike lane widths should be a minimum of 1.2 meters in addition to the standard shoulder width.

- Shoulder - A paved portion of the roadway to the right of the edge stripe designed to serve bicyclists. These areas are not marked or signed as 'bike lanes'.

- Separate Bike Path - A facility physically separated from the roadway and intended for bicycle use.

The FHWA publication categorizes bicyclists into three groups. Group A are advanced bicyclists with experience who can operate under most traffic conditions. Group B are basic bicyclists who are casual or new adult and teenage riders with less confidence of their ability to operate in traffic without special provisions for bicycles. Group C, children, are pre-teen riders whose roadway use is initially monitored by parents.

Tables A-5-1M through A-5-6M indicate the appropriate design treatments given various sets of traffic operations and design factors. The design treatments are considered "desirable widths" by the FHWA. There are three basic types of roadway sections for bicycles; urban without parking, urban with parking, and rural. Controlled-access freeways are considered a special case and are not addressed by the tables.

Roadway improvements such as bicycle facilities depend on the roadway's design. Bicycle paths located on independent alignment depend on many factors, including the performance capabilities of the bicyclist and the bicycle. The following tables do not include any specific recommendations for separate bike paths and their design standards are addressed under **VDOT/AASHTO Design Guidelines** for **Bicycle Paths**.

Tables A-5-1M Group A bicyclists, urban section, no parking (widths are in meters)

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000-10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck,bus,rv				truck,bus,rv				truck,bus,rv		
less than 48.3 km/h	sl 3.7	sl 3.7	wc 4.3	wc 4.3	sl 3.7	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3
48.3 to 54.4 km/h	wc 4.3	wc 4.3	wc 4.6	wc 4.6	wc 4.3	wc 4.6	wc 4.6	wc 4.6	wc 4.3	wc 4.6	wc 4.6	wc 4.6
66 to 80.5 km/h	wc 4.6	wc 4.6	wc 4.6	wc 4.6	wc 4.6	wc 4.6	sh 1.8	sh 1.8	wc 4.6	wc 4.6	sh 1.8	sh 1.8
over 80.5 km/h	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8

For Table A-5-1M: wc and sl widths represent "usable widths" of outer lanes, measured from lane stripe to edge of gutter pan, rather than to the face of curb. If no gutter pan is provided, add 0.3 m minimum for shy distance from the face of curb.

Key: wc=wide curb lane; sh=shoulder; sl=shared lane; bl=bike lane; na=not applicable; truck,bus,rv=where there is regular presence of trucks, buses, and/or recreation vehicles (approximately 30 per hour or more)

Tables A-5-2M Group A bicyclists, urban section, with parking (widths are in meters)

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000-10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck,bus,rv				truck,bus,rv				truck,bus,rv		
less than 48.3 km/h	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.4	wc 4.3	wc 4.6	wc 4.6	wc 4.3
48.3 to 54.4 km/h	wc 4.3	wc 4.3	wc 4.6	wc 4.6	wc 4.3	wc 4.6	wc 4.6	wc 4.6	wc 4.3	wc 4.6	wc 4.6	wc 4.6
66 to 80.5 km/h	wc 4.6	wc 4.6	wc 4.6	wc 4.6	wc 4.6	wc 4.9	wc 4.9	wc 4.9	wc 4.6	wc 4.6	wc 4.9	wc 4.9
over 80.5 km/h	na	na	na	na	na	na	na	na	na	na	na	na

For Table A-5-2M: wc widths represent "usable widths" of outer travel lanes, measured from the left edge of the parking space (2.4 to 3.0 m minimum from the curb face) to the left stripe of the travel lane.

Source: FHWA's "Selecting Roadway Design Treatments to Accommodate Bicycles" dated 1994.

Tables A-5-3M Group A bicyclists, rural section (widths are in meters)

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000-10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck,bus,rv				truck,bus,rv				truck,bus,rv		
less than 48.3 km/h	sl 3.7	sl 3.7	wc 3.7	wc 4.3	sl 3.7	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	sh 1.2	sh 1.2
48.3 to 64.4 km/h	wc 4.3	wc 4.3	sh 4.3	sh 1.2	wc 4.3	wc 4.6	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2
66 to 80.5 km/h	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8
over 80.5 km/h	sh 1.2	sh 1.8	sh 1.8	sh 1.2	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8

For Table A-5-3M: wc and sl widths represent "usable widths" of outer lanes, measured from the lane stripe to the edge of the pavement if a smooth, firm, level shoulder is adjacent. If rough or dropped pavement edges or a soft shoulder exists, add 0.3 m minimum for shy distance from the edge of the pavement.

Key: wc=wide curb lane; sh=shoulder; sl=shared lane; bl=bike lane; na=not applicable; truck,bus,rv=where there is regular presence of trucks, buses, and/or recreation vehicles (approximately 30 per hour or more)

Tables A-5-4M Group B/C bicyclists, urban section, no parking (widths are in meters)

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000-10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck,bus,rv				truck,bus,rv				truck,bus,rv		
less than 48.3 km/h	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	bl 1.5	bl 1.5	bl 1.5	bl 1.5
48.3 to 64.4 km/h	bl 1.5	bl 1.5	bl 1.5	bl 1.5	bl 1.5	bl 1.8	bl 1.8	bl 1.5	bl 1.5	bl 1.8	bl 1.8	bl 1.5
66 to 80.5 km/h	bl 1.5	bl 1.5	bl 1.5	bl 1.5	bl 1.6	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8
over 80.5 km/h	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8

For Table A-5-4M: wc widths represent "usable widths" of outer lanes, measured from lane stripe to edge of gutter pan, rather than to the face of curb. If no gutter pan is provided, add 0.3 m minimum for shy distance from the face of curb. bl widths represent the minimum width from the curb face. The bike lane stripe should lie at least 1.2 m from the edge of the gutter pan, unless the gutter pan is built with adequate width to serve as a bike lane by itself.

Source: FHWA's "Selecting Roadway Design Treatments to Accommodate Bicycles" dated 1994.

Tables A-5-5M Group B/C bicyclists, urban section, no parking (widths are in meters)

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000-10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck,bus,rv				truck,bus,rv				truck,bus,rv		
less than 48.3 km/h	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	wc 4.3	bl 1.5	bl 1.5	bl 1.5	bl 1.5
48.3 to 64.4 km/h	bl 1.5	bl 1.5	bl 1.5	bl 1.5	bl 1.5	bl 1.8	bl 1.8	bl 1.5	bl 1.8	bl 1.8	bl 1.8	bl 1.8
66 to 80.5 km/h	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8	bl 1.8
over 80.5 km/h	na	na	na	na	na	na	na	na	na	na	na	na

For Table A-5-5M: wc widths represent "usable widths" of outer travel lanes, measured from the left edge of the parking space (2.4 to 3.0 m minimum from the curb face) to the left stripe of the travel lane.

Key: wc=wide curb lane; sh=shoulder; sl=shared lane; bl=bike lane; na=not applicable; truck,bus,rv=where there is regular presence of trucks, buses, and/or recreation vehicles (approximately 30 per hour or more)

Tables A-5-6M Group B/C bicyclists, rural section (widths are in meters)

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000-10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck,bus,rv				truck,bus,rv				truck,bus,rv		
less than 48.3 km/h	sh 1.2	sh 1.2	sh 1..2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2
48.3 to 64.4 km/h	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.2	sh 1.8	sh 1.8	sh 1.2	sh 1.8	sh 1.8	sh 1.8	sh 1.8
66 to 80.5 km/h	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 1.8
over 80.5 km/h	sh 1.8	sh 1.8	sh 1.8	sh 1.8	sh 2.4	sh 2.4	sh 2.4	sh 2.4	sh 2.4	sh 2.4	sh 2.4	sh 2.4

Source: FHWA's "Selecting Roadway Design Treatments to Accommodate Bicycles" dated 1994.

VDOT/AASHTO DESIGN GUIDELINES

The following design guidelines are to assist in the design of bicycle facilities and have been obtained from AASHTO's 1991 "Guide for the Development of Bicycle Facilities" and in combination with VDOT Policy. These will be considered as "minimum criteria" by designers.

When bicycle facilities are proposed, the roadway conditions will be examined for potential problems specific to bicyclists. Safe drainage grates and railroad crossings, smooth pavements, and signals responsive to bicycles will be provided where warranted. Drainage grate inlets and utility covers in particular are potential problems to bicyclists. When a new roadway is designed, all such grates and covers should be out of the bicyclists' expected path.

Shoulders

Wide curb lanes and bicycle lanes are usually preferred in restrictive urban conditions and the widened shoulder will generally be more accommodating in rural circumstances. Where it is intended that bicyclists ride on shoulders, smooth paved shoulder surfaces will be provided and maintained. Pavement edge lines delineate the shoulder from the motor vehicle lanes. Rumble strips can be a deterrent to bicycling on shoulders and their benefits should be weighed against the probability that bicyclists will ride in the motor vehicle lanes to avoid them.

Shoulder width will be a minimum of 1.2 meters when intended to accommodate bicycle travel. Roads with shoulders less than 1.2 meters wide normally will not be signed as bikeways. If motor vehicle speeds exceed 55 km/h, if the percentage of trucks, buses, and recreational vehicles is high, or if static obstructions exist at the right side, then additional width is desirable.

Adding or improving shoulders can often be the best way to accommodate bicyclists in rural areas, and they are also a benefit to motor vehicle traffic. Where funding is limited, adding or improving shoulders on uphill sections first will give slow moving bicyclists needed maneuvering space and decrease conflicts with faster moving motor vehicle traffic.

Wide Outside (or Curb) Lanes

On highway sections without bicycle lanes, a right lane wider than 3.7 meters can better accommodate both bicycles and motor vehicles in the same lane and thus is beneficial to both bicyclists and motorists. In many cases where there is a wide curb lane, motorists will not need to change lanes to pass a bicyclist. Also, more maneuvering room is provided when drivers are exiting from driveways or in areas with limited sight distance.

In general, a lane width of 4.3 meters of usable width is desired. Usable width will normally be from curb face to lane stripe, or from edge line to lane stripe, but adjustments will be made for drainage grates, parking, and longitudinal ridges between pavement and gutter sections. Widths greater than 4.3 meters may encourage the undesirable operation of two motor vehicles in one lane, especially in urban areas, and consideration will be given to striping as a bicycle lane when wider widths exist.

Restriping to provide wide curb lanes may also be considered on some existing multi-lane facilities by making the remaining travel lanes and left turn lanes narrower. This should only be performed after careful review of traffic characteristics along the corridor.

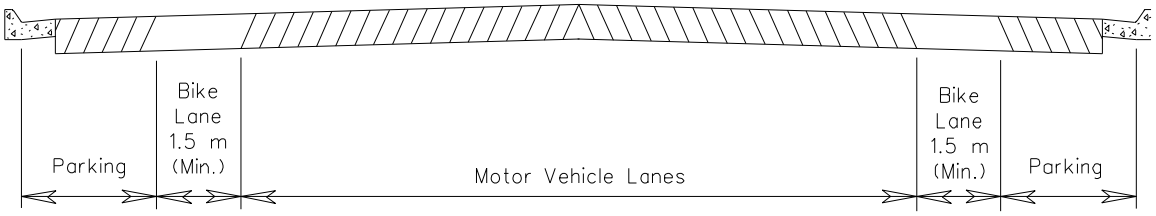
Bicycle Lanes

Bicycle lanes are a portion of the roadway designated by striping, signing, and/or pavement markings for preferential or exclusive use of bicycles. Bicycle lanes should always be one-way facilities and carry traffic in the same direction as adjacent motor vehicle traffic. Two-way bicycle lanes on one side of the roadway are unacceptable. Figure A-5-1M depicts typical locations and minimum widths for bicycle lanes.

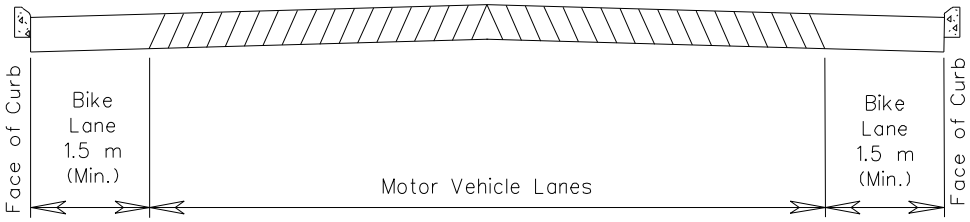
A bicycle lane width of 1.5 meters or greater is recommended; additional width is desirable where substantial truck traffic is present, where prevailing tailwinds exist, on grades with slopes greater than 5 percent, or where motor vehicle speeds exceed 55 km/h. On non-curb or non-curb and gutter projects, bicycle lanes may have a minimum width of 1.2 meters where the shoulder provides additional maneuvering width. The standard shoulder width will be maintained and not include the bike lane width. For recommendations from the Federal Highway Administration see Tables A-5-1M through A-5-6M.

At intersections, bicycle lanes tend to complicate both bicycle and motor vehicle turning movements. Because bicycle lanes encourage bicyclists to keep to the right and motorists to keep to the left, both operators are discouraged from merging in advance of turns. This is especially problematic when motorists making right turns cross paths with bicyclists proceeding straight through the intersection. Figure A-5-2M depicts typical pavement markings for bicycle lane and motorist right turn lane to minimize the conflict.

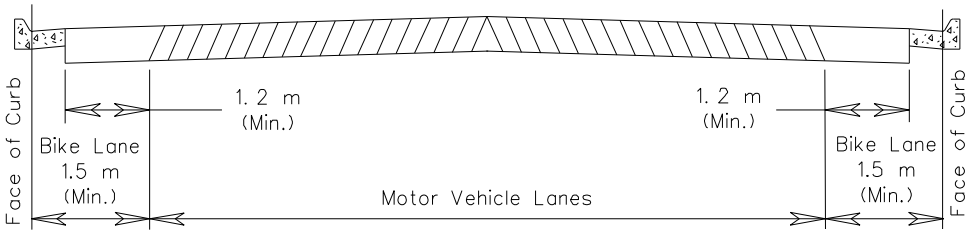
Bridge pavement width requirements are: When a bike lane exists or is proposed, the bridge pavement width will equal the roadway pavement width (including the paved portion of the bike lane) plus 0.6 meter. Locations where bike lanes exist or are proposed along both sides of the roadway, the bridge pavement width shall equal the roadway pavement width (including the paved portion of the bike lanes) plus 1.2 meters.



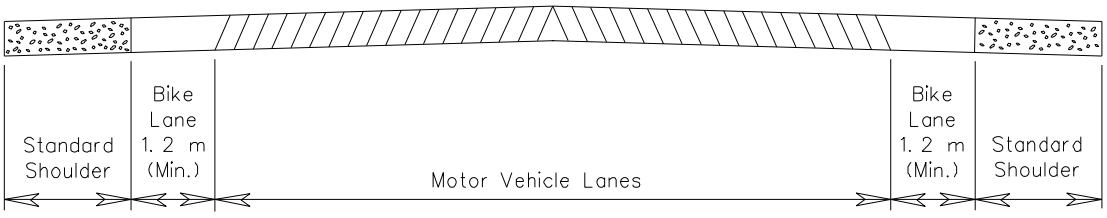
CURBED STREET WITH PARKING



CURBED STREET WITHOUT PARKING
(WITHOUT GUTTER PAN)



CURBED STREET WITHOUT PARKING
(WITH GUTTER PAN)



STREET OR HIGHWAY WITHOUT CURB OR GUTTER

Source: “Guide for the Development of Bicycle Facilities.” AASHTO, 1991.

Figure A-5-1M
Typical Bicycle Lane Cross Section

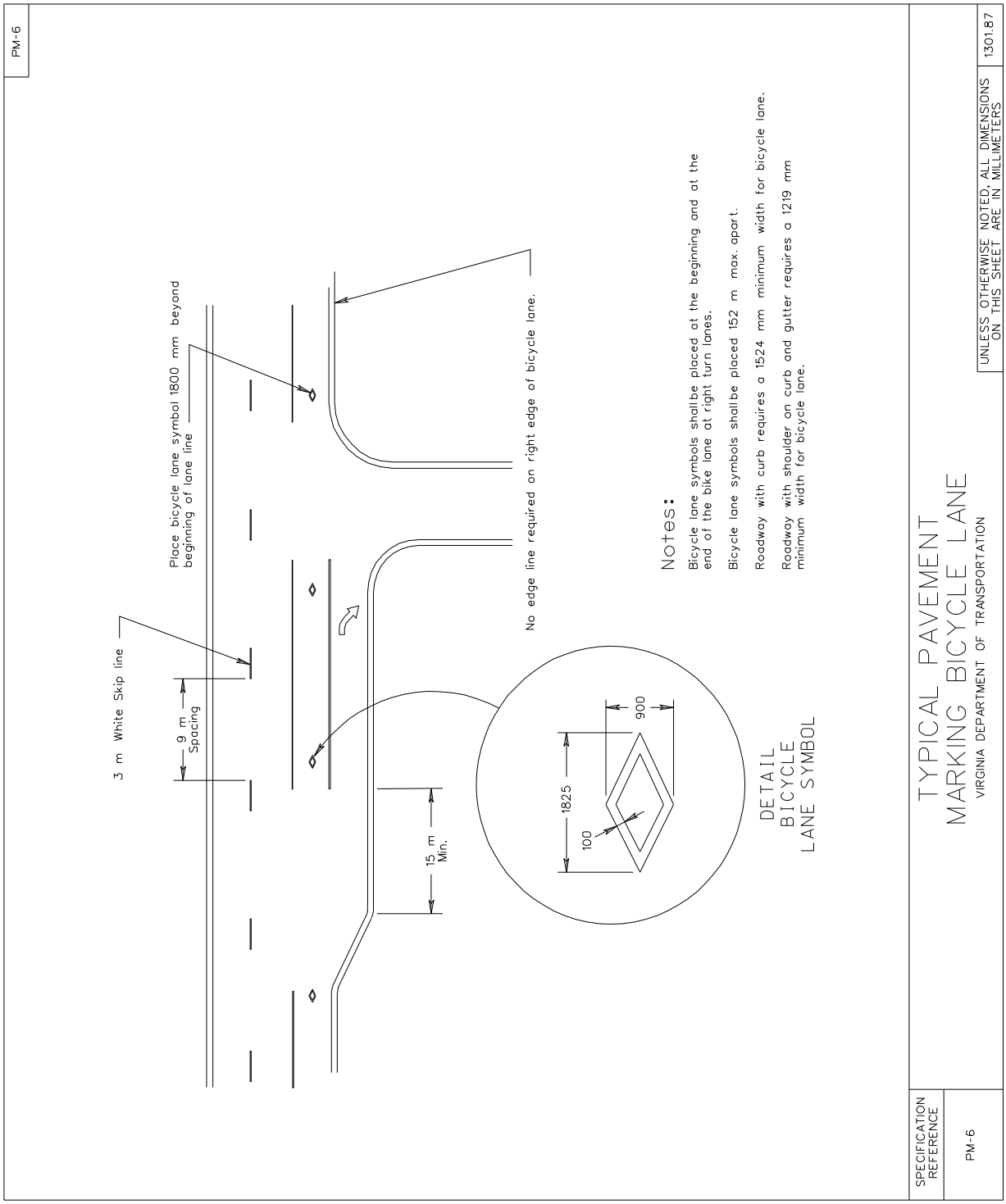


Figure A-5-2M
Pavement Marking for Bicycle Lane

Bicycle Paths

Bicycle paths are located on independent alignments and have their own specific design factors. Bicycle paths are facilities placed on exclusive rights-of-way with minimal cross flow by motor vehicles. Figure A-5-3M illustrates a typical bicycle path on a separate right of way.

Sound judgment will be exercised in situations where restrictions dictate less than desirable design criteria. Adequate markings and signs will be provided to inform and warn bicyclist and motorist of unique situations. These may include bicycle speed limit signs or warnings of steeper than recommended slopes. The traffic Engineering Division is a resource for such recommendations.

The minimum width of a one-directional bicycle path is 1.5 meters. One-way bicycle paths often will be used as a two-way facility unless effective measures are taken to assure one-way operation. Without such enforcement, it should be assumed that bicycle paths will be used as two-way facilities and designed accordingly. Under most conditions, a recommended paved width for a two-directional bicycle path is 3 meters. In some instances a minimum of 2.4 meters can be adequate. This minimum will only be used where bicycle traffic is expected to be low, pedestrian use is expected to be occasional, there will be good horizontal and vertical alignment providing safe and frequent passing opportunities and maintenance vehicle loading conditions will not cause pavement edge damage. Under certain conditions it may be necessary to increase the width to 3.7 meters. These may be because of substantial bicycle volume, probable shared use with joggers or other pedestrians, large maintenance vehicles, steep grades or where bicyclists will likely ride two abreast.

A wide separation between bicycle path and an adjacent travel way is desirable to confirm to both the bicyclist and the motorist that bicycle path functions as an independent travel way for bicycles. When this is not possible and the distance between the edge of the roadway and the bicycle path is less than 1.5 meters, a suitable physical divider should be considered. Where used, the divider will be a minimum of 1.4 meters high to prevent bicyclists from toppling over it and will be designed so that it does not become an obstruction in itself.

When it is required that the bicycle path be carried across a bridge with other traffic it is best to continue the approach roadway width across the structure. The proposed shoulder width on the bridge may provide the space needed to satisfy the design width selected for the approaches. Where the posted speed limit is more than 55 km/h, a positive barrier should be used between the bicycle path and the travel way (see Figure A-5-8M).

In general, a minimum design speed of 32 km/h will be used for bicycles. However, when the grade exceeds 4 percent or strong prevailing tailwinds exist, a design speed of 48 km/h is recommended.

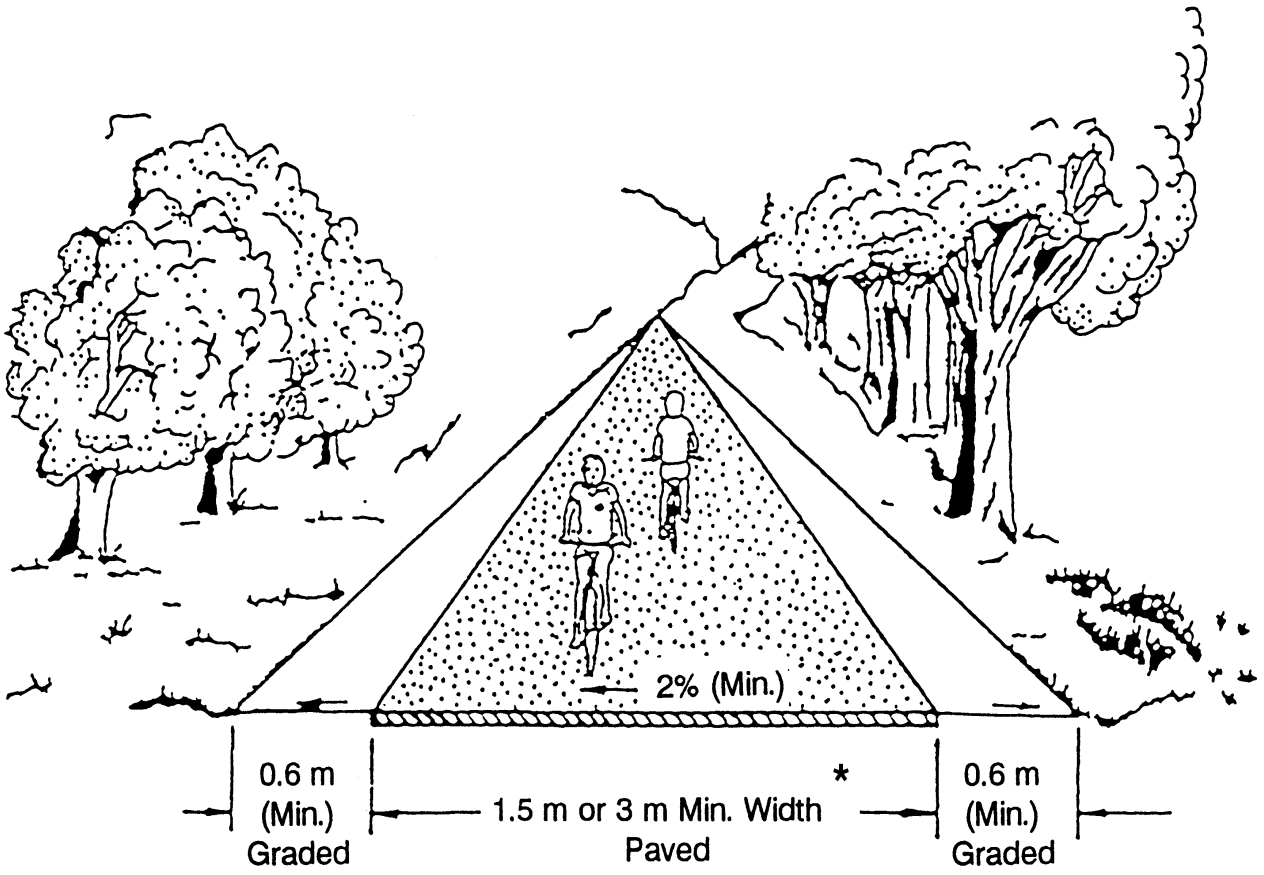
A minimum superelevation of 2 percent will be adequate for most conditions and will simplify construction. A maximum superelevation of approximately 5 percent should not be exceeded.

Figure A-5-4M shows the minimum stopping sight distances for various design speeds and grades. For two-way bicycle paths, the sight distance in the descending direction where "G" is negative, will control the design. Figure A-5-5M is used to select the minimum length of vertical curve necessary to provide minimum stopping sight distance at various speeds on crest vertical curves. Figure A-5-6M displays the minimum clearance that will be used for line of sight obstructions on horizontal curves. The lateral clearance is obtained from Figure A-5-6M using the stopping sight distance from Figure A-5-4M and the proposed horizontal radius of curvature.

It is recommended that bicycle paths in fill areas be designed with a fence or other protection where a fill slope greater than 2 to 1 exists within 1.8 meters of the bicycle path. The protection will extend along the bicycle path at the hinge point (where the fill slope ties to the flatter slope along the path). Circumstances may warrant protection in other areas such as high fills or where conditions present a danger to the bicyclist. A fence or other protection is also recommended when a fixed object is within 1.2 meters of a bicycle path. For situations covered in this paragraph, contact the Engineering Services Section for design guidance and necessary special design drawings.

Figure A-5-7M, "Geometric Design Standards For Bicycle Paths", lists the minimum design criteria for bicycle paths.

Since bicycles and pedestrians do not mix well, a multi-use path is undesirable. Whenever possible, separate bicycle and pedestrian paths should be provided. If this is not feasible, additional width, signing, and/or striping will be used to minimize conflicts.

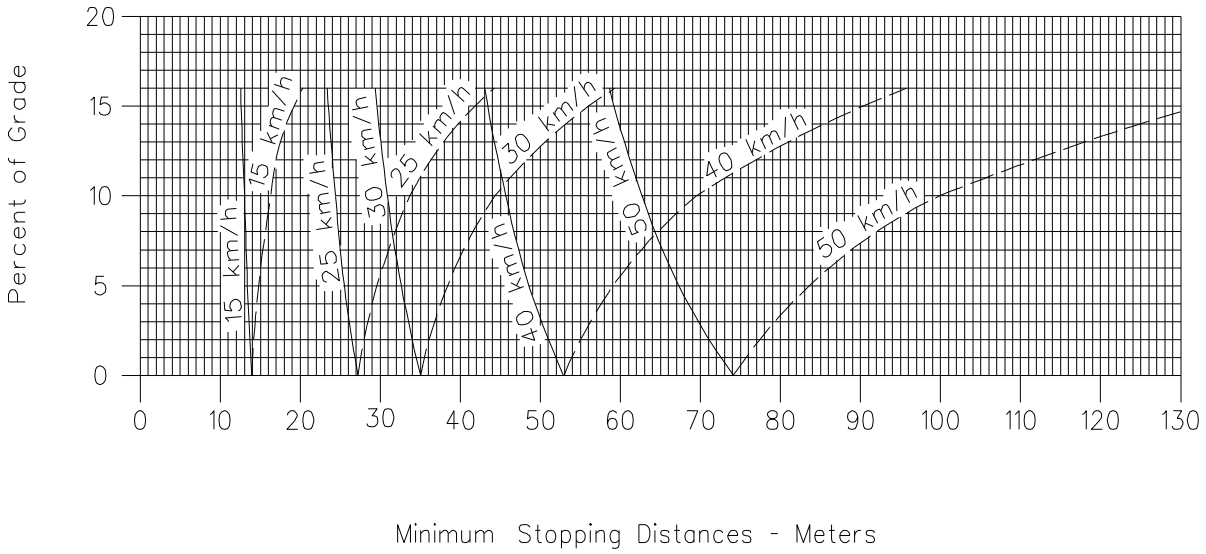


*
One-Way: 1.5 m Minimum Width
Two-Way: 3 m Minimum Width

(Not To Scale)

Source: "Guide for the Development of Bicycle Facilities." AASHTO, 1991.

Figure A-5-3M
Bicycle Path On Separate Right of Way



Minimum Stopping Distances - Meters

— — — — — — Decend (-G)

———————— Ascend (+G)

$$S = \frac{V^2}{254\ (f \pm G)} + \frac{V}{1.4}$$

S = Minimum Sight Distance in Meters

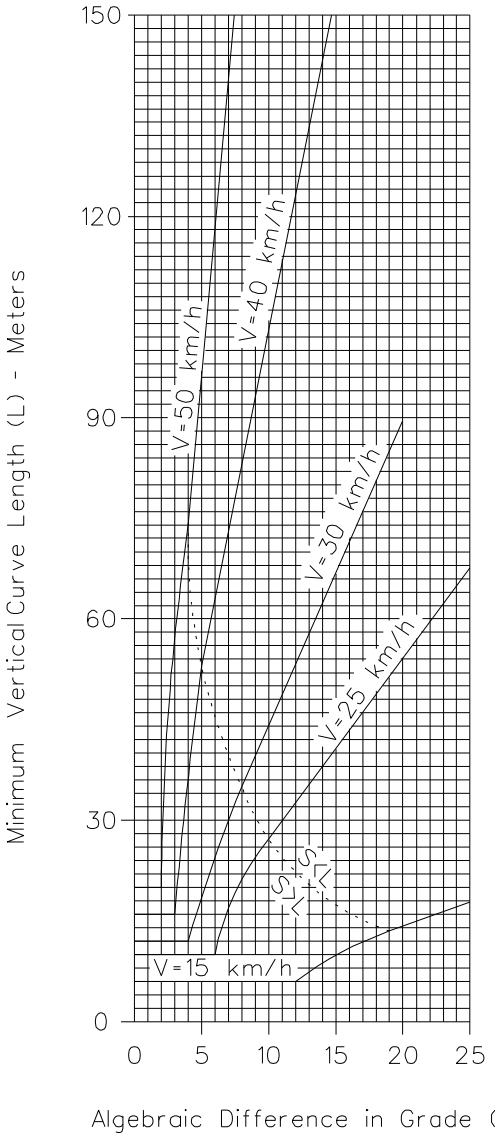
V = Velocity in km/h

f = Coefficent of Friction (use 0.25)

G = Grade m/m (rise/run)

Source: “Guide for the Development of Bicycle Facilities.” AASHTO, 1991.

Figure A-5-4M
Minimum Stopping Sight Distances For Bicycle Paths



$L_{MIN} = .4V$

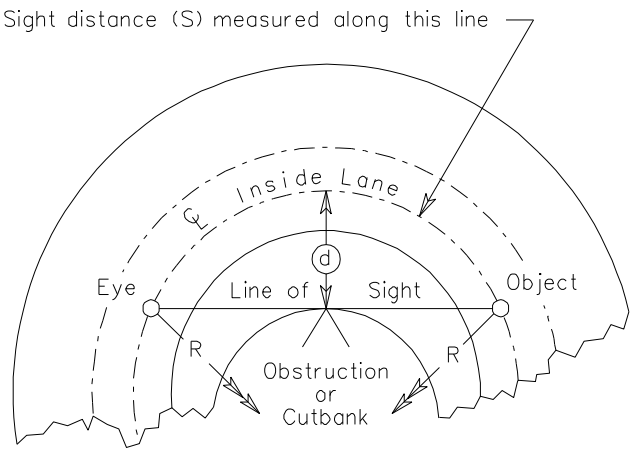
$$L = 2S - \frac{200\ (\sqrt{h_1} + \sqrt{h_2}\ )^2}{A} \quad \text{When } S>L$$

$$L = \frac{AS^2}{100\ (\sqrt{2h_1} + \sqrt{2h_2}\ )^2} \quad \text{When } S<L$$

S = Stopping Sight Distance (m)
A = Algebraic Difference in Grade
h_1 = Eye Height of Bicyclist (1.37 m)
h_2 = Height of Object (0 m)
L = Minimum Vertical Curve Length (m)

Source: “Guide for the Development of Bicycle Facilities.” AASHTO, 1991.

Figure A-5-5M
Minimum Vertical Curve Length For Bicycle Paths



Line of Sight is 0.6 m above ℄ inside lane at point of obstruction

S = Sight distance in meters.

R = Radius of ℄ inside lane in meters.

d = Distance from ℄ inside lane in meters.

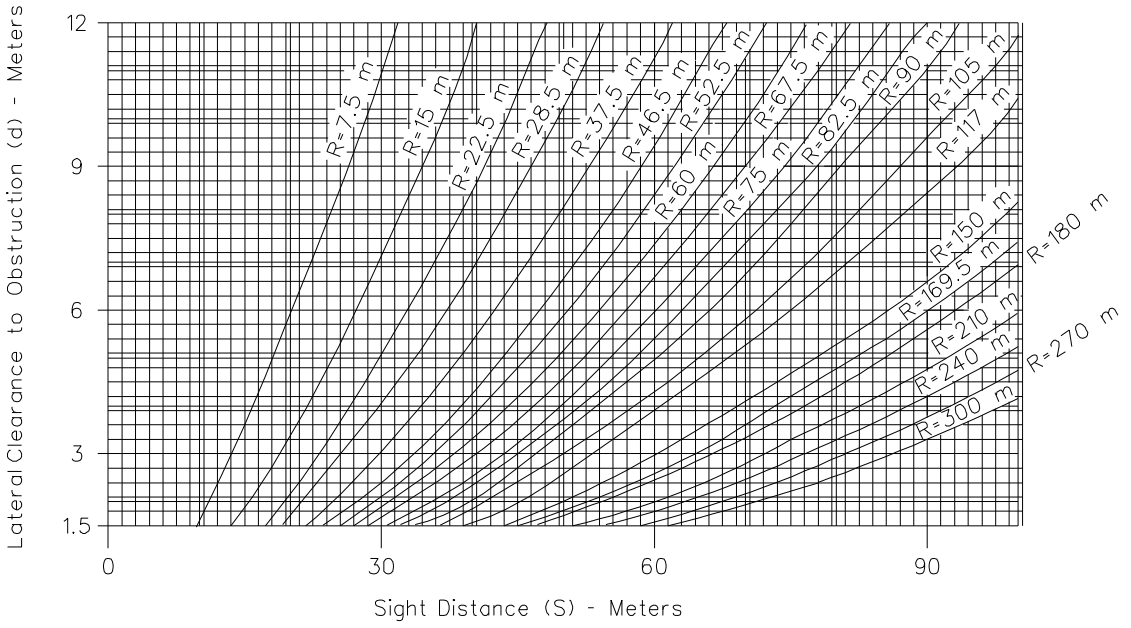
V = Design speed for S in km/h.

Angle is expressed in degrees

$$d = R\left[\text{vers}\left(\frac{28.65\ S}{R}\right)\right]$$

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

Formula applies only when S is equal to or less than length of curve.



Source: "Guide for the Development of Bicycle Facilities." AASHTO, 1991.

Figure A-5-6M
Minimum Lateral Clearance On Horizontal Curves For Bicycle Paths

BICYCLE PATHS										
(1) DESIGN SPEED	(2) MINIMUM RADIUS	(3) MAXIMUM PERCENT OF GRADE	(4) STOPPING SIGHT DISTANCE	(5) LATERAL CLEARANCE HORIZ. CURVES	(6) BICYCLE PATH - ONE DIRECTION	(7) BICYCLE PATH - TWO DIRECTIONS	(7) SHOULDER WIDTH GRADED	BRIDGES (8) CLEARANCE AT UNDERPASS		BRIDGES (9) BIKE PATH BRIDGE WIDTH
			MINIMUM	MINIMUM				VERT.	HORIZ.	
30 km/h	24 m	4	38 m (-G)	7.1 m	1.5 m	3.0 m	0.6 m	2.4 m	1.5 m ONE DIR.	DESIRABLE = 0.6 m + P + 0.6 m
			33 m (+G)	5.4 m						
40 km/h	46 m	4	58 m (-G)	8.8 m						(MIN. 1.5 m FOR ONE DIRECTION)
			49 m (+G)	6.4 m						
50 km/h	82 m	5	84 m (-G)	10.5 m					3.0 m TWO DIR.	(MIN. 3.0 m FOR TWO DIRECTIONS)
			67 m (+G)	6.7 m						

FOOTNOTES:

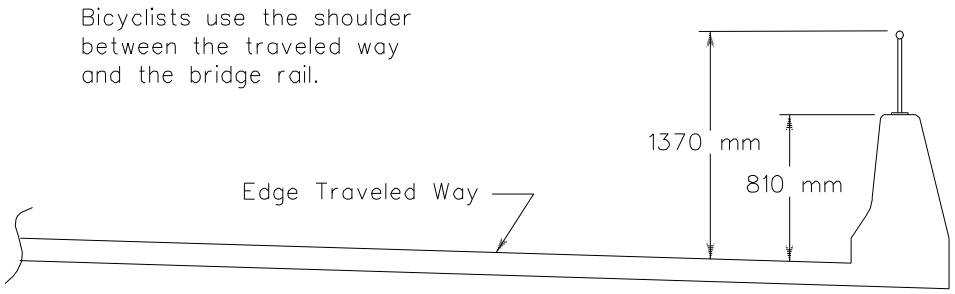
1. A minimum of 30 km/h is to be used; however, when the grade exceeds 4% or where strong prevailing tailwinds exist, a design speed of 50 km/h is recommended.
2. Minimum radius based on superelevation rate of 2%. A superelevation rate of 2% is adequate for most conditions and will simplify construction.
3. Grades over 5% and less than 150 m long are acceptable when a higher design speed is used and additional width is provided.
4. Descend (-G), Ascend (+G). For two directional bicycle paths, the sight distance in the descending direction where "G" is negative will control design.
5. Relation to stopping sight distance and proposed horizontal radius.
6. Under most conditions, a desirable minimum width for two directional bicycle path is 3 m. In some instances, a minimum of 2.4 m is adequate.
7. 0.9 m or more is desirable to provide clearance from trees, poles, walls, fences, guardrails, or other lateral obstructions.
8. Vertical clearance may need to be increased to permit passage of maintenance vehicles and in undercrossings and tunnels a clearance of 3 m is desirable.
9. "P" denotes the recommended non-bridge bike path width. It is desirable to provide a 0.6 m wide clear area. Desirable 0.6 m + P + 0.6 m, to include the minimum 0.6 m approach clear widths.

GENERAL NOTES:

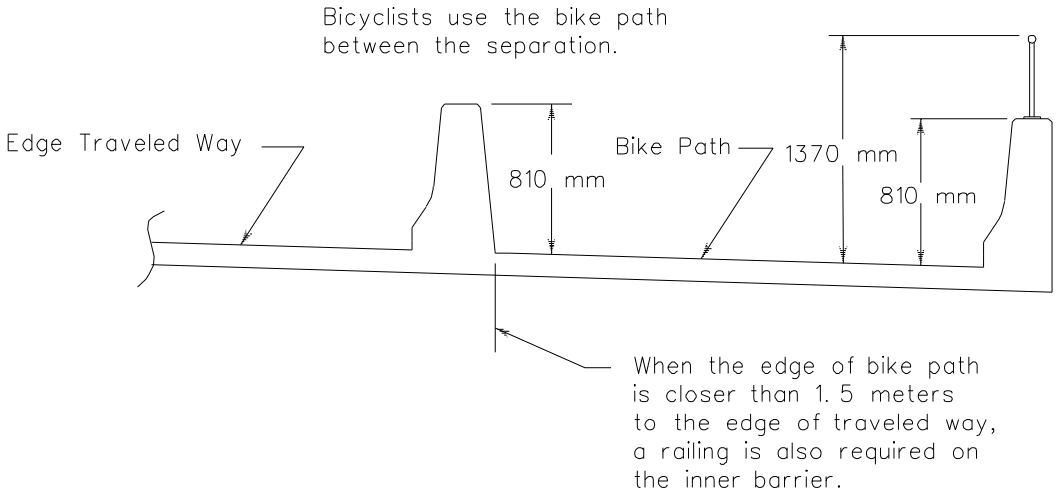
A. Pavement design for bicycle paths and roadway shoulders are recommended by Materials Division.

B. Standards delineated on this path chart were extracted from AASHTO's 1991 Guide for the Development of Bicycle Facilities.

Figure A-5-7M
GEOMETRIC DESIGN STANDARDS FOR BICYCLE FACILITIES



One-Way Bike Paths Where Posted Vehicle Speed Limit Is 55 km/h And Less



One-Way Bike Paths Where Posted Vehicle Speed Limit is Greater Than 55 km/h
And All Situations With Two-Way Bike Paths

Figure A-5-8M
BICYCLE PATHS ON BRIDGES

AASHTO APPROVED INTERSTATE BICYCLE ROUTES

VDOT provides signing along the designated AASHTO approved Interstate Bicycle Routes. The attached print titled "Bicycle Routes" shows the corridors for Interstate Bicycle Routes 1 and 76 and the counties the routes pass through. The individual county maps provide detailed location information. County maps are to be checked by the plan designer to determine if their project is on a designated Interstate Bicycle Route. All proposed projects involving major construction or redevelopment along designated Interstate Bicycle Routes are to provide the necessary design features to facilitate bicycle travel in accordance with the parameters established in these guidelines.

RESOURCES

It should be understood that this Guide is not all inclusive. The publications listed below will provide additional information to be used in the design of bicycle facilities.

"Guide for the Development of Bicycle Facilities." AASHTO, 1991

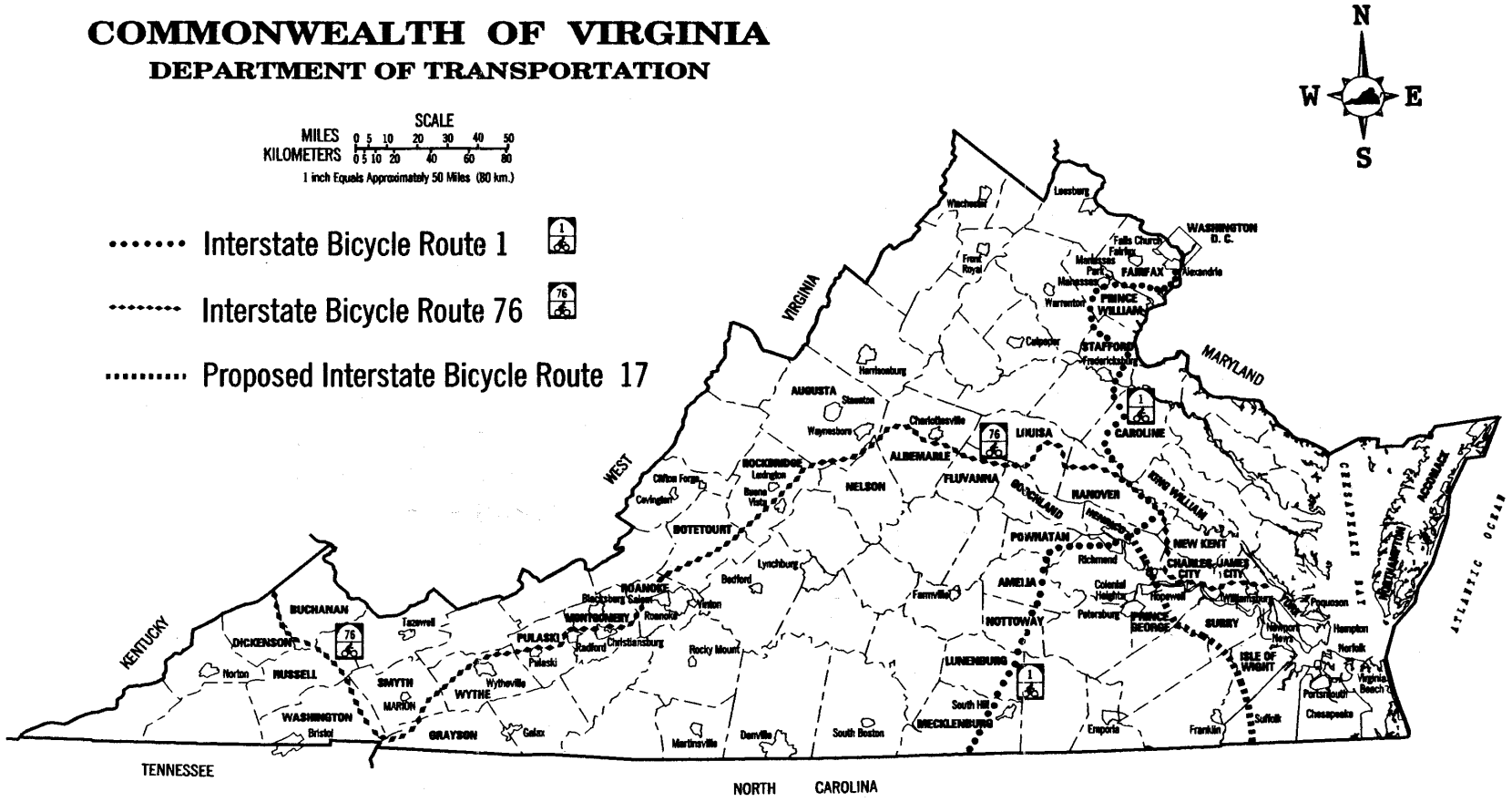
"Manual on Uniform Traffic Control Devices." Federal Highway Administration, 1994

"Selecting Roadway Design Treatments to Accommodate Bicycles." Federal Highway Administration, 1994

"A Virginia Guide for Bicycle Facility Planning." Virginia Department of Transportation, 1994

INTERSTATE BICYCLE ROUTES
GENERAL LOCATIONS

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF TRANSPORTATION



The detailed locations of Interstate Bicycle Routes 1 and 76 are marked on county maps.

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