CHAPTER 17 – BICYCLE FACILITIES DESIGN AND TECHNICAL CRITERIA
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CHAPTER 17 – BICYCLE FACILITIES DESIGN AND TECHNICAL CRITERIA

17.1 GENERAL

This chapter sets forth the minimum criteria to be used in the design of all bike lanes, bike paths, or other bicycles facilities within the Local Entity's rights-of-way or easements.

17.1.1 AASHTO Basis

In this chapter, the **AASHTO "Guide for the Development of Bicycle Facilities"** as published by the American Association of State Highway and Transportation Officials was used as a reference.

17.1.2 Bicycle Master Plan

This subsection was developed based on the **Master Plans** for each Local Entity. All projects shall optimize bicycle travel within the GMA by providing bicycle facilities in all new developments in accordance with the Local Entity's **Master Plan**.

17.1.3 Permitted Bicycle Travel Areas

On public streets, bicycle travel should use designated bike lanes whenever possible. Bicyclists may share vehicular travel lanes in cases where no designated bike lanes are provided, except in certain cases where bicycle travel may be prohibited.

17.1.4 Requirement for Other Accesses

Off-site improvements may be required to provide citizens with access to schools, and local commercial and other community facilities.

17.1.5 ADA Requirements

All designs for off-street bicycle paths are considered multi-use paths and shall conform to ADA requirements.

17.1.6 Use of Drainage System and Open Space

The bike path and pathway system may use the drainage and open space system in accordance with the Local Entity's utility standards.

17.1.7 Access Easements

Where bike paths cross private land or coincide with private access facilities, the Developer shall provide a public access easement. This will ensure that bike paths or other access facilities become part of the overall Local Entity bike path plan.

17.1.8 Maintenance Responsibility

Maintenance and operation responsibility for new bike paths will be determined during the site/subdivision plan approval process. Public access/bike path easements shall be conveyed to the Local Entity. The easement width shall be clearly indicated on the site plan or construction plans.

17.1.9 Appurtenances Not Allowed

Manholes, utility poles or other appurtenances or obstructions, should not be located in bike lanes or bike paths.

17.2 ON-STREET BIKE LANES DESIGN REQUIREMENTS

17.2.1 On-Street Bike Routes

Specific streets are designated in the **Master Plans** as on-street bicycle routes. These routes are on streets with lower traffic volumes and speeds, wide outside lanes, and minimal stop signs, stop lights, curb cuts, driveways, and interference with turning traffic. Streets designated as on-street bicycle routes shall be designed with additional width for bike lanes. Some streets within new developments or re-developments must also contain additional roadway width for bike lanes, in accordance with **Figures 7-1F** through **7-13F** and **7-1L** through **7-11L.**

17.2.2 Width and Cross Sections

The bike lane shall be designed with widths shown in standard street classification sections. Bicycle lanes on one-way streets shall be on the right side of the street, unless otherwise specified by the Local Entity. Refer to **Chapter 7, Street Design and Technical Criteria,** for the standard cross section requirements. Bike lane width shall not be less than 5 feet.

17.2.3 Signage and Striping

All designated bike lanes shall be signed and striped, as required by MUTCD and as required in **Chapter 14, Traffic Control Devices**.

17.2.4 Actuation Loop

Separate actuation loops are required in bike lanes at signalized intersections. Quadra pole-type loops are required. Loop installation shall be similar to that in **Sections 22.5.8 C5 and 22.5.9, E6, HBP-Superpave** and **HBP – Marshall Method**.

17.2.5 Rural Roads

In rural road sections, the paved roads shall include not less than a 5-foot paved shoulder, and not less than a 6-foot paved shoulder in Fort Collins (city limits only), for bicycle travel.

17.2.6 Bike Lanes at Intersections

At the intersections where a separate right turn lane exists and is striped, the bicycle lane shall transition and be placed between the through lane and the right turn lane. The bike lane width shall remain the same as the approaching bike lane.

17.3 OFF-STREET BICYCLE PATHS DESIGN REQUIREMENTS

The Applicant should refer to the Local Entity's parks and recreation department for the recreation trail design requirements.

17.3.1 Bike Path Location

A. Location Criteria

Bike path locations shall be based on safety, circulation, and access considerations.

B. Easements

Where needed, a 10 to 20-foot minimum easement width shall be procured for a 10-foot wide bike path, in accordance with **Figure 7-14.**

17.3.2 Trees, Vegetation, and Other Obstacles

A. Preserving Trees

Where possible, bike paths shall be routed to minimize the loss of trees and disruption of natural environmental conditions.

B. Distance from Obstacles

A minimum of 2 feet is required between the bike path edge and any vertical obstructions such as trees, utility poles, signs, fences, or other obstacles. Greater separation may be required by the Local Entity where grades exceed 4 percent.

C. Clearing of Vegetation

Regardless of bike path surface, all vegetative material within 4 feet of the bike path shall be removed prior to bike path construction. This requirement shall be specified by the Designer and included on the approved plans. See **Figure 17-1**.

D. Overhead Clearance

All bike paths shall have a minimum of 10 feet clear vertical distance above the path. See **Figure 17-1**.

17.3.3 Cross Section

Typical cross-sections shall be provided for all critical points (i.e. change in grade, direction) along the length of the bike path. See **Figure 17-1**

17.3.4 Grade

A. Profile

A profile of the proposed bike path construction shall be included in the construction plans or site plan. If the bike path profile is not consistent with the roadway profile, provide a separate profile for the bike path.

B. Minimum and Maximum Grade

Minimum grade shall be 0.60 percent except in sag curves where proper drainage is provided by cross slope. The minimum grade shall be waived if cross slope is 2 percent and good drainage is provided off the side and is unobstructed. Maximum grade shall be 5 percent or as allowed by ADA.

17.3.5 Design Speed

A. Paved Surfaces

For paved surfaces a minimum design speed of 20 mph shall be used. Where grades exceed 4 percent, a design speed of 30 mph shall be used.

B. Unpaved Surfaces

For unpaved surfaces, a minimum design speed of 10 mph shall be used. Where grades exceed 4 percent, a design speed of 20 mph shall be used.

17.3.6 Horizontal Alignment

A. Minimum Radius of Curvature

The minimum radius of curvature negotiable by a bicycle is a function of the superelevation rate of the bicycle path surface, the coefficient of friction between the bicycle tires and the bicycle path surface, and the speed of the bicycle.

B. Formula for Radius Calculation

The minimum design radius of curvature shall be based upon the following formula:

$$R = \frac{V^2}{15(e+f)}$$

where:

R = Minimum radius of curvature (ft)
V = Design speed (mph)
e = Rate of superelevation
f = Coefficient of friction

C. Rate of Superelevation

Bicycle path superelevation rate shall be a minimum of 2 percent (the minimum necessary to encourage adequate drainage) and a maximum of 3 percent.

D. Coefficient of Friction

The coefficient of friction depends upon speed, surface type, roughness, and condition; tire type and condition; and whether the surface is wet or dry. Friction factors used for design should be selected based upon the point at which centrifugal force causes the bicyclist to recognize a feeling of discomfort and instinctively act to avoid higher speed.

E. Coefficient of Friction Values

Extrapolating values used in highway design, design friction factors for paved bicycle paths can be assumed to vary from 0.27 at 20 mph to 0.22 at 30 mph. Unpaved surface friction factors are to be reduced by 50 percent to allow a sufficient margin of safety.

F. Minimum Radius

Based upon a superelevation rate (e) of 2 percent, the minimum radius of curvature to be used is 95 feet for 20 mph.

G. Substandard Radius Curves

When substandard radius curves must be used on bicycle paths because of Right-of-Way, topographical, or other considerations, standard curve warning signs and supplemental pavement markings shall be installed in accordance with the MUTCD. The negative effects of substandard curves can also be partially offset by widening the pavement through curves.

17.3.7 Sight Distance

Refer to **Figures 17-2** through **17-4** and Chapter 7, Street Design and Technical Criteria, for sight distance requirements.

17.3.8 Cross Slope

The cross slope shall be 2 percent.

17.3.9 Drainage

A. Requirements and Standards

All bike path designs shall satisfy the storm drainage requirements of the Local Entity's utilities department. Bike paths located within state Right-of-Way shall meet CDOT standards.

B. Ditch Placement

Where a bike path is cut into a hillside, a ditch shall be placed along the high side of the bike path to prevent sheet flow across it.

17.3.10 Safety Considerations

A. Consideration of Pedestrians

The safety of pedestrians, and others who may use or travel on a bike path, shall be a prime consideration in the bike path design.

B. Clearance Between a Bike Path and a Street

A utility easement, as required in **Chapter 12, Utility Locations**, is required between the edge of the bike path and the back edge of curb and gutter. No bike path shall be constructed directly adjacent to street curb or street pavement. Minimum separation shall be 6 feet.

The Local Entity Engineer may require a larger distance of separation when it is feasible and would improve safety.

C. Barriers and Other Safety Devices

For bike paths adjacent to streets with speed limits over 25 mph, and with slopes greater than 6 percent, the Local Entity Engineer may require special safety measures. Examples include barriers or other safety devices between the roadway and bike path, or an increase in the distance between the bike path and highway.

D. Signs for Hazards and Regulatory Messages

Standard signing and pavement markings in the MUTCD shall be specified in the design of the bike path to alert bike path users to hazards and to convey regulatory messages.

E. Intersection Grade

Maximum grade of the bike path at intersections is 3 percent extending for 30 feet in each direction from the centerline of the intersection.

F. Access Ramps

Standard access ramps will be provided at all bike path curb crossings to allow continuity of bike path use by bicyclists and pedestrians. Curb depressions equaling the bike path width shall be used, with the bike path surface sloping to the pavement at 1:12 maximum slope.

17.3.11 Bicycle Path Bridges

A. Crossings of Water Courses

All bike paths require either a bridge or a fair weather crossing. See **Chapter 11, Structures**, for design requirements for bridges.

B. Pedestrian Crossings on Major Collectors and Arterials

On all Local Entity major Collectors and Arterials, wherever desirable, underpass or overpass (grade separated) pedestrian crossings shall be provided for regional/neighborhood bike paths. These pedestrian crossings must be coordinated with the Local Entity Engineer or the Local Entity's appropriate department.

C. Railings, Fences, or Barriers

Railings, fences, or barriers on both sides of a bicycle path structure shall be a minimum of 4.5 feet high. Smooth rub rails should be attached to the barriers at handlebar height of 3.5 feet. Barriers should not impede storm water runoff from the path.

D. Bridge Requirements

See Chapter 11, Structures.

E. Bridge Underpass Lighting

All bike path bridge underpasses shall have lighting in accordance with **Chapter 15, Street Lighting**.

17.3.12 Bicycle Path Underpasses

The minimum clearances for underpasses are as follows:

Horizontal:	10 feet from abutment to curb or edge of water, 12 feet if equestrian accommodation is required.
Vertical:	10 feet from trail surface to underside of bridge, 12 feet if equestrian accommodation is required.

The trail surface elevation shall be at or above the high water mark for the 10 year storm.

17.3.13 Signage and Pavement Marking

A. Basic Requirements

All signs, except locally adopted bike route signs, shall conform to MUTCD.

B. Painted Centerline on Curves

All curves with restricted sight distances are required to be painted with a centerline to separate traffic. The centerline shall be 4 inches in width and painted yellow.

17.3.14 Lighting

See Chapter 15, Street Lighting.

17.3.15 Intersections

The following requirements apply to all bike path intersections with either streets or other bike paths:

A. Curb Ramps

Curb ramps the same width as the bike path shall be provided at each intersection.

B. Sight Distance

Sight distance requirements shall be in conformance with AASHTO requirements. The Designer shall ensure sufficient stopping and intersection sight distance at all bike path intersections and curves, particularly where steep grades are proposed at bike path/ roadway intersections. Obstructions to the visibility of motorists or bike path users shall be removed or the bike path aligned around the obstruction to maximize visibility.

C. Turning Radius at Intersections

The minimum turning radius at bike path intersections shall be 20 feet.

17.4 BICYCLE PARKING AREAS

17.4.1 Bicycle Parking Area Requirement

A. U Type Bike Rack

The inverted U type bike rack is required for all bicycle parking racks. See **Construction Drawings 1701** through **1707.**

B. Bike Parking Spaces

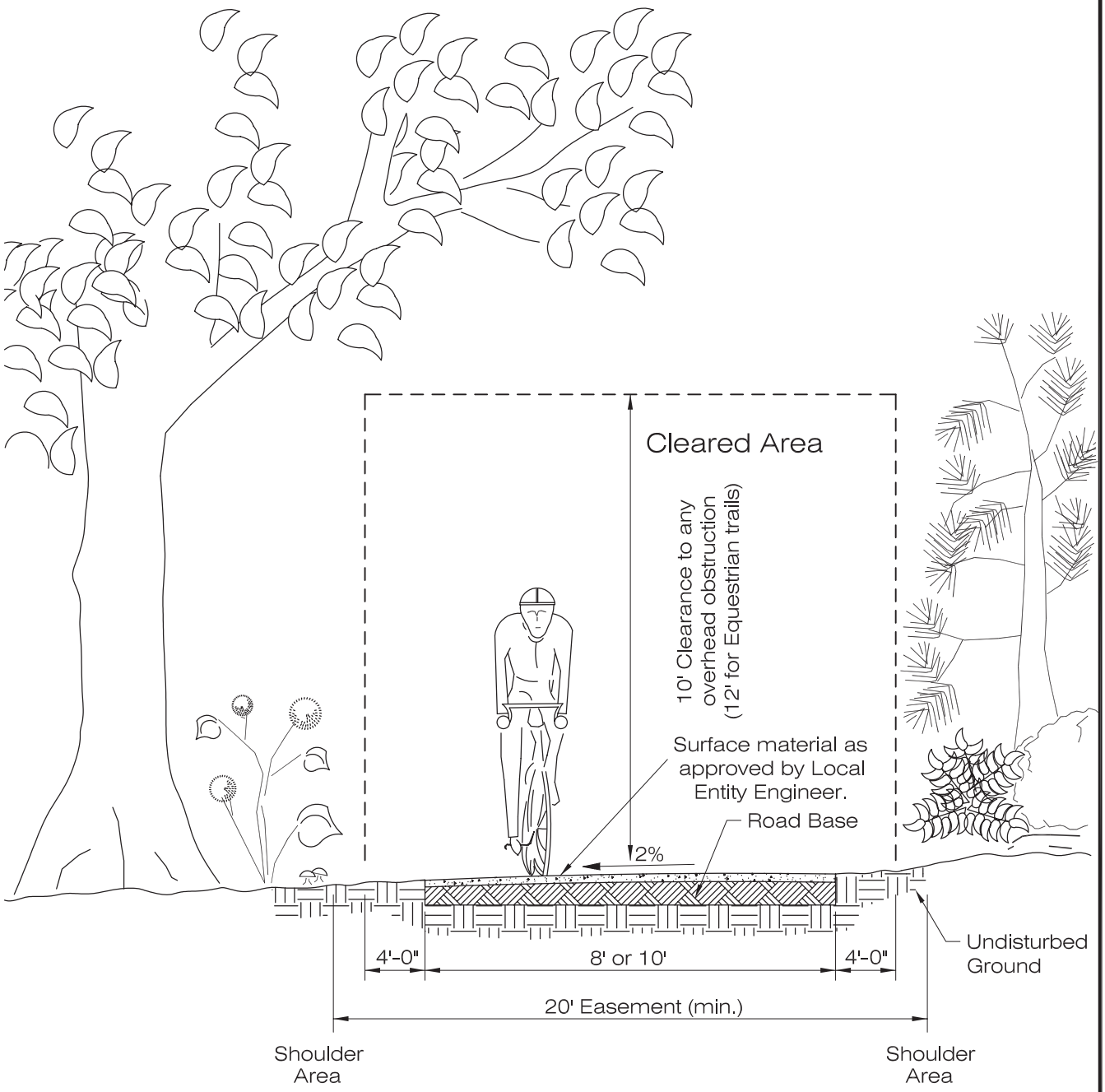
For proposed nonresidential land uses, bicycle parking shall be equivalent to 5 percent of the off-street vehicle parking requirement with a minimum of 2 spaces. Each inverted U rack provided will count as two bicycle parking spaces.

17.4.2 Placement of Bike Racks

Racks shall be within 30 feet of building entrances. All bicycle parking provided shall be on concrete, and located a minimum distance as follows from any wall:

Bike Orientation	Min. Distance of Rack from Wall
Parallel to wall	24 inches
Perpendicular to wall	30 inches

Covered parking is encouraged where possible.



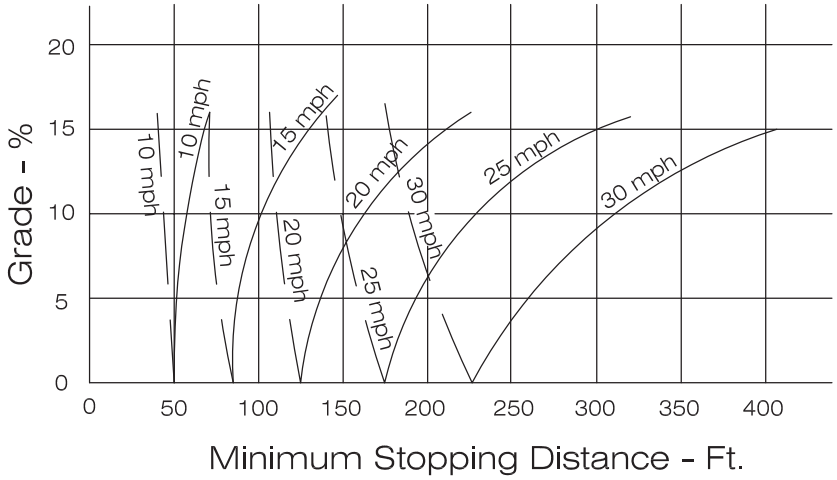
BIKE PATH CLEARING

NOTES:

1. Clear trail and shoulder areas of all vegetative matter and debris.
2. For bike paths 10 feet or greater in width, 4 feet in width more than the bike path shall be cleared.
3. 8' width (min.) for one way traffic, 10' width (min.) for two way traffic.

BIKE PATH

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17-1



$$S = \frac{V^2}{30(f \pm G)} + 3.67\,v$$

Where: S = Minimum Sight Distance, Ft.
V = Velocity, mph
f = Coefficient of Friction (use 0.25)
G = Grade Ft./Ft. (rise/run)

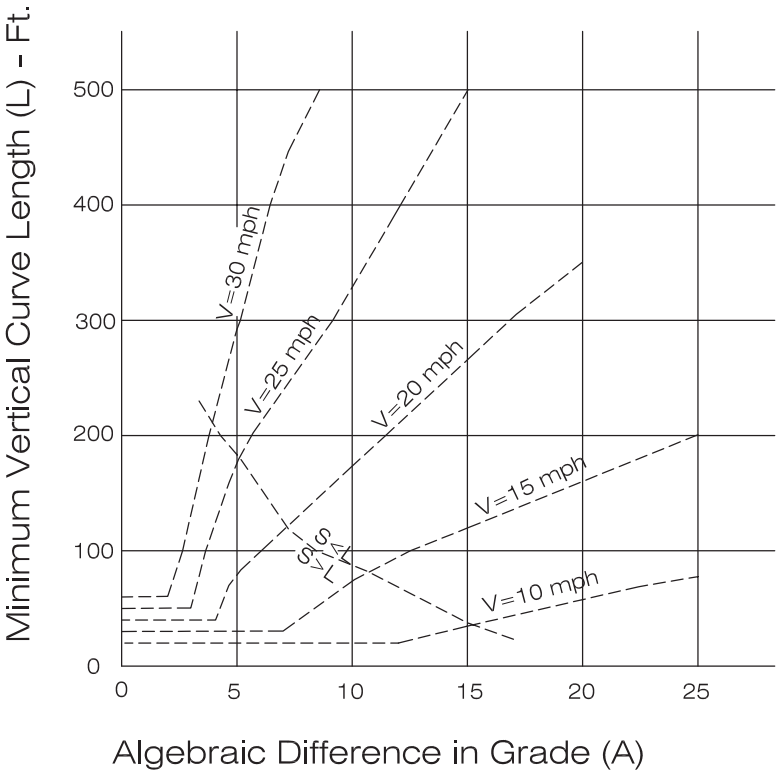
Descend (-G) ————
Ascend (+G) —— ——

(Metric Conversion: 1 FT. = 0.3 m. 1 mph = 1.6 km/h)

From AASHTO

MINIMUM STOPPING SIGHT DISTANCES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17–2



$$L = 25 - \frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A} \quad \text{When } S>L$$

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

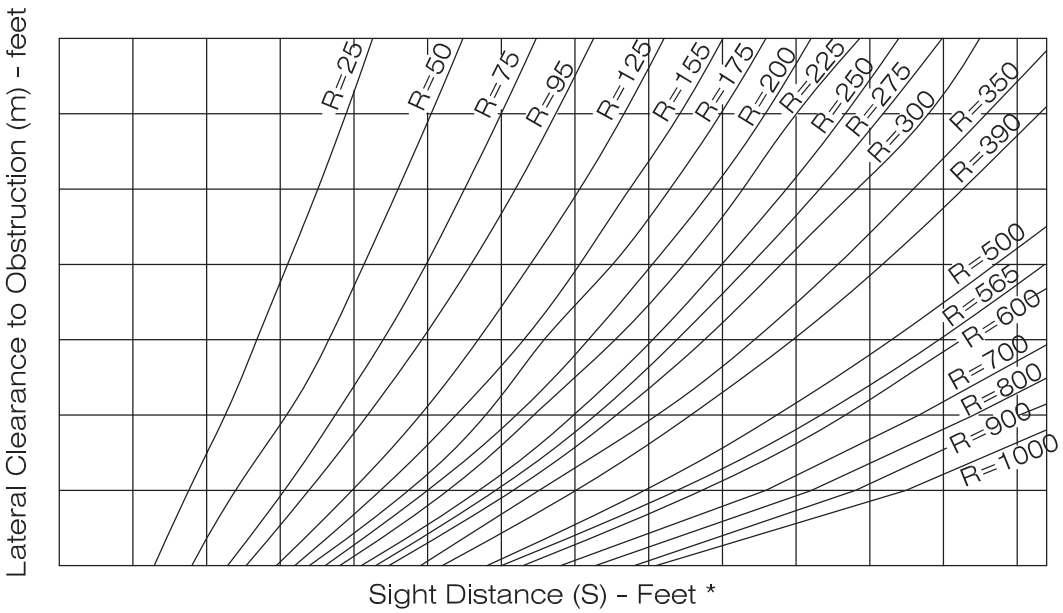
L (min.) = $2V$

Where: S = Stopping Sight Distance (ft.)
A = Algebraic Difference in Grade
h_1 = Eye Height of Bicyclist (4.5 Feet)
h_2 = Height of Object (0 Feet)
L = Minimum Vertical Curve Length (ft.)

From AASHTO

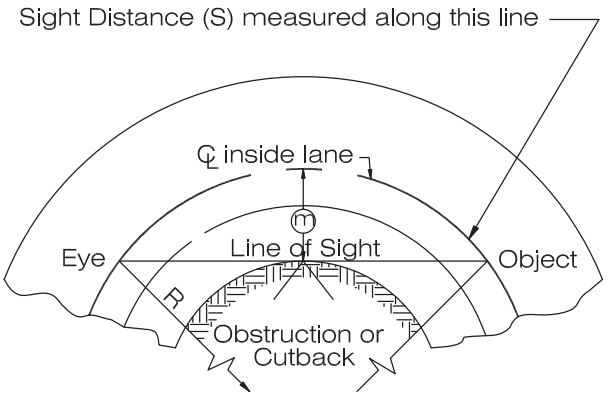
MINIMUM LENGTH OF VERTICAL CURVES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17-3



(Metric Conversion: 1 FT. = 0.3 m.)

* Lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists traveling in opposite directions around the curve. See text for additional discussion.



Line of sight is 2.0' above ℄ inside lane at point of obstruction.

S = Sight distance in feet.
R = Radius of ℄ inside lane in feet.

m = Distance from ℄ inside lane in feet.

v = Design speed for 5 in mph.

Angle is expressed in degrees

$$m = R\left[v \text{ or } s\left(\frac{28.655}{R}\right)\right]$$

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

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

From AASHTO

MINIMUM LATERAL CLEARANCES ON HORIZONTAL CURVES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17-4