11. Highway Design

Figures, Tables, Examples, and Exhibits

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1100. Introduction

1100.1. Establishment of Design Criteria

Alaska statues require the Department to establish design standards, and the Federal Highway Administration (FHWA) encourages the development of design standards by states in the interest of uniformity. AS 19.10.160(a) states:

> *The Department shall prepare and adopt uniform standard plans and specifications for the establishment, construction, and maintenance of highways in the state. The Department may amend the plans and specifications as it considers advisable. The standards must conform as closely as practicable to those adopted by the American Association of State Highway and Transportation Officials.*

The FHWA lists standards, specifications, policies, guides, and references that are approved for use on federal-aid projects in the *Code of Federal Regulations, Title 23 Highways, Part 625 – Design Standards for Highways.*

The *Alaska Highway Preconstruction Manual* (HPCM) establishes or references standards for design of highways by the Department. This manual interprets, amends, and supplements AASHTO standards.

Standards, specifications, policies, guides, and references are routinely revised or replaced with newer versions. The Department does not necessarily and immediately adopt these newer versions. Table 1100-1 lists the version dates formally adopted.

1100.2. Project Design Criteria

1100.2.1. General

Use design criteria contained or referenced in this manual. Criteria in this manual takes precedence if there is a conflict between criteria provided in this manual and criteria in referenced publications. When selecting design criteria, use expertise and judgment to achieve designs that fit into the natural and human environments while considering preservation and enhancement of scenic, aesthetic, historic, community, and environmental resources; while also improving or maintaining safety, efficiency, mobility, operations, and infrastructure conditions. Consider economics, but do not use it as the sole determination for design criteria selection.

Design criteria varies according to the type of project, e.g. New Construction, Reconstruction, 3R, or Pavement Preservation project. The type of project is identified in the planning and scoping of the project. Generally, the type of project is reflected in the project title, scope, description, electronic Project Information Document, Project Development Authorization, and Design Designation. Any questions or inconsistencies regarding the type of project should be resolved with planning and project control as this can affect the applicable design criteria.

In some situations, it may be necessary to use values less than the minimums, or greater than the maximums, provided due to constraints beyond the engineer's control. In such cases, follow the procedures set forth in Section 1100.3. – Design Exceptions and Design Waivers.

Document project design criteria and any exceptions using Figure 1100-2, Project Criteria Summary, for New Construction / Reconstruction and 3R projects.

Use U.S. customary units of measure for all designs.

1100.2.2. Application of Design Criteria

Designers need to recognize that every project is unique and that flexibility in the design standards exists. This flexibility is permitted to allow independent designs tailored to a particular project. Minimum values are given by the lower value in a given range of values. Larger values within a given range can be used when the social, economic, and environmental impacts are not critical.

The Department follows a context sensitive solutions approach in designing projects. This approach encourages designers to take advantage of the flexibility in design standards to produce designs that fit their natural and human environments while functioning efficiently and operating safely.

Designers are directed to the following publications for a further, more detailed, discussion of design flexibility:

- Forward to the AASHTO "A Policy on Geometric Design of Highways and Streets"
- FHWA's "Flexibility in Highway Design"
- AASHTO's "A Guide for Achieving Flexibility in Highway Design."

1100.2.3. New Construction and Reconstruction Project Design Criteria

Design new construction and reconstruction projects in accordance with the criteria provided in Figure 1100-2(a). For any criteria not provided in Figure 1100-2(a), refer to the Green Book version noted in Table 1100-1.

1100.2.4. 3R Project Design Criteria

The design criteria for 3R projects are documented using Figure 1100-2(b). Waivers or design exceptions of 3R design criteria are required only when the results or determinations of the 3R design procedures provided in Section 1160 require a feature improvement and the proposed project does not include that improvement.

1100.2.5. HSIP Project Design Criteria

The design criteria for Highway Safety Improvement Program (HSIP) projects are different from other projects. Because HSIP projects are intended to be cost-effective solutions to specific safety problems, project scope is limited to that which was HSIP-approved by the FHWA. In general, it is not necessary to improve features that do not meet current standards unless the improvements contribute to solving the safety problem targeted by the project. However, it is necessary to make improvements that are *legally* required, such as those covered by the Americans with Disabilities Act, on all facilities that are physically altered by an HSIP project.

In some cases, it may be appropriate to expand the scope of an HSIP project beyond that approved by FHWA. Submit proposed scope change to the regional traffic and safety engineer (RTSE) for consideration. If the additional work qualifies under the HSIP process, the RTSE submits the recommended changes to the state traffic engineer for scope modification and HSIP funding change approvals. If the additional work does not qualify under the HSIP process, the RTSE submits the recommended scope change to the state traffic engineer for scope modification approval prior to seeking funding for the work from other sources.

1100.2.6. Pavement Preservation Project Design Considerations

Design considerations for Pavement Preservation projects are found in Section 1140.

1100.3. Design Exceptions and Design Waivers

1100.3.1. General

A design exception or waiver may be granted for an individual project element or a segment of the project where design criteria does not satisfy applicable design standards. 23 CFR 625.3(f) provides that design exceptions may be given on a project-specific basis to designs which do not conform to minimum design criteria. The Americans with Disabilities Act legally imposes design requirements that cannot be waived.

Justification for an exception or waiver may include:

- High cost of construction
- Negative environmental impacts
- Difficulty or cost of obtaining right-of-way
- Sensitivity to context or community values

The careful application of flexibility in design standards and policies, appropriate use of design exceptions and waivers, and coordination with transportation enhancement activities can result in projects that provide safe and efficient transportation facilities and are sensitive and responsive to scenic and historical resources.

Two types of roadway design criteria are provided in Figure 1100-2: controlling design criteria and non-controlling design criteria. Use Section 1100.3.2 - Design Exceptions - for controlling design criteria and Section 1100.3.3 Design Waivers for non-controlling design criteria.

Design exceptions and waivers are not required for Pavement Preservation projects due to their scope, except for vertical clearance.

1100.3.2. Design Exceptions

Design exceptions apply only to controlling design criteria. FHWA identifies controlling design criteria as those having substantial importance to the operational and safety performance of a highway such that special attention should be paid to them in design decisions.

The 10 controlling design criteria for high-speed NHS roadways with a design speed greater than or equal to 50 mph are:

1. Design speed
2. Lane width
3. Shoulder width
4. Horizontal curve radius
5. Superelevation
6. Maximum grade
7. Stopping sight distance (SSD)
8. Cross slope
9. Vertical clearance
10. Design loading structural capacity

The two controlling design criteria for low-speed NHS roadways with a design speed less than 50 mph are:

1. Design speed
2. Design loading structural capacity

Design exceptions to these controlling criteria can, for the most part, be easily identified and defined.

Design speed is a design control rather than a specific design element. It is used to determine the range of design values for many of the individual design elements such as stopping sight distance and horizontal curvature. Exceptions for design speeds are rare and can often be handled by exceptions for specific design elements rather than the design control (design speed).

Justification, Evaluation, and Approval of Design Exceptions

When design standards for controlling design criteria are not met, a design exception is required. If no minimum or maximum design standards are provided for the specific controlling design criteria, an exception is not required.

Design exceptions need to document all of the following:

- Specific design criteria not met
- Existing roadway characteristics
- Alternatives considered
- Comparison of the safety and operational performance of the roadway
- Right-of-way
- Environmental impacts
- Cost
- Comparison of usability of all modes of transportation
- Proposed mitigation measures
- Compatibility with adjacent sections of roadway

When a design exception involves design speed, additional documentation is required:

- Length of section with reduced design speed compared to the overall length of the project
- Measures used in transitions to adjacent section with higher or lower design or operating speeds

Refer to the *Alaska Bridges and Structures Manual* for design exceptions involving design loading structural capacity.

Submit the design exception request, including the proposed preliminary design, cost estimates, justification, and evaluation to the regional preconstruction engineer. The regional preconstruction engineer will either approve the design exception request in writing or reject it. Furnish an informational copy of all approved design exceptions to FHWA. FHWA must concur with design exception approvals on PoDI projects.

Discuss all design exceptions in the Design Study Report (DSR) and include approvals in the DSR appendix.

For further information regarding design exceptions, see FHWA publication *Mitigation Strategies for Design Exceptions, July 2007* (FHWA-SA-07-011):

http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/fhwa_sa_07011.pdf with accompanying memo:

https://www.fhwa.dot.gov/design/standards/140501.pdf

1100.3.3. Design Waivers

A design waiver is a documented decision to design a highway element or a segment(s) of a highway project to design criteria that do not meet standards as established for that highway or project. The design criteria, for this definition, are all design criteria not considered controlling design criteria as previously defined in Section 1100.3.2.

Submit the design waiver request, including the proposed preliminary design, cost estimates, justification, and evaluation to the regional preconstruction engineer. The regional preconstruction engineer will either approve the design waiver request in writing or reject it.

Discuss all design waivers in the DSR and include approvals in the DSR appendix.

1100.4. Specific Project Criteria

The engineering manager is provided source program documents that describe the proposed design project which are used to develop the Design Designation.

1100.4.1. Design Designation

The Design Designation requires written approval by the regional preconstruction engineer. The Design Designation contains the data which is the basis for establishing the design criteria. The Design Designation contains the following:

- State route number
- Route name
- Project limits
- State project number
- Federal project number
- General project description
- Project type
- Design functional classification
- Project design life
- Traffic projections
- Traffic mix
- Design vehicle(s) description
- Design vehicle loading
- Equivalent single-axle loads (ESALs)
- Level of service (urban)
- Design Speed
- Terrain Type

An example Design Designation form is shown in Figure 1100-1.

Functional Classification

The design designation establishes the appropriate functional classification for design.

Chapter 1 of the Green Book provides definitions and descriptions of functional systems for rural and urban areas. The portion of Chapter 1, titled Functional Classification as a Design Type, provides guidance for establishing appropriate functional classification for design.

Design Life

The engineering manager establishes the project design life.

AS 19.10.160 requires use of the minimum design life listed in the following table for new construction and reconstruction projects (Pavement Preservation and 3R projects are excluded) within federally recognized metropolitan planning areas:

Contract Amount[1]	Min. Design Life[2]
0 - $5 Million	10 Years
> $5 Million	20 Years

[1] The Contract Amount is the estimated construction contract amount at Environmental Document approval.
[2] The beginning of the design life period is the calendar year following the estimated calendar year of construction final acceptance.

For reconstruction and new construction highway projects outside recognized metropolitan planning areas, use the above table as guidance.

The design life for all projects, including 3R projects, should at least equal the expected service life of the improvements.

For Pavement Preservation projects, the design life equals the pavement design life as specified in Section 1140.

1100.4.2. Project Design Criteria

Project design criteria are developed from the Design Designation and the project development process. The Project design criteria are integral to the DSR and the regional preconstruction engineer must approve them. Summarize the Project Design Criteria in a form similar to Figure 1100-2.

DESIGN DESIGNATION

State Route Number: ______________________ Route Name: ______________________

Project Limits: ______________________

State Project Number: ______________________ Federal Aid Number: ______________________

Project Description: ______________________

Design Functional Classification:
- ☐ Freeway
- ☐ Rural Arterial
- ☐ Urban Arterial
- ☐ Other ______________________
- ☐ Collector, type ______________
- ☐ Local Recreational Rd.
- ☐ Local Resource Recovery Rd.
- ☐ Rural Local Rd.
- ☐ Urban Local St.
- ☐ Local Service Rd.

Project Type:
- ☐ New Construction - Reconstruction
- ☐ Pavement Preservation (PM,1R, 2R)
- ☐ 3R
- ☐ HSIP

Project Design Life (years): 5 ☐ 10 ☐ 20 ☐ 25 ☐ 30 ☐ Other ______________

Traffic Projections:

	Current Year	Construction Year	Mid - Life Year	Design Year
2-Way AADT*				
2-Way DHV				
Peak Hour Factor				
Directional Distribution				
Percent Recreational Vehicles				
Percent Commercial Trucks				
Compound Growth Rate				
ESALs				
Pedestrians (Number/Day)				
Bicyclists (Number/Day)				

* Request Transportation Data on-line at: http://dotsobdeviis1.dot.soa.alaska.gov/

Design Vehicle: ______________________

Level of Service (Urban Only):______________

Design Speed : ______________

Terrain : ☐ Level ☐ Rolling ☐ Mountainous

Attach intersection diagrams to this document, when appropriate

APPROVED ______________________________________ DATE ______________

Preconstruction Engineer

Figure 1100-1
Design Designation Form

DESIGN CRITERIA CHECKLIST

Project Name Page of
State Project No. Fed. Project No.
Functional Classification: Terrain:
Present Year (&ADT): Design Year (&ADT):
DHV (%): Directional Split (%): Percent Trucks:
Pavement Design Year: Pavement Design ESAL:
Design Turning Vehicle: Design Accommodated Vehicle:
Project Type: Choose an item.

FEDERAL 10 CONTROLLING DESIGN CRITERIA	SOURCE	STANDARD	AS DESIGNED	EXCEPTION[1]
1. Design Speed[1]		mph	mph	Choose an item.
2a. Travel Lane Width		ft	ft	Choose an item.
2b. Auxiliary Lane Width		ft	ft	Choose an item.
3a. Outside Shoulder Width		ft	ft	Choose an item.
3b. Inside Shoulder Width		ft	ft	Choose an item.
3c. Auxiliary Lane Shoulder Width		ft	ft	Choose an item.
4. Horizontal Curvature Radius		ft	ft	Choose an item.
5. Superelevation Rate*, e(max)		%	%	Choose an item.
6. Stopping Sight Distance (SSD)*		ft	ft	Choose an item.
7. Grade — Min.		%	%	Choose an item.
7. Grade — Max.		%	%	Choose an item.
8. Cross Slope		%	%	Choose an item.
9. Vertical Clearance*		ft	ft	Choose an item.
10. Design Loading Structural Capacity[1]				Choose an item.

** Attach calculations.*

1. On low speed roadways (<50 mph) on the NHS only Design Speed and Design Loading Structural Capacity require a Design Exception; all other criteria become a Design Waiver. For projects off the NHS, all criteria become a Design Waiver.

Figure 1100-2(a)
Project Design Criteria
For New Construction and Reconstruction Projects

OTHER DESIGN CRITERIA		SOURCE	STANDARD	AS DESIGNED	WAIVER
Superelevation Transition*, Δ			%	%	Choose an item
Bridge Clear-Roadway Width			ft	ft	Choose an item
Vertical Curvature, Min.	K(crest)				Choose an item
	K(sag)				Choose an item
Lateral Offset to Obstruction			ft	ft	Choose an item
Surfacing Material					Choose an item
Clear Zone Slope					Choose an item
Clear Zone Width			ft	ft	Choose an item.
Bicycle Lane Width			ft	ft	Choose an item
Sidewalk Width			ft	ft	Choose an item
Intersection Sight Distance, Left Turn*			ft	ft	Choose an item
Right Turn*			ft	ft	Choose an item.
Crossing*			ft	ft	Choose an item.
Passing Sight Distance			ft	ft	Choose an item
Degree of Access Control					Choose an item
Median Treatment					Choose an item
Median Width			ft	ft	Choose an item.
Illumination					Choose an item
Curb Type					Choose an item

* *Attach calculations.*

Notes:

Proposed by: ______________________ Date: ______________
Designer Signature (Consultant or Staff)

Recommended by: ______________________ Date: ______________
Engineering Manager Signature

Accepted by: ______________________ Date: ______________
Regional Preconstruction Engineer Signature

Figure 1100-2(a)
Project Design Criteria
For New Construction and Reconstruction Projects

PROJECT DESIGN CRITERIA - 3R PROJECTS

Project Name:				
Project Number:				
Functional Classification:				
Design Year:			Present ADT:	
Design Year ADT:			Mid Design Period ADT:	
DHV:			Directional Split:	
Percent Trucks:			Equivalent Single Axle Loading:	
Pavement Design Year:			Design Vehicle:	
Terrain:			Number of Roadways:	
Design Speed:	☐ As-Built ☐ Posted			
85th Precentile Speed:	☐ Speed Study ☐ Project Drive-thru ☐ Derived from existing geometrics			
Existing Lane Width				
Existing Shoulder Width				
Existing Lane + Shoulder Width				
Lane + Shldr Width for New Const.				
Exist. Superelevation Rate:				
Min. Radius for New Const.		(Evaluate Curves tighter than this)		
Min K-Value for Vert. Curves (new)	Sag:		Crest:	
Stopping Sight Distance:				
Passing Sight Distance:				
Exist. Bridge No(s):				
Exist. Bridge Width(s):				
Surface Treatment:	T/W:		Shoulders:	
Degree of Access Control:				
Median Treatment:				
Existing Illumination:				
Proposed Illumination:				
Existing Bicycle Accomodation:				
Proposed Bicycle Accomodation:				
Existing Pedestrian Provisions:				
Proposed Pedestrain Provisions:				
Misc. Criteria:				

The shaded area represents features requiring 3R evaluation per Section 1160.

Proposed - Designer/Consultant: ______________________ Date: __________

Accepted - Engineering Manager: ______________________ Date: __________

Approved - Preconstruction Engineer: ______________________ Date: __________

Figure 1100-2(b)
Project Design Criteria
For 3(R) Projects

Table 1100-1
Adopted Design Standards

Acronym	Design Publication	Date
ABSM	Alaska Bridges and Structures Manual	See Note 1
ADA[2]	U.S. Department of Transportation ADA Standards for Transportation Facilities, and U.S. Department of Justice ADA Standards for Accessible Design	2006 2010
AGTF[3]	AASHTO Guide for Transit Facilities	2014
AHDM	Alaska Highway Drainage Manual	2006
ASP	Alaska Standard Plans Manual	See Note 4
ATM	Alaska Traffic Manual	See Note 5
GB	AASHTO A Policy on Geometric Design of Highways and Streets (Green Book) – 7th Edition	2018
GDBF	AASHTO Guide for the Development of Bicycle Facilities	2012
GDLVR	AASHTO Guidelines for Design of Low-Volume Roads	2019
HCM	Highway Capacity Manual	2010
RDG	AASHTO Roadside Design Guide	2011
RPRL	IES Recommended Practice for Roadway Lighting (RP-8-14)	2014
SSSS[6]	AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals	2013 2015

Note 1: Use latest edition with interims effective at time of design approval
Note 2: In most cases, the 2006 US DOT ADA Standards for Transportation Facilities applies. See ADA design policy below for when the 2010 US DOJ ADA Standards apply
Note 3: Use existing transit operator guidance, if available.
Note 4: Use the latest edition at the time of advertising
Note 5: Use the latest edition at the time of design approval
Note 6: Either standard may be used. Use version indicated with interim revisions effective at the time of design approval.

<u>ADA Design Policy:</u>

Transportation facilities and their appurtenances constructed in public rights-of-way are required to accommodate those with disabilities. These disabilities include, but are not limited to: limited mobility, impaired vision, and impaired hearing.

Design all new public transportation facilities, including bus stops and stations, and rail stations, to meet the *Americans with Disabilities Act (ADA) Standards for Transportation Facilities* adopted by the U.S. Department of Transportation (DOT) (2006). Other types of facilities covered by the ADA are subject to the *2010 ADA Standards for Accessible Design* adopted by the U.S. Department of Justice (DOJ). 49 CFR 37, Appendix D, Subpart B, Section 37.21 states, "Both sets of rules apply; one does not override the other.

The DOT rules apply only to the entity's transportation facilities, vehicles, or services; the DOJ rules may cover the entity's activities more broadly. For example, if a public entity operates a transit system and a zoo, DOT's coverage would stop at the transit system's edge, while DOJ's rule would cover the zoo. DOT and DOJ have coordinated their rules, and the rules have been drafted to be consistent with one another. Should, in the context of some future situation, there be an apparent inconsistency between the two rules, the DOT rules would control within the sphere of transportation services, facilities and vehicles."

The following figure contains the initial design references for project type and design particular. The initial design reference may direct the designer to succeeding references.

Design Particular	New Construction and Reconstruction			3R
	Urban	Rural	~~Very Low Volume Local Roads~~	All
1. Design Speed*	GB	GB	~~N/A~~	HPCM Sect. 1160
2. Lane Width	GB	GB	~~N/A~~	HPCM Sect. 1160
3. Shoulder Width	GB	GB	~~N/A~~	HPCM Sect. 1160
4. Horizontal Curve Radius	GB	GB	~~N/A~~	HPCM Sect. 1160
5. Superelevation Rate	GB	GB	~~N/A~~	HPCM Sect. 1160
6. Stopping Sight Distance (SSD)	GB	GB	~~N/A~~	HPCM Sect. 1160
7. Maximum Grade	GB	GB	~~N/A~~	HPCM Sect. 1160
8. Cross Slope	GB	GB	~~N/A~~	HPCM Sect. 1160
9. Vertical Clearance	GB	GB	~~N/A~~	HPCM Sect. 1160
10. Design Loading Struct. Capacity*	GB	GB	~~N/A~~	HPCM Sect. 1160
Note: *All 10 apply to high-speed facilities. Those with an * apply to low-speed facilities.*				

Figure 1100-3(a)
Highway Design Controlling Criteria Summary
For Roads on the NHS

Design Particular	New Construction and Reconstruction			3R
	Urban	Rural	Very Low Volume Local Roads	All
Alleys	GB	Not Applicable	Not Applicable	HPCM Sect. 1160
Bicycle Facilites	HPCM Ch. 12	HPCM Ch. 12	HPCM Ch. 12	HPCM Sect. 1160
Bridge Width	GB	GB	GDLVR	HPCM Sect. 1160
Bus Turnouts	AGTF[1]	AGTF[1]	AGTF[1]	HPCM Sect. 1160
Capacity	HPCM Ch. 10	HPCM Ch. 10	HPCM Ch. 10	HPCM Sect. 1160
Clear Zone	GB[2]	HPCM Sect. 1130	GDLVR	HPCM Sect. 1160
Climbing Lanes	GB	GB	GB	HPCM Sect. 1160
Cross Slope	HPCM Sect. 1130	HPCM Sect. 1130	GDLVR	HPCM Sect. 1130
Cul De Sacs	GB	GB	GB	HPCM Sect. 1160
Curbs	ASP	ASP	ASP	HPCM Sect. 1160
Design Loading Structural Capacity	ALBDS	ALBDS	ALBDS	HPCM Sect. 1160
Design Speed	GB	GB	GDLVR	HPCM Sect. 1160
Design Vehicle (Turning)[3]	GB	GB	GB	HPCM Sect. 1160
Drainage	AHDM	AHDM	AHDM	HPCM Sect. 1120.6
Driveways	HPCM Sect. 1190	HPCM Sect. 1190	HPCM Sect. 1190	HPCM Sect. 1160
Escape Ramps	GB	GB	GB	HPCM Sect. 1160
Foreslopes	HPCM Sect. 1130	HPCM Sect. 1130	GDLVR	HPCM Sect. 1160
Freeways	GB	GB	N/A	HPCM Sect. 1160
Grade	HPCM Sect. 1120	HPCM Sect. 1120	HPCM Sect. 1120	HPCM Sect. 1160
Horizontal & Vert. Curvature	HPCM Sect. 1120	HPCM Sect. 1120	GDLVR	HPCM Sect. 1160
Interchanges	GB	GB	N/A	HPCM Sect. 1160
Intersection Design	GB	GB	GDLVR	HPCM Sect. 1160
Lane & Shoulder Width (ADT<2000)	GB	HPCM Sect. 1130	GDLVR	HPCM Sect. 1160
Lane & Shoulder Width (ADT>2000)	GB	GB	N/A	HPCM Sect. 1160
Lane & Shoulder Width (Interstate)	HPCM Sect. 1120	HPCM Sect. 1120	N/A	HPCM Sect. 1160
Level of Service	GB Table 2-5[4]	GB Table 2-5[4]	GB Table 2-5[4]	HPCM Sect. 1160
Lighting	RPRL	RPRL	RPRL	HPCM Sect. 1160
Medians	HPCM Sect. 1150	HPCM Sect. 1150	HPCM - Sec. 1150	HPCM Sect. 1160
On-Street Parking	GB	GB	GB	HPCM Sect. 1160
Pavement	HPCM Sect. 1180	HPCM Sect. 1180	HPCM Sect. 1180	HPCM Sect. 1160

Figure 1100-3(b)
Highway Design Criteria Summary
(Page 1 of 2)

Design Particular	New Construction and Reconstruction			3R
	Urban	Rural	Very Low Volume Local Roads	All
Rail Road Grade Crossing	GB	GB	GB	HPCM Sect. 1160
Sidewalks	GB	GB	GB	HPCM Sect. 1160
Stopping Sight Distance (SSD)	HPCM Sect. 1120	HPCM Sect. 1120	GDLVR	HPCM Sect. 1160
Structural Supports for Signs, Luminaires and Traffic Signals	SSSS	SSSS	SSSS	SSSS
Superelevation	HPCM Sect. 1130	HPCM Sect. 1130	GDLVR	HPCM Sect. 1160
Super Transitions	HPCM Sect. 1130	HPCM Sect. 1130	GDLVR	HPCM Sect. 1160
Traffic Control Devices	ATM	ATM	ATM	HPCM Sect. 1160
Traffic Barriers	HPCM Sect. 1130	HPCM Sect. 1130	GDLVR	HPCM Sect. 1160
Turn Lanes	HPCM Sec. 1150	GB	GB	HPCM Sect. 1160
Turnouts	HPCM Sec. 1120.6	HPCM Sec. 1120.6	HPCM Sec. 1120.6	HPCM Sect. 1160
Vertical Clearance	HPCM Sect. 1130	HPCM Sect. 1130	HPCM Sect. 1130	HPCM Sect. 1160

1 Consult with the local transit authority to determine local area specific requirements. Verify that GB minimums are being met.

2 Follow the requirements of HPCM Section 1130 for uncurbed urban sections.

3 Reference 17 AAC 25.012 and 17 AAC 25.014 for allowable legal vehicle sizes.

4 For urban and suburban arterials, see section 7.3.2 of the Green Book for further discussion on selecting the design level of service. For urban and suburban freeways, see section 8.2.3 of the Green Book for further discussion on selecting the design level of service.

Figure 1100-3(b)
Highway Design Criteria Summary
(Page 2 of 2)

1110. (Reserved)

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1120. Elements of Design

1120.1. General

Figure 1100-3, Highway Design Criteria Summary, provides the acceptable initial design references for project types and design specifics. The initial design reference may direct the designer to succeeding references. For any criteria not provided in Table 1100-3, refer to the *AASHTO A Policy on the Geometric Design of Highways and Streets* (GB).

Follow the guidance provided in Section 1100.3 for design exceptions and design waivers.

1120.2. Horizontal Curves, Grades and Sight Distance

1120.2.1. General

When developing alignments for a given design speed use generally flat curves, reserving the minimum radii for the most critical conditions.

1120.2.2. Horizontal Curves

Design horizontal curves following guidance in Section 3.3 of the GB.

For gravel roads, use the guidance presented in Figure 1120-1 and the AASHTO Guidelines for Design of Low-Volume Roads (GDLVR).

Simple curves should be used for the design of all roadways. Rehabilitation projects and interchanges may require use of compound or spiral curves to meet site constraints.

1120.2.3. Grades

Use the following for determining maximum grades on specific functional classes:

On low volume local and minor collector roads, use the GDLVR.

Local	GB Table 5-2
Collector	GB Table 6-2
Arterial	GB Table 7-2

On non-NHS highways, short grades of 500 feet in length, or less, and one-way downhill grades may be 1.0% steeper than those given in the GB tables listed above.

Grades may be 2.0% steeper for low-volume rural highways off the NHS.

For streets with curb and gutter, use GB Subsection 3.4.2.2.2, with a preferred minimum grade of 0.5%.

1120.2.4. Sight Distance

Use the following for determining minimum stopping and passing sight distance on specific functional classes:

Local	GB Table 5-3 & 5-4
Collector	GB Table 6-3 & 6-4
Arterial	GB Table 7-1

On Low Volume Local and Minor Collector Roads, use the GDLVR.

1120.3. Interstate

1120.3.1. General

Interstate design criteria are essentially the same as for any limited-access, high-speed arterial. Some exceptions apply to Alaskan Rural Interstate roadways by agreement with the FHWA. This section describes these exceptions.

1120.3.2. Roadway Width

Interstate criteria generally require a minimum four-lane divided facility. In Alaska, unless the DHV exceeds the capacity of a two-lane, two-way facility, a two-lane is acceptable provided the width requirements for arterials in the GB are followed and the interstate surface is no less than 36 feet from outside shoulder to outside shoulder.

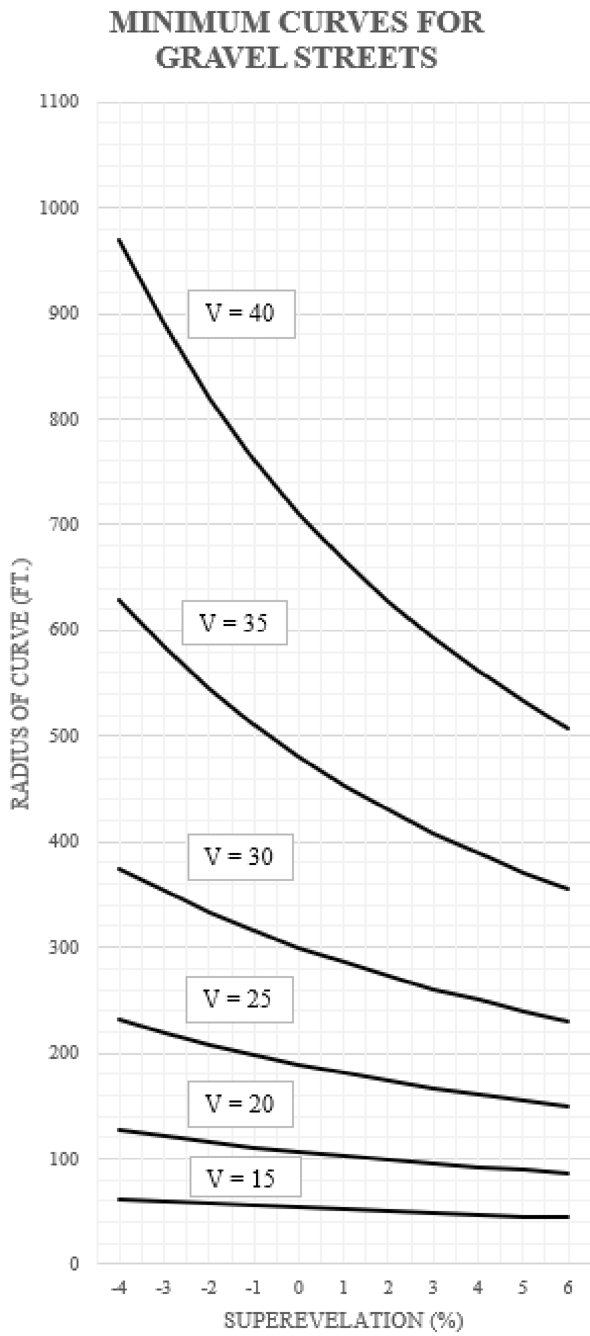
1120.3.3. Access Control

Interstate roadways by definition are major arterials and continuous control of legal access is highly desirable. In urban and suburban areas, legal access to interstate roadways should only be via a public roadway; there should be no private access points. In rural areas, public roadways are desirable access points. However, private access points may be required where the route traverses major private land holdings.

In accordance with 23 USC 111 all new or modified access points to the Interstate Highway System require FHWA approval. See Section 1190.1 for additional requirements.

1120.4. Bridges

Design Bridges in accordance with the *Alaska Bridge and Structures Manual (ABSM)*.



V	f
15	0.27
20	0.23
25	0.20
30	0.17
35	0.15
40	0.13
45	0.12

Figure 1120-1
Minimum Curves for Gravel Streets

1120.5. Retaining Wall Design

1120.5.1. General

DOT&PF uses retaining walls to provide lateral support for a variety of applications.

Before retaining wall design can begin, the geotechnical engineer conducting the foundation investigation must complete a written foundation report. The requirements for this report are found in the Alaska Geotechnical Procedures Manual.

Submit the report to the project manager upon completion.

After completion of the foundation report, design and plan preparation can begin. All contract documents for retaining walls must contain a fully detailed Department-approved wall system, or a list of acceptable retaining wall systems selected from the Department's current list of pre-qualified retaining wall systems.

Additional requirements and details regarding retaining walls can be found in Chapter 21 of the *ABSM*.

1120.5.2. Retaining Wall Classification

Earth retaining structures are divided into three classifications.

State-Designed Structures
State-designed structures are designed completely by the Department or a consultant without use of proprietary systems.

Pre-Approved Proprietary Structures
These are patented systems. Pre-approved status means that these retaining walls may be listed in the special provisions as an alternative retaining wall system based on the recommendation of the Statewide Materials Section.

Proprietary Structures Pending Approval
A vendor has submitted these retaining wall system designs for approval. They may be added to the pre-approved list if they meet the Statewide Materials Section requirements.

1120.5.3. Federal Requirements, Proprietary Items

See Section 450.7.4 for requirements.

1120.5.4. Wall Selection

Selection of wall types depends on several performance variables:

- Material availability and cost
- Ease of Construction
- Walls in Cut vs. Fill
- Potential Settlement
- Service Life
- Surcharge
- Aesthetics
- Railings

Refer to Chapter 21 of the *ABSM* for more in-depth discussion on wall selection.

1120.5.5. Wall Design

In all cases, determine the wall controlling geometry. The wall must fit the facility site. Design the structural aspects of retaining walls in accordance with the *ABSM.*

Walls are classified according to their construction method (e.g. fill-wall construction, cut-wall construction) and the mechanism used to develop lateral support (externally stabilized or internally stabilized). Common fill-wall construction types are MSE walls and CIP concrete cantilever walls. Cut wall construction may include:

- Soldier-Pile walls
- Anchored walls
- Soil-Nail walls
- Sheet Pile walls

The DOT&PF Bridge Section, or a consultant experienced in retaining wall design, will design all non-proprietary cast-in-place retaining walls over 4 feet in height.

1120.5.6. Alternative Wall Designs (Proprietary)

Consider alternative or proprietary wall designs where different wall systems appear to be equal in performance and approximately equal in estimated cost. Provide sufficient information in the contract plans so that the Department-designed wall system or pre-qualified retaining wall systems can be competitively bid. Proprietary wall systems must have the approval of the Statewide Materials Section. Provide sufficient geometric controls on the contract plans so that a vendor may prepare a wall system structural design.

It is the responsibility of the designer to ensure that the wall can be constructed within the constraints of the site. Contact the Statewide Materials Section for the most current list of pre-approved retaining wall systems.

1120.5.7. Contract Plans

The contract plans must include a Department-approved wall system design that typically provides geometric/design information and figures such as wall dimensions, elevations, and cross-sections. Refer to the *ABSM* for a complete list.

1120.6. Drainage

1120.6.1. General

This section provides design criteria for the hydraulic and hydrologic development of drainage systems for highways. Use the hydraulic and hydrologic design methods found in the *Alaska Highway Drainage Manual* (AHDM) and the *AASHTO Highway Drainage Guidelines* in coordination with the guidance provided in this section.

Use the design flood frequencies presented in Chapter 7, Appendix A, of the AHDM for design of the various types of hydraulic structures.

Consult with the regional hydraulics engineers when designing drainage systems.

1120.6.2. Cross Drainage Culverts

Design culverts for the appropriate Hw/D Ratio. See Chapter 9 of the AHDM for the Hw/D Ratio for the particular application.

The minimum diameter for round cross-drainage culverts shall be 24 inches (Equivalent pipe-arch culverts shall have a minimum span-to-rise of 29 inches by 18 inches.). However, in icing problem areas, 36-inch diameter, round culvert pipes will be the minimum. Equivalent pipe-arch culverts in icing areas is not recommended.

Evaluate all culverts 48 inches in diameter or greater for the potential to fail during a design discharge due to hydrostatic and hydrodynamic forces, erosion, saturated soils, or plugging by debris. Any culvert that is found to have a failure potential must be restrained at the ends by half-height concrete headwalls or an equivalent, deadmen, or other form of vertical restraint. Consult with the regional hydraulic engineer for designs of culverts 48” or larger.

Restrain all mitered pipes with half-height concrete headwalls or an equivalent. Deadmen or other forms of comparable vertical restraint are acceptable if the culvert invert lip is structurally reinforced.

1120.6.3. Storm Sewers

Inlets in sag locations require special attention from the designer and special design criteria are required to size and space them properly. A sag is any portion of the roadway where the profile grade changes from a negative grade to a positive grade. The depression formed is capable of ponding water that extends more than halfway into the nearest traveled lane if all the grate inlets become plugged with debris. This ponded area is generally contained by a curb, traffic barrier, retaining wall, or any other obstruction that prevents it from flowing off the traveled roadway.

A sag vertical curve that is located in a fill section would not be considered a sag in the above sense if the runoff can overtop the curb and flow down the fill slope without ponding water over more than half of the nearest traveled lane. Width of spread criteria for gutter flow can be found in the AHDM.

Avoid placing sags on bridges. It is difficult to fit inlets among the reinforcing steel and the location of downspouts is often limited.

Locate and size the inlets using the procedures outlined in the AHDM.

Provide inlet grates that are hydraulically-efficient and bicycle-safe on all storm sewer inlets. The AHDM lists acceptable grates.

1120.6.4. Filter Courses or Subsurface Drainage Matting

All required filter cloth, geotextile filters or fabrics, geomembrane systems, geosynthetic materials, or granular material filter courses must be specifically designed for the application and be called for and/or detailed in the project plans.

1120.6.5. Bioengineered Bank Stabilization

Use bioengineered bank stabilization with caution.

Do not use bioengineered bank stabilization in areas of critical infrastructure. Critical infrastructure includes bridges, guide banks and other river training work, and single access roadways or roadways where concern about stream erosion exists. Bridges in particular are vulnerable to stream erosion processes and must be well protected.

If the engineering manager determines an area is low risk and use of bioengineered bank stabilization would provide substantial benefit, it may be used in an area of critical infrastructure if written approval of the State Hydraulics Engineer is obtained.

1120.6.6. Hydraulic Site Surveys

Coordinate site survey efforts with the Statewide Hydraulics Engineer for all bridge structures.

Bridge structures are defined as all hydraulic structures greater than 20 feet in length measured parallel to the roadway centerline, including single and multiple culvert installations.

Coordinate with the Regional Hydraulics Engineer for culvert installations (especially fish passage culverts), other drainage structures such as stormwater facilities, and erosion and sediment control.

Early coordination is critical. The hydraulics engineer may be required to visit the site prior to or with the survey crew.

Site survey consultant contract designs shall be under the direction of the consultant's engineer-in-responsible-charge.

Conduct all hydraulic site surveys in accordance with the guidance provided in section 6.4 of the AHDM.

1120.6.7. Hydrologic and Hydraulic Standards

Use the hydrologic methods prescribed in the AHDM to determine flood flow frequencies.

Use the hydraulic design standards prescribed in the AHDM and the *AASHTO Highway Drainage Guidelines.*

1120.6.8. Hydrologic and Hydraulic Reports

For design of all bridges over water and all culverts 48 inches in diameter or greater, an engineered Hydrologic and Hydraulic Report is required.

For projects that include maintenance and rehabilitation of existing drainage facilities, perform the level of hydrologic and hydraulic study commensurate with the significance of risk and environmental impacts.

Minimum requirements for Hydrologic and Hydraulic Reports are included in Chapter 4 of the AHDM.

Final hydrological and hydraulic reports are signed and sealed by a professional engineer.

1120.6.9. Summary Hydraulic Report

A Summary Hydraulic Report may be used for projects that have minor hydraulic impacts or risks such as smaller bridges, maintenance or rehabilitation of existing drainage facilities, projects with culverts only, or minor encroachments.

Consultant-prepared reports may use a Summary Hydraulic Report after consultation with the responsible DOT&PF hydraulics engineer.

Minimum requirements for Summary Hydraulic Reports are included in Chapter 4 of the AHDM.

1120.6.10. Hydrologic and Hydraulic Summary

Include a Hydrologic and Hydraulic Summary Table in the plans as follows:

1. For bridges – on the site plan sheet
2. For floodplain encroachments – on the applicable plan and profile sheet. If the encroachment spans more than one sheet, place the summary on the sheet where the encroachment begins.
3. For culverts – in a summary table, culvert detail sheet, or on the plan and profile sheet as follows:
    a. All culverts 48 inches in diameter or greater
    b. Any multiple culvert installation that has a total high water flow of 500 cubic feet per second (cfs) or greater for an exceedance probability of 2 percent (Q50)
    c. All culverts smaller than 48 inches in diameter for which a hydraulic analysis has been performed

Minimum requirements for the Hydrologic and Hydraulic Summary are included in Chapter 4 of the AHDM.

1120.6.11. Minor Structure - Culverts

Minor structure culverts are culverts with a span, combined or single, from 10 feet to 20 feet. Provide a signed and sealed final design for all minor structures for incorporation into the Final PS&E package for construction. Provide a copy of the structural and hydraulic calculations to the Bridge Section upon request.

Reference Chapter 21 of the ABSM for additional requirements.

1120.7. Turnouts

1120.7.1. Types

Truck Emergency Turnout: This is a widened shoulder area that is used at locations where frequent truck stops are anticipated or experienced. Typically these turnouts are provided at the beginning of passes to install tire chains or at the top of steep grades to check brakes.

Slow Vehicle Turnout: A widened shoulder area provided for slow moving vehicles to pull over without stopping to allow a queue to pass. Generally, two-lane highways with substantial recreational vehicle traffic and limited passing opportunities can benefit from these turnouts.

Scenic Turnout: This is a widened shoulder area or a separated turnout for the motorist to stop to view a point of interest. Anticipated stays are short and rest facilities generally are not provided.

Rest Area: This is a separated turnout to provide breaks for motorists. Convenience and comfort facilities may be provided.

1120.7.2. References

Figures 1120-2 through 1120-5 are examples of minimum recommended scenic turnouts and rest areas. Geometric, geomorphic, and environmental conditions generally dictate a custom design. References available for rest area design are provided below:

- *A Guide for Development of Rest Areas on Major Arterials and Freeways*, AASHTO, 2001
- *A Guide for Transportation Landscape and Environmental Design*, AASHTO, 1991
- FHWA-IP81-1, *Safety Rest Areas: Planning, Location and Design*, FHWA, 1981
- FHPM 6-2-5-1 *Landscape and Roadside Development*
- RD-77-07 *Waste Water Treatment Systems for Safety Rest Areas*, FHWA, 1977

1120.7.3. Accessibility

Scenic turnouts and rest areas and any included facilities must be accessible in accordance with the ADA Standards for Transportation Facilities.

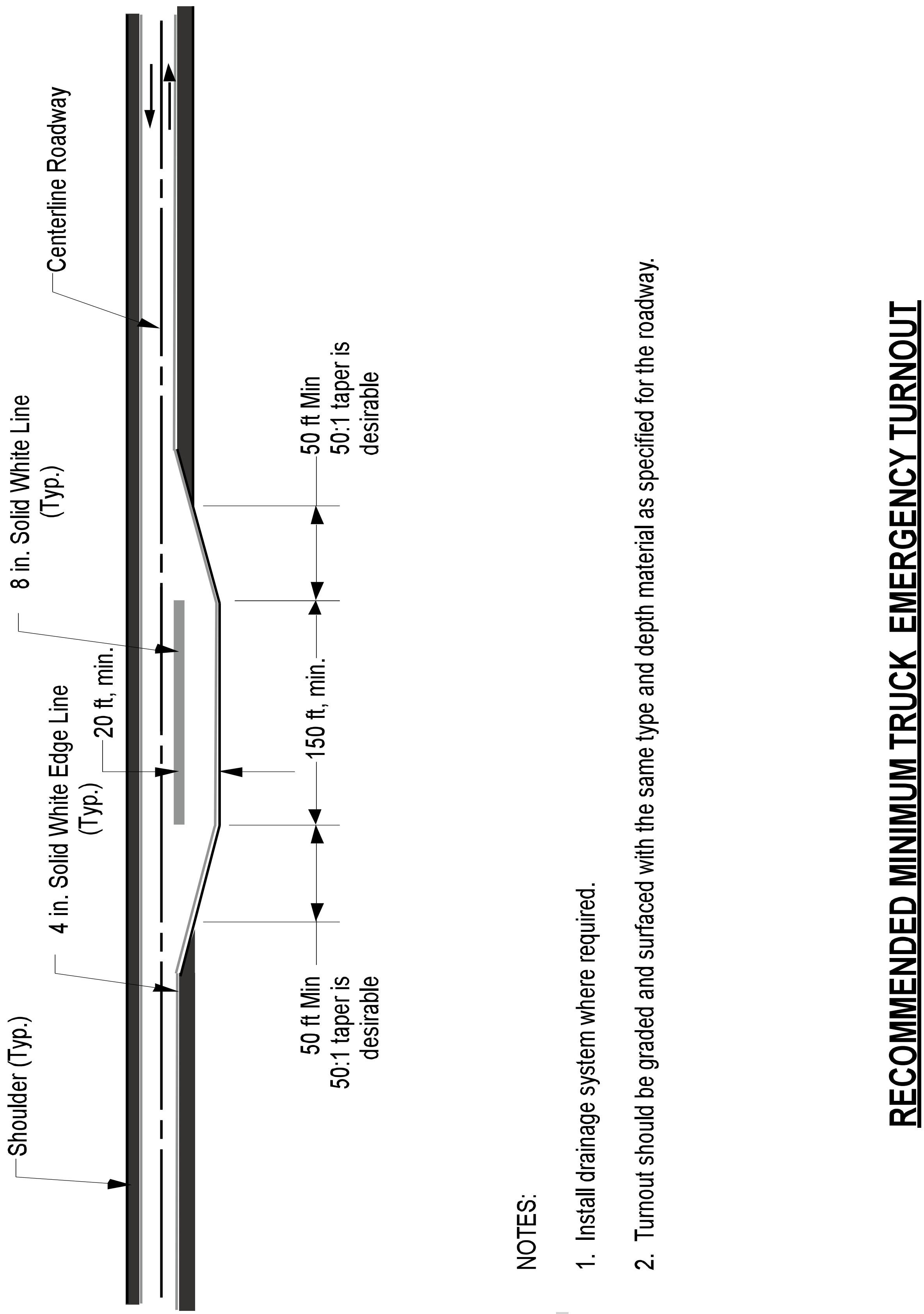
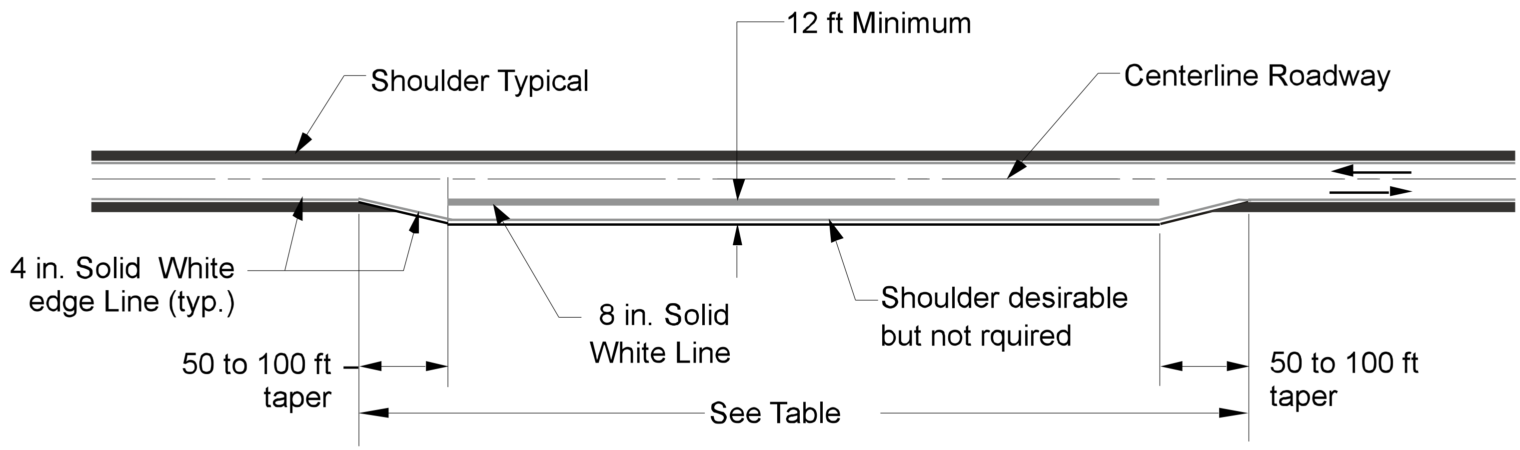


Figure 1120-2
Recommended Minimum Truck Emergency Turnout



APPROACH SPEED (mph) OF SLOW VEHICLE	MINIMUM LENGTH (ft) *
25	200
30	200
40	300
45	350
50	450
55	550
60	600

* Maximum Length should be 1250 ft where opportunities exist.

SIGNS

See Alaska Sign Design Manual for applicable signs.

See the Alaska Traffic Manual for sign placement.

SLOW VEHICLE TURNOUT FOR RURAL TWO LANE ROADWAYS

Figure 1120-3
Slow Vehicle Turnout for Rural Two-Lane Roadways

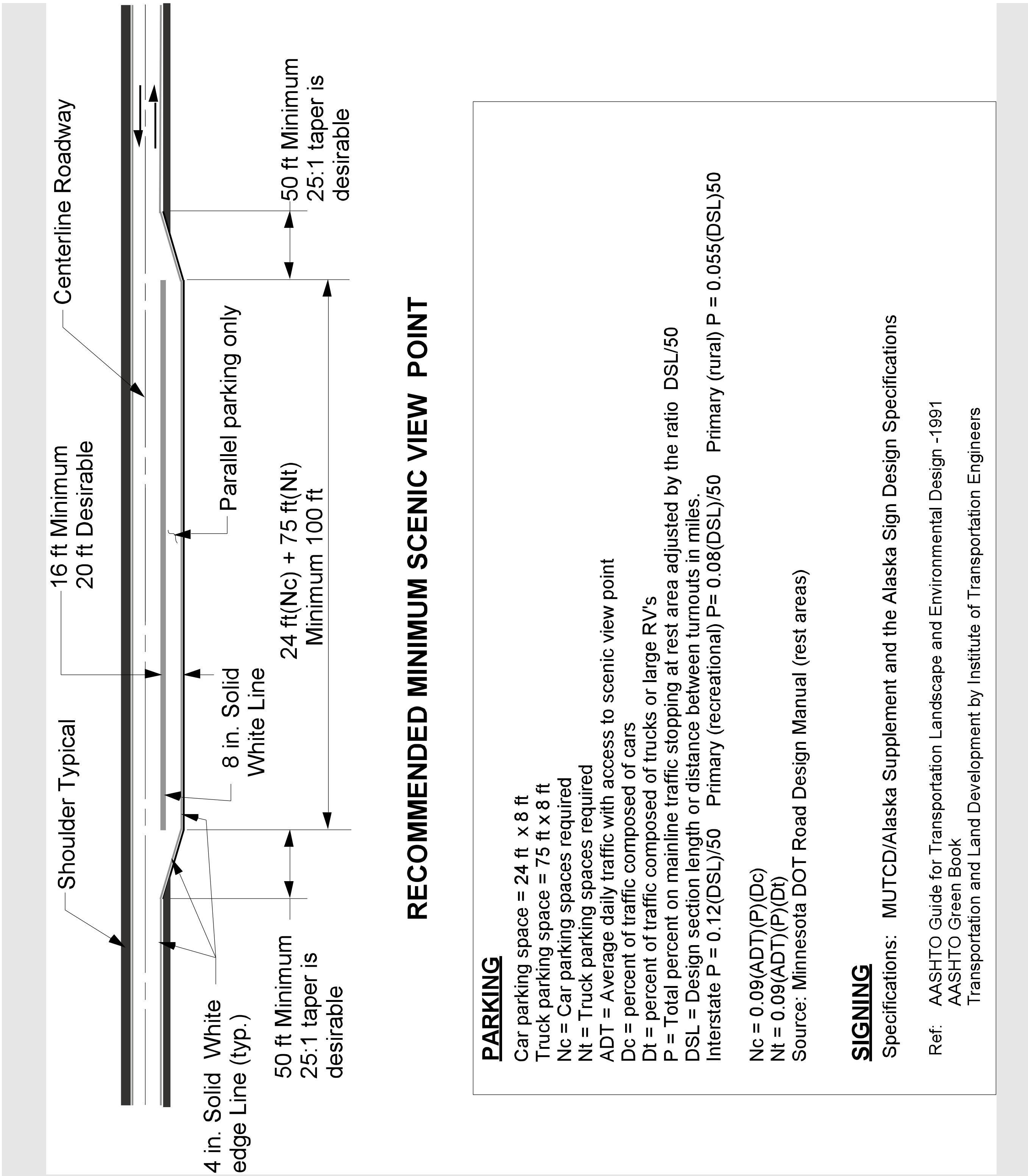


Figure 1120-4
Recommended Minimum Scenic Viewpoint

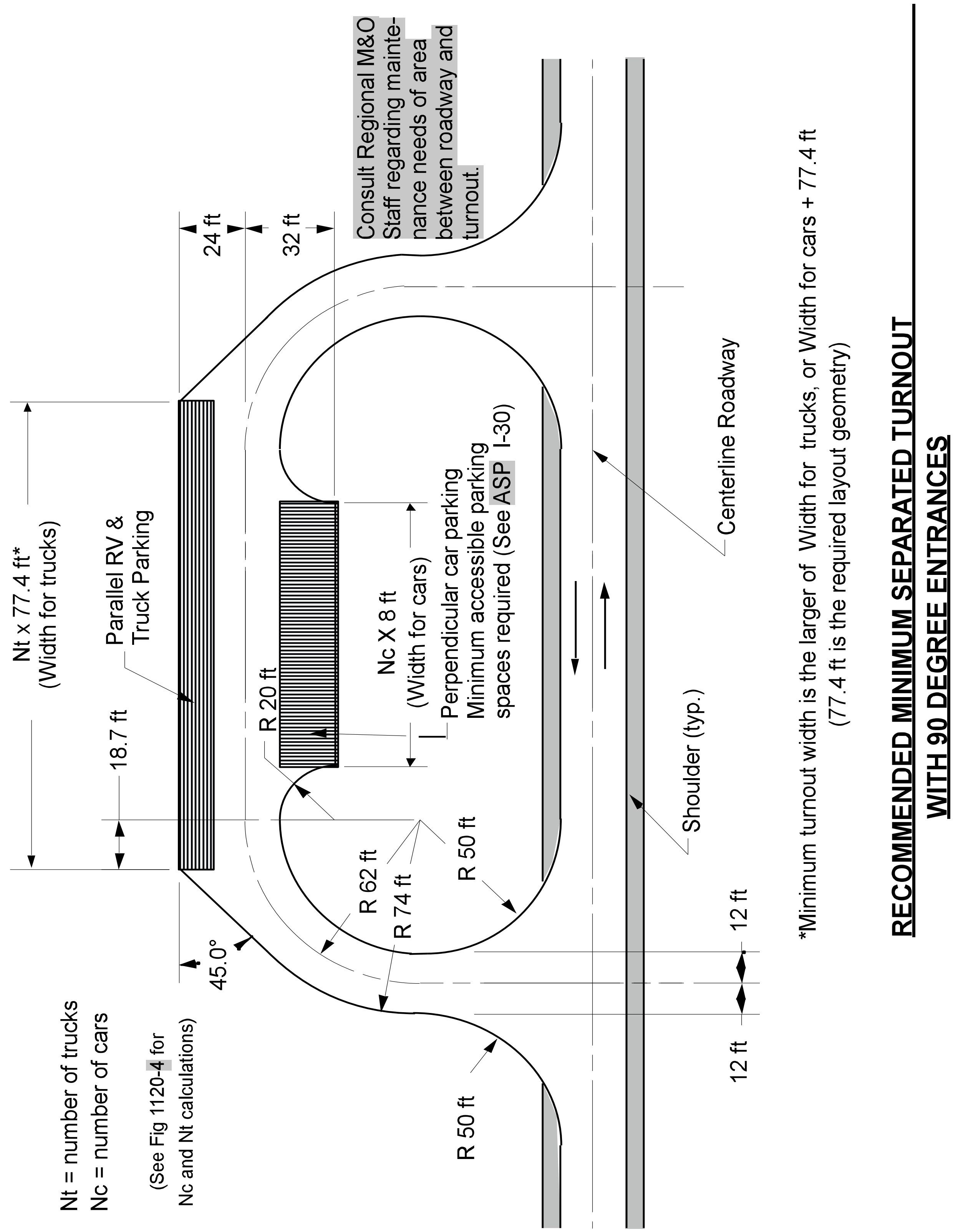


Figure 1120-5
Recommended Minimum Separated Turnout With 90-Degree Entrances

1120.8. Erosion & Sediment Control Plans (ESCPs)

1120.8.1. Background

Water pollution in the U.S. is regulated under the Federal Water Pollution Control Act of 1972, now referred to as the Clean Water Act (CWA). Eroded sediment from construction sites that discharges into waters of the U.S. is considered pollution.

Section 402 of the CWA provides the legal basis for the Alaska Pollutant Discharge Elimination System (APDES) permit program. The Department conducts construction activities under APDES permits, primarily, the DEC Construction General Permit (CGP). The CGP requires a site-specific erosion control plan for construction activities.

DEC assumed the issuance, inspection and enforcement of all storm water permits from the EPA on November 1, 2009.

23 CFR 650 Subpart B states that:

> *" . . . all highways funded in whole, or in part under title 23, United States Code, shall be located, designed, constructed and operated according to standards that will minimize erosion and sediment damage to the highway and adjacent properties and abate pollution of surface and ground water resources."*

Construction contractors developing a Storm Water Pollution Prevention Plan (SWPPP) as required by the CGP, must receive sufficient information and guidance in the contract documents to prepare a well-conceived, cost effective SWPPP. The purpose of an Erosion and Sediment Control Plan (ESCP) is to provide this information.

1120.8.2. ESCP Policy

Develop an ESCP for all projects with disturbed ground that meet either of the following conditions:

- Owned by the Department, or
- Designed (or design administered by) and constructed (or construction administered) by the Department

Utility Relocations - There are three types of utility relocation:

1. **Concurrent Relocation** - When the utility construction work happens at the same time as the highway construction.
2. **Partial Advance Relocation –** When the utility construction work starts prior to the highway construction project.
3. **Complete Advance Relocation –** When all of the utility construction work is complete prior to award of the highway construction project.

All utility relocation projects require an ESCP. Types 1 and 2 generally have the ESCP developed in conjunction with the highway project's ESCP. For type 3, a specific stand-alone ESCP must be developed for the utility relocation project.

1120.8.3. ESCP Development

Develop the ESCP early and in collaboration with Construction and the environmental analyst. An ESCP can consist of the following components:

- Plan sheets
- *Alaska DOT&PF Standard Specifications for Highway Construction* (SSHC)
- Special provisions
- Narrative (as an Appendix to the contract document or notes on the ESCP sheets)
- SWPPP template pre-filled to extent possible

Show permanent Erosion and Sediment Control (ESC) features, including final stabilization, on the roadway plan and detail drawings. These drawings are sealed and signed in accordance with 12 AAC 36.185.

Show temporary ESC features and construction phasing in the ESCP drawings, if known, and reference permanent ESC features identified elsewhere in the plans and specifications. ESCP drawings are intended to be modified by the construction contractor in preparation of his SWPPP. Do not seal ESCP drawings.

Develop the ESCP with the DOT&PF SWPPP Template format and content in mind. Designers should prepare a draft electronic copy of the project-specific SWPPP by populating the DOT&PF SWPPP Template with data, as appropriate, from the project design.

Provide a copy of the initial electronic DOT&PF SWPPP Template to Construction who will provide it to the construction contractor to assist in developing their SWPPP.

Use Chapter 16 of the *Alaska Highway Drainage Manual* (AHDM) for:

- Fundamentals of erosion control
- Guidance and technical principals for controlling erosion
- Preparation and requirements of an ESCP

ESCP preparers are allowed to use other recognized resources for selection and application of temporary and permanent Best Management Practices (BMPs), such as:

- Alaska DOT&PF SWPPP Guide
- Alaska Storm Water Guide
- EPA National Menu of Stormwater BMPs
- Other state DOT or municipal stormwater/BMP manuals

Do not use Appendix B of Chapter 16 in the *AHDM* for seed mixes. Use the following revegetation resources instead:

- Alaska Department of Natural Resources (DNR) *"A Revegetation Manual for Alaska"* – 2008 updated version
- DNR's "*Alaska Coastal Revegetation and Erosion Control Guide"*, if located in a coastal area.
- DNR's "*Interior Alaska Revegetation & Erosion Control Guide"*, if located in the interior of the state.

The AHDM is found here:

www.dot.state.ak.us/stwddes/desbridge/pop_hwydrnman.shtml

The DNR manuals are located here:

http://plants.alaska.gov/

1120.8.4. Payment for Erosion, Sediment, and Pollution Control

Include the following pay items (refer Section 641 of the SSHC on all projects with ESC work:

- 641.0001.0000- Erosion, Sediment, and Pollution Control Administration.
- 641.0002.0000 or 641.0003.0000- Temporary Erosion, Sediment, and Pollution Control (contingent sum or lump sum payment – use one or the other, not both).
- 641.0006.0000- Withholding

Every project should contain the combination of:

- 641.0001.0000, 641.0002.0000, and 641.0006.0000 or
- 641.0001.0000, 641.0003.0000, 641.0004.0000, and 641.0006.0000 pay items.

Pay items 641.0005.0000 and 641.0007.0000 should be added at the discretion of the designer or regional policies.

The project's temporary and permanent ESC items can be paid for under:

- Pay items 641.0002.0000 through 641.0005.0000
- SSHC pay items outside of Section 641
- Items established by special provision.

1120.9. Nondomestic Wastewater Systems

1120.9.1. Background

The Alaska Department of Environmental Conservation (DEC) has defined storm water runoff from highways as nondomestic wastewater. By Alaska Code (18 AAC 72.600), DEC must review and approve any project that constructs, alters or modifies (an existing), or operates any part of a nondomestic wastewater system.

1120.9.2. Policy

Ensure DEC review and approval of projects with certain types of nondomestic wastewater systems prior to certifying and advertising projects. If the project does not require a review, either by exemption (see 1120.9.4) or as determined by consultation with DEC, include documentation in the contract documents.

1120.9.3. Design

Consult the Alaska Highway Drainage Manual (AHDM) for guidance on design of storm water elements and systems.

Refer to Chapter 15 – *Surface Water Environment* – of the *AASHTO Model Drainage Manual* for design guidance on treatment systems for removing water pollutants of concern such as:

- Sediment, including turbidity
- Hydrocarbons
- Heavy metals
- De-icing chemicals and other toxic contaminants
- Nutrients (BOD)
- Pathogenic organisms, or
- pH

Use regional hydraulics expertise as necessary.

1120.9.4. DEC Review Submittal

Where applicable, submit storm water system plans to DEC for review and approval prior to construction.

Certain types of wastewater treatment features require a review, including:

- Detention or retention ponds
- Constructed wetlands
- Wet ponds
- Sand filters
- Oil/grit separators
- Rotational flow separators
- Other similar treatments controls

Information regarding the DEC Engineering Plan Review of storm water systems is found at:

https://dec.alaska.gov/water/wastewater/stormwater/

Note that Plan Review Checklist found at the link above must be completed and submitted with the stormwater plans.

Plan review fees are listed at 18 AAC 72.955.

DEC typically gives approval by a "Letter of Non-Objection." Include this letter in an appendix of the contract documents.

1120.10. ADA Accessibility

Transportation facilities and their appurtenances constructed in public right-of-ways are required to accommodate those with disabilities. These disabilities include, but are not limited to; limited mobility, impaired vision, and impaired hearing.

Design all new construction to meet the ADA Standards for Transportation Facilities:

https://www.access-board.gov/files/ada/ADAdotstandards.pdf

For reconstruction and 3R projects, all new and reconstructed pedestrian facilities must meet the referenced ADA Standards.

For ADA upgrade requirements on Preservation Projects, see Section 1140.

1130. Cross Sections

1130.1. Roadway Surfaces

1130.1.1. Vertical Clearance

Provide vertical clearances conforming to Table 1130-1.

1130.1.2. Cross-Slopes (See Figure 1130-1)

1. Two-lane and wider two-way undivided roadways on tangents should be crowned on the centerline dividing traffic flow. Traveled ways should slope downward from the crown to the outside edges in a plane surface at a slope not flatter than 2.0% for paved surfaces and not flatter than 3.0% for unpaved gravel surfaces.

2. One-way traveled ways on tangent divided roadways with two lanes may slope downward from the median or left edge of the traveled way in a single plane at a slope no flatter than 2.0% or may be crowned as in two-lane, two-way undivided roadways. We suggest that you use a crowned section if you anticipate future widening. Crown one-way traveled ways on tangent divided roadways with three lanes or more with slopes not flatter than 1.5%.

3. On all superelevated sections where the rate of cross-slope exceeds the normal shoulder rate, the superelevated rate should be carried across the entire shoulder area. If superelevation is not carried across the full shoulder width due to site specific constraints the algebraic difference in slopes shall not exceed 8 percent.

1130.1.3. Superelevation

Use guidance provided in the AASHTO *A Policy on Geometric Design of Highways and Streets* (GB) for superelevation design on new construction and reconstruction projects on urban, rural and all low-volume roads unless otherwise directed in this section.

The superelevation rate is limited to 6.0% maximum due to icing of roadways. 4.0% maximum superelevation may be warranted in some conditions, such as signalized intersections.

Superelevation Rates, ADT >2000

Use the GB to determine acceptable superelevation rates for normal superelevation conditions.

Superelevation Rates for

- Local Roads with ADT ≤ 2000
- Collector Roads with ADT < 2000 that primarily serve drivers who are familiar with the roadway

You may use the AASHTO Guidelines for Geometric Design of Low-Volume Roads (GDLVR) or the GB to determine acceptable superelevation rates for normal superelevation conditions.

1130.1.4. Lane and Shoulder Widths

New Construction and Reconstruction

For projects on the National Highway System (NHS) use the roadway widths presented in the GB as minimum design criteria.

On unpaved roads off the NHS and local roads with design ADTs less than 2,000, use the lane and shoulder widths shown in the GDLVR.

For all urban roads use the roadway widths presented in the GB as minimum design criteria.

1130.2. Roadside Geometry

1130.2.1. General

This Subsection applies to new construction and reconstruction. Section 1160 applies to 3R projects.

The term “clear zone” is used to designate the unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. The clear zone distance is a function of traffic volumes, speed, and roadside geometry. The speed used to determine the clear zone distance should be the design speed. The general design procedure using the clear zone concept consists of:

1. Determine the suggested clear zone distance
2. Identify obstacles in the clear zone

3. Determine alternative treatments for obstacles within the clear zone. Except where modified by Sections 1130.2, 1130.3, and 1130.4, discussions, graphs, figures, and examples from the *AASHTO Roadside Design Guide* (RDG) should be the basis of roadside design. Section 1130.6 presents a method for evaluating and selecting treatment alternatives.

1130.2.2. Lateral Offset

In urban or restricted environments it may not be practical to establish a clear zone using the guidance in Chapter 3 of the RDG. In these instances, use the guidance provided in Chapter 10 of the RDG to establish a lateral offset to obstructions.

Characteristics of urban and restricted environments that preclude development of a full clear zone include, but are not limited to: lower operating speeds, limited rights-of way, curb and gutter, sidewalks, on-street parking, non-motorized and transit users, closely spaced intersections and driveways, and dense abutting development.

1130.2.3. Clear Roadside Concept

The Clear Zone Concept

It is desirable to provide a roadside clear of obstacles for a distance related to speed, traffic volume, and geometric conditions of the site. Provide clear zone or cost-effective alternative obstacle treatment for all new construction and reconstruction designs.

Clear Zone Distance

Use guidance in Chapter 3 of the RDG for selection of clear zone distances. Use Table 3-1 of the RDG, as modified below, to establish suggested clear zone distances for various combinations of design speeds, design ADTs, and roadside geometry. The suggested clear zone distances are measured from the edge of travelled way and include shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes.

Modifications to Table 3-1 of the RDG:

1. Clear zones are limited to 30 feet for practicality and economy. Consider increasing the clear zone where a specific site investigation or engineering judgment indicate that an area has a higher probability of crashes and high severity conditions are present beyond 30 feet.

Where there are through-auxiliary lanes see Section 3.3.6 of the RDG.

Treatment of Roadside Obstacles

Design alternatives for reducing roadside obstacles in order of preference are as follows:

1. Remove the obstacle
2. Redesign the obstacle so that it is traversable.
3. Relocate the obstacle to a point where it is less likely to be struck.
4. Reduce the impact severity by using an appropriate breakaway device. Use breakaway devices meeting MASH requirements or have approved eligibility determinations under the roadside hardware eligibility program.
5. Shield the obstacle with a longitudinal traffic barrier designed for redirection, or a crash cushion.
6. Delineate the obstacle if the previous alternatives are not appropriate.

Evaluate the alternatives by using the cost-effective analysis procedures in Section 1130.6 where warranted.

Culvert Ends in Clear Zone

Refer to Chapter 3 of the RDG for treatment of obstacles and traversable features, including approach culvert ends and cross slope pipe ends.

Standard Plans D-42, 43, 44, and 45-show Type C and D inlets, which have traversable designs. Verify hydraulic capacity will meet design flows before using in the project design. Other treatments are described in Sections 3.4.2, 3.4.3, and 3.4.4 of the RDG.

Trees in the Clear Zone

Remove all trees greater than 4 inches in diameter, or those that are likely to be greater than 4 inches in diameter at full maturity, from the clear zone unless there are unusual circumstances—for example, an eagle nesting tree, or the existence of cost-effective alternate treatments.

If clear zone is not provided, evaluate the trees using cost-effective analysis in Section 1130.6 to determine the appropriate treatment.

1130.2.4. *Clear Zones on Horizontal Curves*

Designers may consider increasing the clear zone distance on the outside of horizontal curves. This should be done when (1) crash histories indicate such a need,-and (2) increases are cost-effective.

Use Table 3-2 of the RDG for horizontal curves clear zone adjustment factors.

1130.2.5. *Clear Zones on Slopes Steeper Than 4:1*

Where embankment slopes are steeper than 4:1, but equal to or flatter than 3:1, a vehicle is considered to have the ability to traverse that slope but not recover. Slopes steeper than 3:1 are not considered traversable and should be treated as obstacles.

In short, the recovery area is the required clear zone plus the horizontal distance occupied by slopes steeper than 4:1. Do not use slopes steeper than 4:1 as part of the clear zone. For additional guidance on traversable slopes, see Section 3.2 of the RDG. The clear runout area shown in the RDG should have a desirable minimum width of 10 feet.

1130.3. Sideslopes, Roadway Sections and Drainage Channels

1130.3.1. *Transverse Sideslopes*

Refer to the RDG*,* Section 3.2.3 Transverse Slopes, for guidance in designing transverse slopes within the clear zone.

1130.3.2. *Roadway Sections*

Roadway sections should reflect the clear roadside concept. Provide recoverable slopes within the clear zone unless more cost-effective alternatives are used or site constraints prohibit.

1130.3.3. *Ditches and Drainage Channels*

Figure 1130-3 shows recommended ditch section in rock slopes. The recommended rock excavation section uses the additional consideration of trapping falling debris by dissipating kinetic energy prior to reaching the traveled way.

The RDG presents traversable channel configurations and design considerations.

Examples of slope averaging and ditch section calculations with regard to clear zones are shown in Chapter 3 in the RDG. In some circumstances, these recommended sections will not be adaptable to certain design demands. Use the cost-effective analysis procedures in Section 1130.6 to analyze other designs.

1130.4. Mailboxes

Mailboxes are generally found in the clear zone and, to maintain mail service, they usually cannot be relocated outside of the clear zone. Although a mailbox and the supporting structure are obstacles, you can reduce the severity of impact to an acceptable level.

See Chapter 11 of the RDG for guidance on installing mailboxes on streets and highways. Also see the Alaska Standard Plans Manual for approved details on locating, installing, mounting and anchoring mail boxes.

Table 1130-1
Vertical Clearance Requirements

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="7">Overpassing Facility</th></tr>
<tr><th>State Hwy</th><th>Local Roads or Streets</th><th>Rail-road</th><th>Ped. Structures</th><th>Bottom of Signals</th><th>Sign Bridges</th><th>Overhead Utilities [1,3]</th></tr>
<tr><td rowspan="4">Underpassing Facility</td><td>State Hwys and local roads or streets NOT between the port of Alaska in Anchorage and the North Slope[6]</td><td colspan="3">17.5 ft</td><td>17.5 ft</td><td rowspan="2">18.5 ft [5]</td><td rowspan="2">18.5 ft</td><td rowspan="2">20.0 ft * New Const.[3]

18.0 ft * Existing [3]</td></tr>
<tr><td>State Hwys and local roads or streets from the port of Alaska in Anchorage to the North Slope[6]</td><td colspan="4">18.5 ft</td></tr>
<tr><td>Railroad [4]</td><td colspan="7">24.0 ft *</td></tr>
<tr><td>Pedestrian Facility</td><td colspan="7">8.5 ft</td></tr>
</table>

**Value does not include 6-inch allowance.*

Notes:

1. Provide minimum vertical clearances for the entire right-of-way surface in accordance with this table.
2. All clearance height values identified in the table include a 6-inch allowance for future resurfacing of the roadway, except those noted with an asterisk.
3. These overhead utility vertical clearances are codified in *17 AAC 15.201 (a) & (b)*. Overhead utility vertical clearances for new construction may be greater if required by *17 AAC 15.201 (1981 National Electric Safety Code)*. DOT&PF projects and relocations should strive for an additional 6" of clearance to provide for future overlays.
4. For further guidance on overhead railroad crossings, refer to the *AARC Technical Standards for Roadway, Trail and Utility Facilities in the AARC Right-of-Way*
5. In the event of a conflict between this manual and a Standard Plan the manual controls.
6. Check regional guidance for specific route vertical clearance needs that exceed the values indicated in the table.

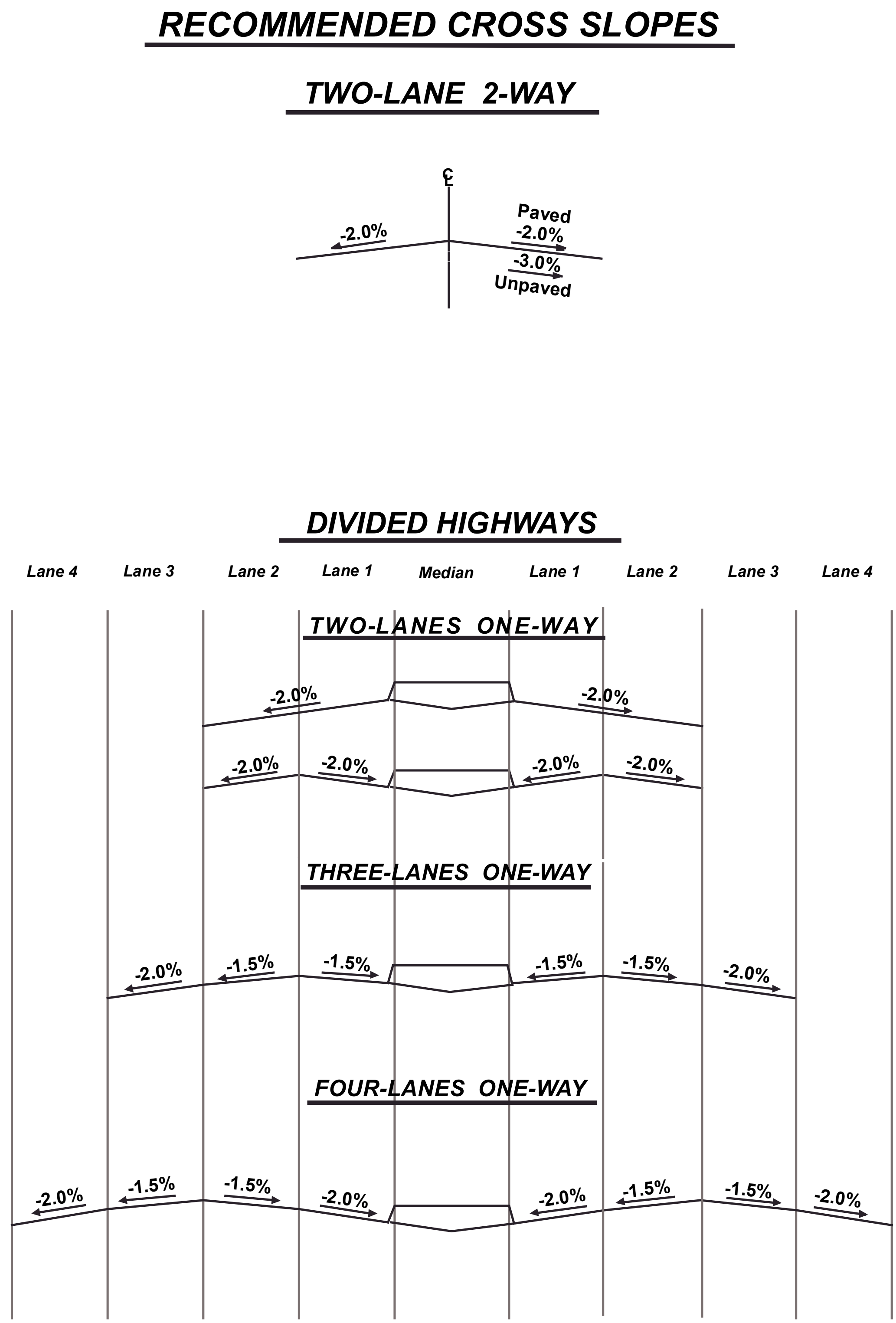


Figure 1130-1
Recommended Cross Slopes

1130.5. Roadside Barriers

1130.5.1. Introduction

There are three categories of barriers commonly used on Alaska roadways: flexible, semi-rigid, and rigid. These can serve as less severe obstacles that redirect traffic from impacting more severe hazards. Strong post w-beam guardrail (semi-rigid) is the most common longitudinal barrier, though concrete barrier (rigid), weak post box-beam (semi-rigid), weak post cable (flexible) and other types of solutions are available to meet site-specific needs. Guidance on performance, design concepts, and selection of roadside barriers is provided in Chapter 5 of the RDG.

End treatments are used at the ends of roadside barriers to provide one or more of the following functions: anchor the barriers, lessen the severity of impacts with the end of the barriers, and bring an errant vehicle to a controlled stop. There are a wide variety of end treatments available, and they generally fall into one of the following categories: anchorages, terminals, and crash cushions. Guidance on performance, design concepts, and selection of end treatments is provided in Chapter 8 of the RDG.

Because no policy can address every real-world condition, temper these guidelines with engineering judgment. See Figure 1130-5 for guidance in evaluating when barrier use is appropriate. Installing barrier is fifth in the order of precedence for treating roadside obstacles. In general, if removing the obstacle and barrier installation are similarly cost-effective, it is preferred to remove the obstacle.

1130.5.2. Guardrails

General

Barriers shall comply with MASH, but may be increased to higher test levels as discussed in RDG Section 5.3.

Guardrail Warrants for Embankments

The primary highway factors contributing to embankment crash severity are the height and slope of the embankment. The embankment height comprises the height of a fill, a natural hillside, or a combination of both. An “embankment” can also be a cut if the subject road exists at the top of that cut.

A cost-effective analysis may be used to determine if guardrail is not warranted (see Section 1130.6.).

Where cost-effective, the flattening of warranting slopes is preferable to guardrail installation.

Guardrail Warrants for Roadside Obstacles

Roadside obstacles may be classified as non-traversable or fixed objects.

Longitudinal Non-Traversable Obstacles

Examples of longitudinal non-traversable obstacles that may warrant guardrail are:

- Rough rock cuts
- Permanent bodies of water over 3’ deep
- Drop-offs with slopes steeper than 3:1

Because of the extended length of the obstacles along the roadway, the probability of an errant vehicle striking the non-traversable obstacles is greater than that of a vehicle hitting a fixed object.

Fixed Objects

Examples of fixed objects that may warrant guardrail are:

- Bridge piers and abutments
- Retaining walls
- Fixed sign bridge supports
- Trees
- Approach roadway embankment

For clear zone distances, see Subsection 1130.2.3 and 1130.2.4.

Length of Need

Length of need is equal to the length of guardrail needed to shield the obstacle plus a length in advance to prevent vehicle penetration behind the rail into the obstacle. The obstacle may be a fixed object such as a tree, or a longitudinal area such as a roadway section with non-traversable slopes.

Where slopes beyond the graded shoulder are flat enough (see Guardrail Position Requirements: Guardrail Beyond Shoulder Edge), locate the guardrail as far away from the graded shoulder as possible to minimize this length of need, but with adequate clearance for guardrail deflection. In the more common instances, where slopes are steeper, the guardrail will run along the shoulder.

Section 5.6.4 of the RDG discusses length-of-need considerations. Figure 5-39 in the RDG illustrates the variables that should be considered in designing a roadside barrier to shield an obstruction effectively. The primary variables are (1) the lateral extent of the area of concern, and (2) the runout length. Use Table 5-10(b) for runout lengths.

For additional information on calculating the length of need, as shown in Figure 1130-2,-refer to the RDG.. The assumption of a specific encroachment angle to determine a length of barrier, as mentioned in the RDG, is not an approved method for DOT&PF.

Guardrail Position Requirements

Guardrail Beyond Shoulder Edge: At fixed objects, it is best to locate guardrail as far away from the travelled way as practical to maximize recovery area and minimize the length of need. Adequate deflection space must be allowed between the guardrail and the object (See Chapters 5 & 6 of the RDG for deflection data.) For roadside barriers installed on foreslopes steeper than 10:1, see Section 5.6.2.2 of the RDG for guidance.

Guardrail Back of Curb: Curbs in front of guardrail should be avoided where possible. Where no alternative is available, refer to the RDG Sections 3.4.1 and 5.6.2.1 for additional guidance on the design of traffic barriers near curbs.

Bridge Approaches: Guardrail at bridge approaches shall have appropriate transitions to alleviate pocketing for impacts just in front of the abutment or bridge rail ends. Generally, embankments at bridges are steep and may also warrant guardrail protection.

Gaps Between Warranting Features: Avoid gaps in guardrail less than 200 feet where possible to minimize guardrail endings, which are obstacles.

Road Approaches, Driveways, and Turnouts: See Section 5.6.6 (*Guardrail Placed in a Radius)* of the RDG for guidance.

Shy-Line Offset: The distance from the edge of traveled way beyond which a roadside object will not be perceived as an obstacle and result in a motorist's reducing speed or changing vehicle position on the roadway is called the shy-line offset. This is discussed in Section 5.6.1 of the RDG. Shy-line offset is sometimes referred to as shy distance. Use the suggested shy-line offset values in Table 5-7 of the RDG where feasible.

Flare Rate: A roadside barrier is considered flared when it is not parallel to the edge of the traveled way. Flare is normally used to:

- locate the barrier terminal farther from the roadway
- minimize a driver's reaction to an obstacle near the road by gradually introducing a parallel barrier installation
- transition a roadside barrier to an obstacle nearer the roadway, such as a bridge parapet or railing
- reduce the total length of guardrail needed

Refer to Section 5.6.3 of the RDG for a discussion of flare rates. Use Table 5-9 of the RDG for suggested flare rates.

Other Guardrail Considerations

One of the problems with guardrails is they must end somewhere. It is desirable to bury the rail end in the backslope. All guardrail ends must be anchored.

All upstream guardrail ends must be crashworthy. All downstream guardrail ends must be crashworthy except:

1. On one-way roadways
2. On divided highways or two-lane roadways where the downstream end is outside the clear zone for opposing traffic

Consider using crashworthy downstream terminals outside of the opposing traffic flow's clear zone when in the engineer's judgment it is likely that there will be a higher than normal incidence of vehicle encroachment beyond clear zone.

The RDG notes strong-post guardrail exhibits better performance when allowed to rotate in soil (Section 5.6.7). Although posts in rigid foundations, such as partially or fully frozen in the ground, paved around, or in rock formations limit post rotation, Alaska has not noted a demonstrated problem with strong-post or rail performance under these conditions. Alaska does not require pavement leave-outs or other special details to allow strong post guardrail posts (W-beam, thrie beam, or thrie beam transitions), to rotate under rigid foundation conditions.

Proprietary guardrail end terminals must be installed in accordance with the applicable manufacturer's requirements.

1130.5.3. Median Barriers

The principles of guardrail usage are equally applicable to median barriers. However, median barriers additionally prevent errant vehicles from crossing the median area of divided highways and entering the opposing traveled ways. Therefore, they must be capable of containing and redirecting from two directions and on both sides.

Available median width may limit the choice of barrier. If a narrow median exists, a rigid barrier, which does not deflect into the opposing travel lanes, is necessary.

If space limitations present a borderline choice between rigid (concrete "safety shape") and semi-rigid (back-to-back blocked-out W sections) barrier, then take into account economic and other considerations for the particular site. While the concrete barrier may have a slightly higher initial cost, yearly maintenance costs of the W-section barrier may be substantially more than that of the concrete median barrier. Sloped medians may require special consideration. See the RDG.

A true median barrier usually requires a different end treatment than typical guardrail installation unless the median widens sufficiently to terminate outside the clear zones of the two roadways, in which case only structural (anchorage) considerations are mandatory.

Cable safety rail may be used as a flexible median barrier in areas where slopes are 6:1 or flatter and have enough width to accommodate an obstruction free area within the barrier's lateral deflection distance, approximately 12 feet. Coordinate placement locations with maintenance staff to ensure adequate response can be provided to reinstall following any crashes.

Operational median barrier end treatments are provided in the RDG.

Again, eliminate gaps where possible. Coordination with emergency services and enforcement agencies in the design stage may allow elimination of unnecessary emergency crossovers.

Warrants for Median Barriers

Low speed and intermediate speed urban section roadways generally do not require median barriers. Rural section intermediate speed roadways and all high-speed roadways may require median barriers. Section 6.2 of the RDG provides information on median barrier applications and warrants procedures. Median barrier warrants for rural intermediate and all high-speed roadways are shown in Figure 6.1 of the RDG.

1130.5.4. Bridge Rail Transitions

Bridge rail to guardrail transition designs are provided by the Bridge Design Section.

1130.5.5. Crash Cushions

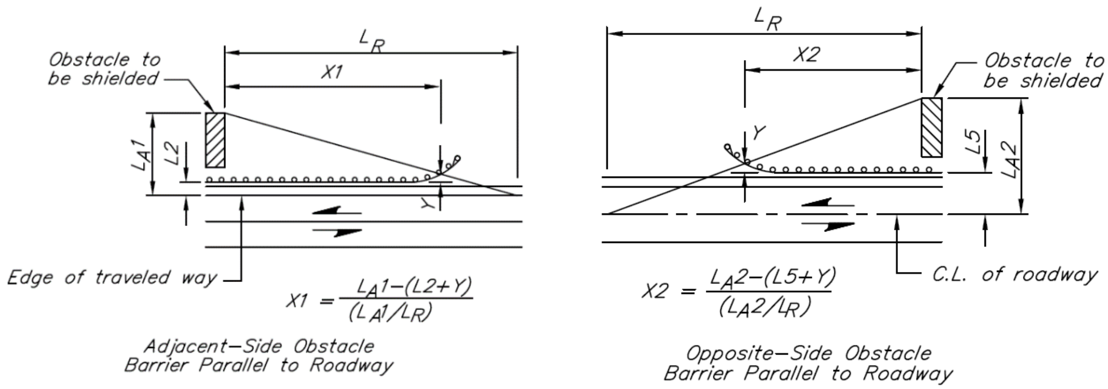
Crash cushions are sometimes used to absorb vehicle energy at a rate that is tolerable to the average, properly restrained vehicle occupant. In many cases, such as at elevated gore areas and bridge piers in medians at underpasses, they should also provide for redirection in side-angle impacts to alleviate pocketing near the fixed object.

Continuing maintenance considerations for crash cushions is extremely important. For proper performance, almost all crash cushions depend on meticulous attention to functional details during installation, routine maintenance, and post-crash replacement or rehabilitation.

Refer to Chapter 8 of the RDG for additional information about crash cushions. For areas of documented repeat impacts, consider using low maintenance or reusable crash cushions, which can be reconstructed in place. Chapter 8, Section 8.4.2.2 and Table 8-6 of the RDG have additional information, including maintenance and crash repair.

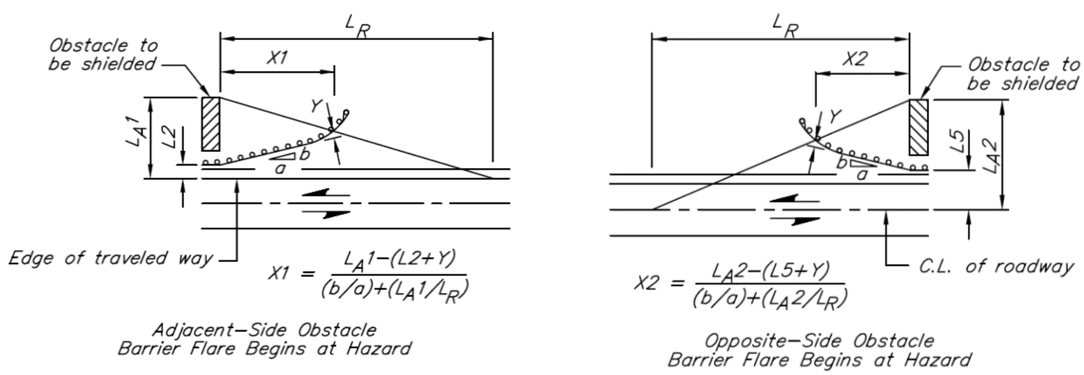
1130.5.6. Guardrail End Terminal Replacement

Replace all guardrail terminals within the project limits, unless they are currently MASH compliant.

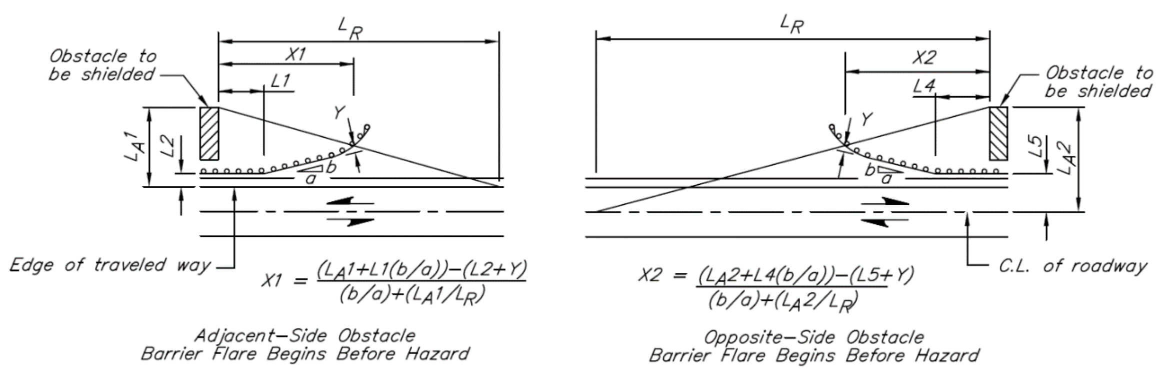


Subfigure 1130-2a

Use Figure 1130-4a for inside of curve and for outside of curve with $L_R < T$



Subfigure 1130-2b



Subfigure 1130-2c

Figure 1130-2
Barrier Advancement Length for G-4S & G-4W Beam Guardrail with Approved End Treatment

Notes on Figure 1130-2: 1. For outside of curves with $L_R \geq T$ Use Figure 1130-3

Key to the variables shown in Figure 1130-2 shown on the previous page:

L1 = Length of barrier parallel to roadway from adjacent-side obstacle to beginning of barrier flare. This is used if a portion of the barrier cannot be flared (such as a bridge rail and the transition).
L2 = Distance from adjacent edge of traveled way to portion of barrier parallel to roadway.
L4 = Length of barrier parallel to roadway from opposite-side obstacle to beginning of barrier flare.
L5 = Distance from center line of roadway to portion of barrier parallel to roadway. Note: if the obstacle is outside of the Clear Zone when measured from the center line, it may only be necessary to provide a crashworthy end treatment for the barrier if the barrier end in within the clear zone.
L_A 1 = Distance from outside edge of traveled way to back side of adjacent-side obstacle.

Note: if an obstacle extends past the Clear Zone, the Clear Zone can be used as LH1.

L_A 2 = Distance from center line of roadway to back side of opposite-side obstacle.

Note: if an obstacle extends past the Clear Zone, the Clear Zone can be used as LH2.

L_R = Runout length (measured parallel to roadway). See Table 5-10(b) of the RDG.
T = Tangent length (on inside of curve) from point of vehicle departure to obstacle.
X1 = Length of need for barrier to shield an adjacent-side obstacle.
X2 = Length of need for barrier to shield an opposite-side obstacle.
b/a = Flare rate value. See Table 5-9 of the RDG.
Y = Offset distance required at the beginning of the length of need*.

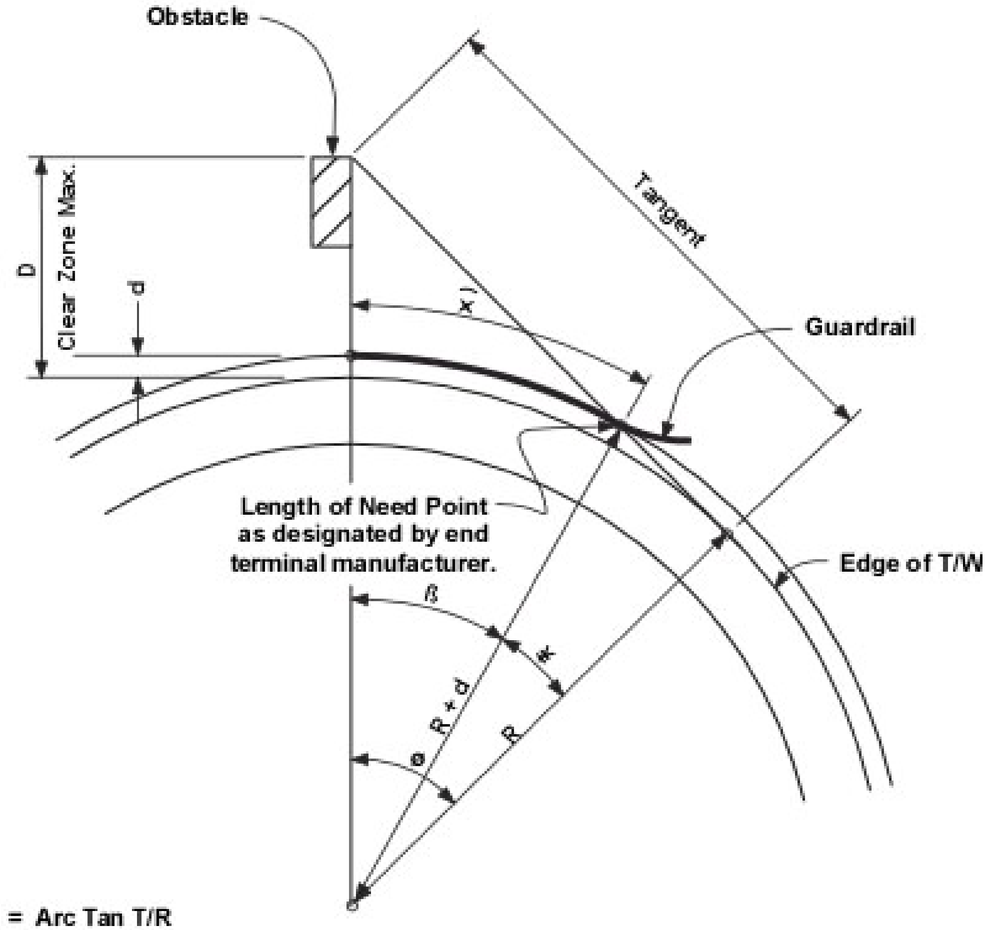
***Note: Different end treatments require different offsets.**

For existing end treatments, use the measured Y.
For other approved proprietary end terminals use the manufacturer's recommendations for Y.
No offset is required for non-flared terminals, or impact attenuator systems. Use Y = 0
Buried terminal end treatments are used with barrier flares and have no offset. Use Y = 0

TRAFFIC BARRIER ADVANCEMENT

LENGTH on OUTSIDE of HORIZONTAL CURVE

TANGENT $\leq L_R$



$\angle$ø = Arc Tan T/R

$\angle$¥ = Arc Cos R /(R+d)

$\angle$ß = ø - ¥

$\overset{\frown}{x} = \pi (R+d)$ ß/180

T = Tangent (feet), $T = \sqrt{(R + D)^2 - R^2}$

L_R = Runout Length

R = Radius to edge T/W

D = Distance from edge T/W to back of hazard = CZ x K_{cz}

Where: CZ = Clear Zone and K_{cz} = Horizontal Curve Adjustment Factor

d = distance from edge T/W to face barrier

$\overset{\frown}{x}$ = Advancement Arc Length

Flare rates are not used on horizontal curves

Figure 1130-3
Traffic Barrier Advancement Length on Outside of Horizontal Curve Tangent $\leq L_R$

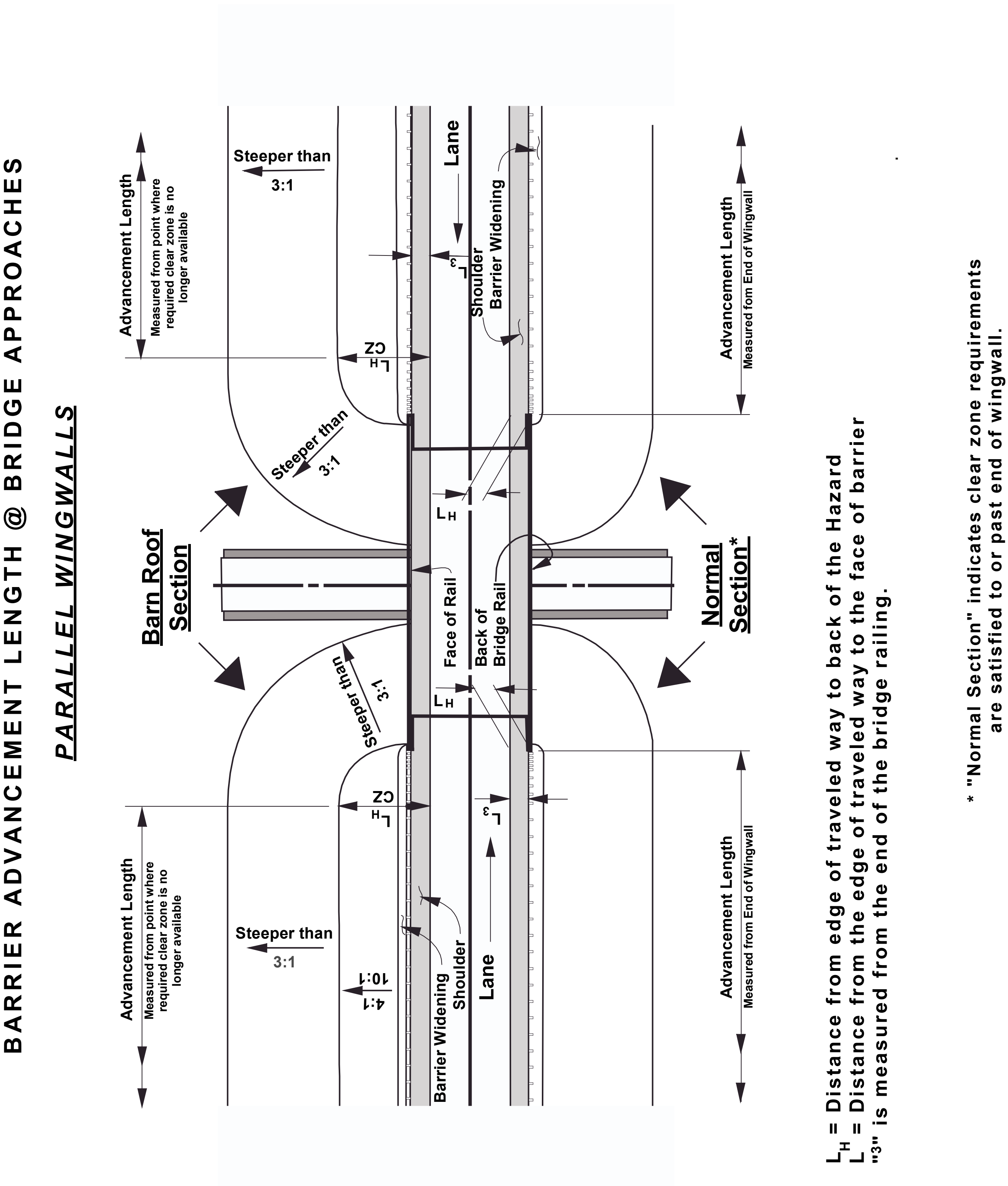


Figure 1130-4a
Barrier Advancement Length at Bridge Approaches (Parallel Wingwalls)

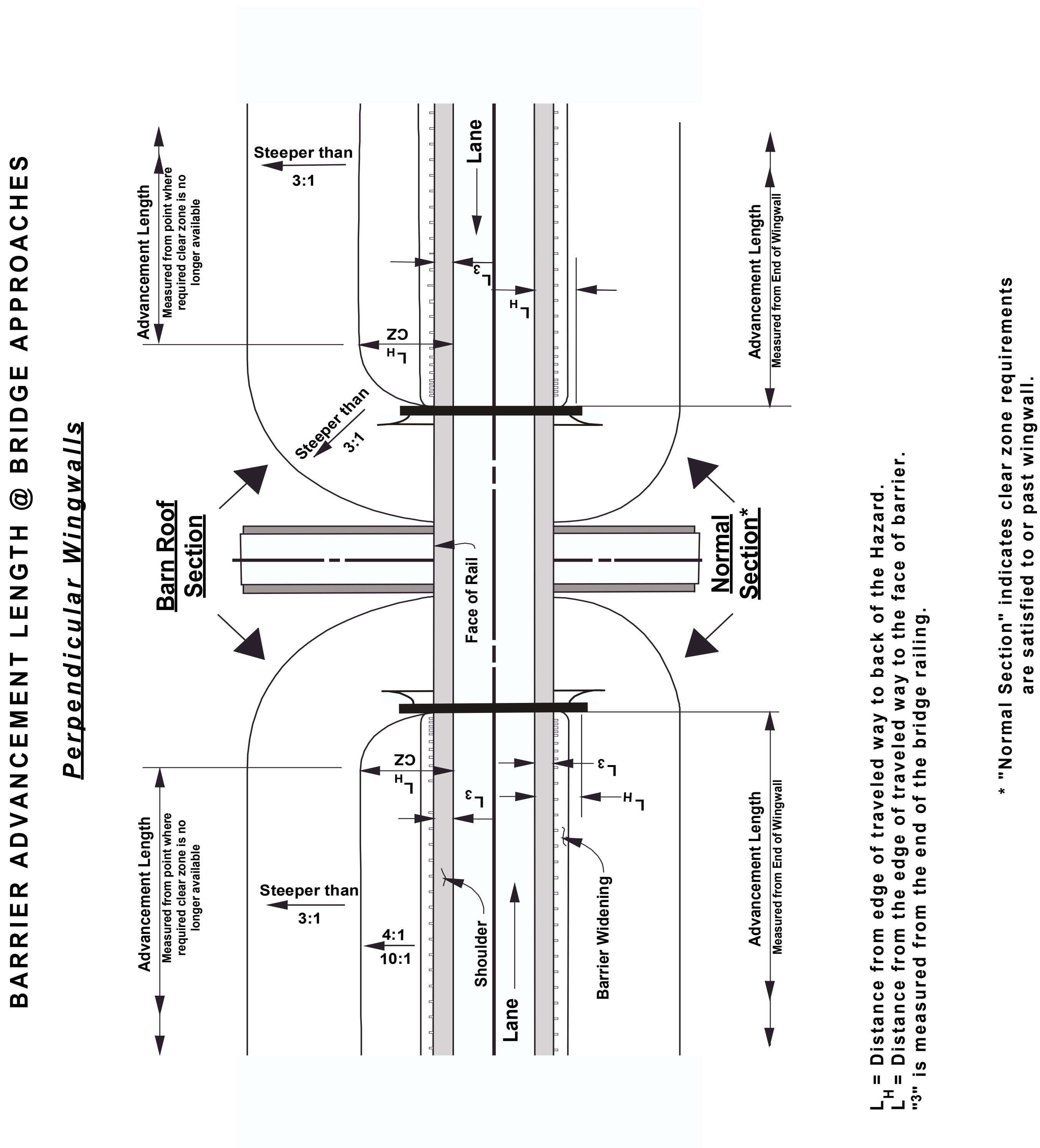


Figure 1130- 4b
Barrier Advancement Length at Bridge Approaches (Perpendicular Wingwalls)

1130.6. Cost-Effective Analysis

1130.6.1. Introduction

A cost-effective analysis (CEA) is one that compares the benefits of an improvement to the cost of that improvement. This subsection focuses on roadway improvements where costs are borne by the Department and benefits accrued by the public.

The CEA procedures presented in Subsection 1130.6 apply to engineering analyses that compare alternatives with respect to the reduction of crash costs (fatalities, injuries, and property damage) to motorists.

The CEA procedures presented here do not apply to Highway Safety Improvement Program (HSIP) projects. See the HSIP Handbook for its own specific procedures.

1130.6.2. Procedure

The procedure presented here is an overview. Consult the ROADSIDE or RSAP User's Manual for more detailed procedures. ROADSIDE and RSAP are analysis programs discussed further in this subsection.

To perform a CEA, you must estimate the costs and benefits for a given alternative. These are calculated as an equivalent uniform annual cost for the design life of the roadway improvement.

Costs

The general formula for cost is: Cost = Improvement Costs + Maintenance Costs + Accident Costs + Salvage Value, where:

- **Improvement Costs** = Construction Costs + Right-of-Way Costs + Utilities Costs.
- **Maintenance Costs** = Cost of maintaining the roadside, including repairing and maintaining obstacles that are damaged by vehicular impacts.
- **Crash Costs** = Predicted or actual costs of fatalities, injuries or property damage due to vehicles impacting obstacles or hazards.

  Costs for actual crashes come from crash reports that identify the type of crash and whether there were fatalities, injuries or property damage. These crash costs are monetized so they can be compared to the cost of the improvement.

  Actual crash data is obtained from the Department's statewide crash database. This data is reported in conformance with the Model Minimum Uniform Crash Criteria (MMUCC). Under the MMUCC crash report system, data is presented in the following format, with the corresponding KABCO value (refer to the Benefits section below) identified:

INJURY STATUS		KABCO Value
Code	Injury Description	
00	No Apparent Injury	O
01	Possible Injury	C
02	Suspected Minor Injury	B
03	Suspected Serious Injury	A
04	Fatal Injury (Killed)	K

  Predicted crash costs come from the use of an engineering analysis program, which is discussed later.

- **Salvage Value** = Value of the material or hardware at the end of its economic life. The salvage value is commonly considered zero for highway applications.

Benefits

In order to determine the benefits of a roadway improvement alternative, it is necessary to monetize the value of reducing fatalities and injuries. The benefit of preventing one fatality is quantified by the Value of a Statistical Life (VSL). The VSL is not the valuation of life as such; rather, it is the valuation in reduction of risks.

The US DOT issues the VSL number and updates it periodically. The following KABCO values are derived from the VSL:

K = Fatality = VSL
A = Incapacitating Injury
B = Non-incapacitating Injury (Evident)
C = Possible Injury
O = Property Damage

The KABCO values are used by engineering analysis programs to predict the crash costs of a given alternative or existing condition. Official KABCO values and discount rates are updated annually and published on the Design and Engineering Services Preconstruction webpage located here:

http://dot.alaska.gov/stwddes/dcsprecon/index.shtml

There are two department approved analysis programs available for predicting crash costs for roadway improvements:

- ROADSIDE
- Road Side Analysis Program (RSAP)

ROADSIDE is an engineering analysis tool that determines the benefits and costs of a given alternative under consideration. The value of ROADSIDE is its ability to predict accident rates and crash costs associated with a given roadside model. It requires input of estimated costs and modeling of the roadway segment under analysis, including cross-sectional geometry, horizontal and vertical alignment, obstacles, et.al.

ROADSIDE was included with early versions of the AASHTO Roadside Design Guide (RDG) beginning in 1989. Copies of this program and its user manual can be found on the Design and Engineering Services Preconstruction webpage located here:

http://dot.alaska.gov/stwddes/dcsprecon/index.shtml

The RSAP (Roadside Safety Analysis Program) is a roadside evaluation model that was developed under National Cooperative Highway Research Program Project 22-9 to assist designers in benefit-cost analyses. It is similar to ROADSIDE in function.

RSAP was included with the RDG (Appendix A) beginning in 2002. Copies of the current RSAP program and user manual can be found on the Design and Engineering Services Preconstruction webpage located here:

http://dot.alaska.gov/stwddes/dcsprecon/index.shtml

Designers may use either, or both, of these programs and should apply engineering judgement in interpreting the results from their use.

CEA Procedure

The discount rate, KABCO values, design life, and improvement costs need to be selected for use in the selected analysis program. In addition, the roadway alignment and cross section geometry, including roadside hardware, need to be modeled and input into the analysis program. The analysis program will compute the uniform annualized cost and benefit for each alternative under consideration and provide the benefit-to-cost (B/C) ratio.

As illustrated in Figure 1130-5, evaluation of alternatives is based on the following order of precedence:

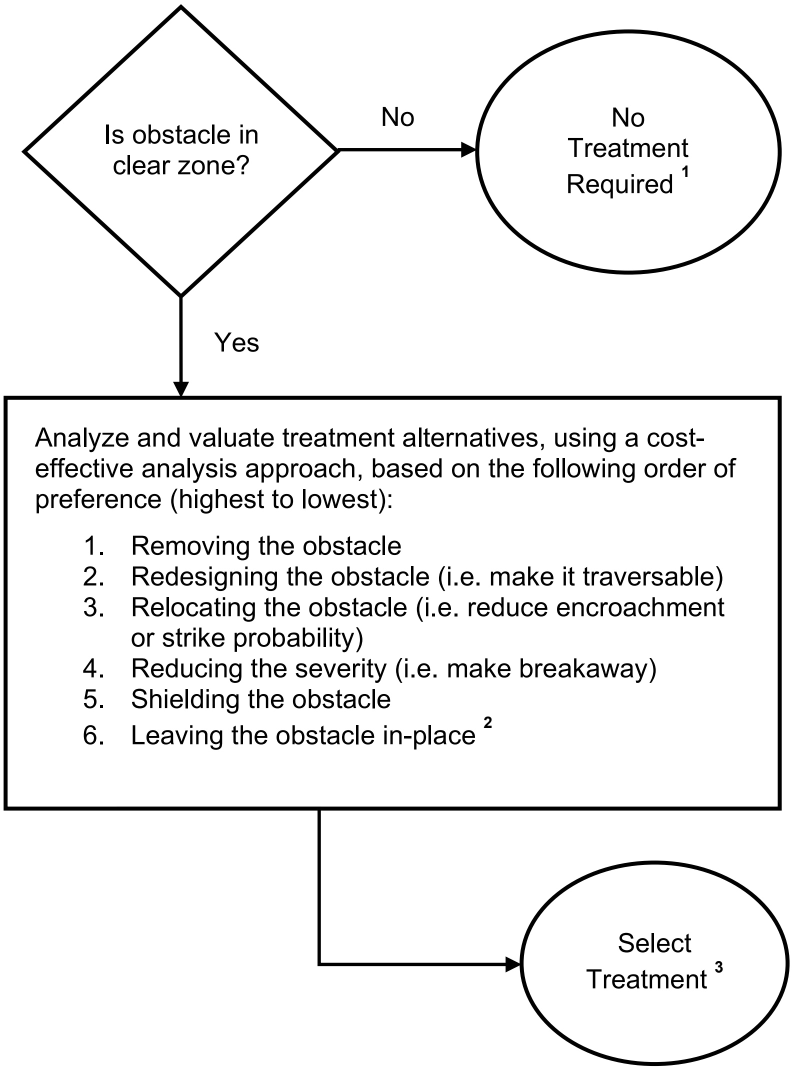
1. Remove the obstacle
2. Redesign the obstacle
3. Relocate the obstacle
4. Reduce the Severity of the obstacle
5. Shield the obstacle
6. Delineate the obstacle

An alternative with a B/C ratio greater than 1.00 is considered cost-effective; however, having a B/C ratio greater than one is not, in itself, sufficient justification for selection of a given alternative.

When comparing several alternatives, do not rely on the magnitude of the B/C ratio as the indicator of the best alternative. Use incremental B/C ratios to determine the most cost-effective solution. Consult the ROADSIDE or RSAP user's manual for further information on incremental B/C ratios and selection of the most cost-effective alternative.

Any alternatives under consideration that are within 10 percent of each other are essentially equal given the accuracy of estimating, analysis program modeling (user input), and analysis program output. The designer should ultimately use engineering judgement in selecting a final solution.

Process for Determining Treatment of Roadside Obstacles for New Construction and Reconstruction Projects



[1] Treatment may be provided if dictated by sound engineering judgment. Instances where pedestrians congregate near roadways (such as playgrounds and multiuse paths), especially adjacent to the outside of curves on high speed roadways and in areas with a history of run-off-road type crashes, should receive special consideration.

[2] Delineate the obstacle when, in the judgment of the engineer, delineations would be effective in reducing accident frequency or severity.

[3] When alternatives have a similar benefit-cost ratios, select the preferred alternative based on the order of precedence provided above.

Figure 1130- 5
Process for Determining Roadside Treatments on New and Reconstruction Projects

1140. Preservation Projects

1140.1. Introduction

Preservation projects are those that extend the service life of existing roadways and bridges by restoring them to a state of good repair. Preservation is a proactive approach to maintaining highway facilities while they are still in relatively good condition.

Preservation performed before the onset of serious damage delays or eliminates the need for major rehabilitation or reconstruction.

FHWA recognizes preservation as an essential and cost-effective tool for achieving and sustaining highway facilities in a state of good repair and supports the increased flexibility in using federal-aid funds for cost-effective preservation.

Preservation projects are categorized as follows:

1. Preventive Maintenance (PM) Projects
2. Resurfacing (1R) Projects
3. Resurfacing and Minor Restoration (2R) Projects

Resurfacing, Restoration and Rehabilitation (3R) projects are covered in Section 1160.

Routine Maintenance is not eligible for federal-aid funding.

1140.2. Project identification

Highway segments and bridges needing preservation are identified and prioritized through the Pavement Management System (PMS) and Bridge Management System. The policy and procedure for these are contained in P&P 07.05.020 and P&P 07.05.025, respectively.

Predictive modeling software uses information from the PMS, Bridge Management System and the Maintenance Management System (MMS) to identify locations that would benefit from preservation. The Pavement Management Engineer and the Bridge Management Engineer select from the software output to create a list of proposed locations, including recommended preservation actions. In addition, segments that are not candidates for preservation (i.e. needing a more substantial treatment) are submitted to Planning for consideration in the STIP. Finalized recommendations are included in the Annual Preservation Plan (APP). The final selection of locations are made by the Regions, which then feeds projects into the Preservation Projects development pipeline.

1140.3. Project Scope

Preservation project scope depends on the preservation treatments needed. It is important to apply the right preservation treatment at the right time. Pavement Preservation projects do not add capacity or alter existing road geometry.

See Table 1140-1 for a summary of Pavement Preservation categories.

All pavement preservation projects are required to:

1. Assure replacement striping is in accordance with the *Alaska Traffic Manual* (ATM).
2. Assure rumble strips are replaced or installed to meet current DOT&PF policy.
3. Follow vertical clearance policy for structures and utility lines per Table 1130-1. If the existing vertical clearance is less than 18 feet or the resulting project improvements will result in a vertical clearance less than 18 feet, relocate the overhead utility with a minimum clearance of 20 feet. When mitigating factors exist, the relocated utility may be installed with a vertical clearance no less than 18 feet.
4. Include required ADA improvements (see Section 1140.4.3.).
5. Assure warning devices for any highway-rail grade crossings within the project limits or near the project terminus are installed and functioning properly per 23 CFR 646.214.
6. Maintain functionality of traffic signal vehicle detection and other ITS elements.
7. Adjust appurtenances (i.e., manholes, valve boxes, monuments, etc.) in pavement as necessary.

8. Approach bridge work in accordance with Section 1140.4.2.

Pavement preservation projects may also include mitigation of pavement edge drop offs per Section 1160.3.7, installation of a safety edge or safety improvements.

Table 1140-1
Pavement Preservation Project Categories

Project Scope	Category	Purpose	Work Types
Pavement Preservation	Preventive Maintenance (PM)	Keep good roads in good condition	Typically pavement seals - fog, sand, scrub, chip seals
	Resurfacing (1R)	Restore fair roads to good condition. Address surface defects beyond preventive maintenance, such as ruts, or areas of high roughness	Mill/fill, overlay or other resurfacing treatment limited to 2" of new HMA
	Resurfacing & Minor Restoration (2R)	Restore roads beyond preventive maintenance or resurfacing to good condition	Mill/fill, overlay or reclamation with an overlay limited to 2" of HMA. Reclamation can include base stabilization.

1140.3.1. Preventive Maintenance Projects

Preventative Maintenance (PM) is the lowest level preservation strategy utilized by the PMS and a cost-effective, proactive means of extending the useful life of highways and bridges. PM slows or delays future deterioration and maintains or improves the functional condition of highway and bridge facilities. PM projects should consider maintaining or enhancing the current level of safety and accessibility. Consider addressing isolated or obvious deficiencies.

Typical activities performed on PM projects include:

1. Crack sealing
2. Profiling
3. Milling
4. Microsurfacing
5. Fog sealing
6. Sand sealing
7. Chip sealing
8. Scrub sealing
9. Roadway surface (gravel) replacement
10. Area-wide or system-wide activities:
    a. Systematic replacement and/or upgrade of light and signal poles, light fixtures, signal heads, signal bulbs or LEDs near the end of their service life, and bases
    b. Area-wide striping
    c. Systematic sign replacement

This list is only a summary of work items previously determined to be federal-aid eligible after consultation with FHWA. Consult with FHWA regarding eligibility on work items not included in this list.

1140.3.2. 1R Projects

1R projects focus on resurfacing and typically have a pavement design life of five to 10 years. A capacity screening analysis is not required for this short duration design life. A safety screening is not required, but addressing known safety issues or enhancing the existing level of safety may be considered.

1R projects:

- May include any work allowed on PM projects
- Do not alter roadway geometry
- Minimizes fill beyond the exiting slope limits
- Do not typically include guardrail work, unless approved by the Preconstruction Engineer
- May include structural section replacement, or digout, limited to 25% of the project area(s) – (example: digout existing structural section to 48 inch depth and replace with new structural section for 25% of project area).

1140.3.3. 2R Projects

2R projects focus on resurfacing and minor restoration, and may include minor rehabilitation work. Minor rehabilitation consists of enhancements to eliminate age-related, top-down surface cracking in flexible pavements that develop due to environmental exposure. Thin overlays (of 2 inches or less) over recycling treatments (hot in-place recycling or cold recycling) are considered minor rehabilitation activities.

2R projects:

- Are cost-effective preservation projects done on facilities that are in a state of good repair and do not require rehabilitation (3R) or Reconstruction
- Do not alter roadway geometry
- Address safety through a Safety Screening
- Check capacity through a Capacity Screening. Projects needing capacity improvements are not good candidates for 2R
- Consider installing, replacing or upgrading guardrail and guardrail end treatments

Work allowed on 2R projects includes:

- Any work allowed on a PM or 1R project.
- Treatment of roadside obstacles
- Upgrade non-crashworthy sign supports in the clear zone, except those permitted under 17 AAC 10 and 17 AAC 60
- Repair drainage, but only as required for the structural integrity of the roadway, or to restore function which has deteriorated

2R projects typically have a 10-year minimum pavement design life. This design life length warrants both a capacity screening and safety screening.

Safety Screening
Regional Traffic and Safety will review the latest available Safety Screening lists summarized through the HSIP Program. Use this data to identify those segments or intersections that need to be addressed on the project, based on the following criteria:

- The overall five-year crash rate or crash frequency (concentration) exceeds 1.5 times the statewide average*

- The overall fatal and serious injury crash rate or crash frequency (concentration) exceeds 1.5 times the statewide average*

* **Notes** (to the bulleted list above):

1. Obtain the statewide crash rate from Statewide Traffic & Safety.
2. A three-year rate or frequency may be used in the absence of five years of available data.
3. Crash rate screening is not applicable for ADT's of less than 2,000 vehicles per day.
4. Crash frequency (concentration) applies at all traffic volumes.

Other safety elements to consider for improvement include:

- Segments or intersections listed on other HSIP Program screening lists for serious injury and fatal crashes. These may include crash strategies listed in the Alaska Strategic Highway Safety Plan.

- All affected railroad crossings, school zones, and marked non-motorized crossings

In addition, review other recent Reconnaissance and Design Study Reports in the project location to identify segments of safety concern. Any other safety concerns previously raised by the public or other stakeholders may also be considered for inclusion during design development.

If a 2R project is unable to address the issues identified in the Safety Screening, a 3R, HSIP, or other type of project should be developed.

Capacity Screening Analysis
A simplified highway capacity calculation method (such as FHWA Report PL-18-003) may be used to determine if there is sufficient capacity to support existing and projected vehicular traffic volumes for the design life of the project.

If the Capacity Screening analysis indicates the roadway cannot handle projected traffic volumes, develop it as a 3R or Reconstruction project.

1140.4. Project Development and Design

Preservation projects generally follow the project development and highway design standards detailed in Chapter 4 and Chapter 11 of this *Manual*, respectively, and those found in the *Alaska Flexible Pavement Design Manual* and the *Alaska Bridges and Structures Manual*.

1140.4.1. Pavement Design

The Pavement Management Engineer provides recommendations for pavement preservation needs. Regional staff may contact the Pavement Management

Engineer for treatment recommendations. If there is no recommendation, the project manager develops the preservation strategy and pavement design. Prepare pavement designs in accordance with the *Alaska Flexible Pavement Design Manual*. Per general policy statement GP-1, a pavement design analysis is only required on arterials and interstates.

1140.4.2. Bridge Work

Evaluate bridges in *fair* or *good* condition located within the limits of Preservation Projects. Bridges in poor condition may also be considered; however, they will generally require major rehabilitation or replacement, which are beyond the scope of preservation.

See Table 23-1 of the *Alaska Bridges and Structures Manual* (ABSM) for bridge railing criteria for all project types.

See the *FHWA Bridge Preservation Guide, Maintaining a Resilient Infrastructure to Preserve Mobility, Spring 2018*, for criteria for bridge preservation goals and activities.

PM and 1R Projects

Apply cost-effective deck surface treatments to bridges in *fair* or *good* condition to extend their service life. These treatments are typically either cyclical or condition-based maintenance activities.

Cyclical maintenance is performed at predetermined intervals and includes cleaning bridge decks, joints, drains and applying concrete sealers. Condition-based maintenance is commonly identified from bridge inspection reports and may include:

- Expansion joint cleaning, repair and replacement
- Deck sealing, overlays and wearing surfaces
- Railing repair

Note, routine maintenance activities (snow and trash removal, crash damage repair, storm damage repair, etc.) are not typically eligible for federal funding.

Evaluate existing surfacing and its impact on load ratings and bridge rail height. Remove existing asphalt surfacing and install waterproofing membrane on concrete decks that do not already have membrane or show signs of excessive leakage. Limit new surfacing thickness to avoid significantly changing load ratings and bridge rail height.

Evaluate vertical clearances at all overcrossings and undercrossings regardless of bridge condition. Consider the impact of new surfacing on the vertical clearance beneath these structures.

2R Projects

Perform the same evaluations as for PM and 1R Projects. Additionally, consider the following preservation treatments, rehabilitation and replacement strategies as defined in Section 10.2.3 of the ABSM:

- Crack sealing and concrete spall repairs
- Channel debris removal
- Scour countermeasures
- Railing retrofit and replacement
- Painting and metalizing structural steel

1140.4.3. ADA Improvements

Projects considered alterations are required to make certain simultaneous ADA upgrades while projects considered maintenance are not.

Maintenance includes:

- Chip seals
- Crack filling and sealing
- Diamond grinding
- Dowel bar retrofitting
- Fog seals
- Joint crack seals
- Joint repairs
- Pavement patching
- Scrub sealing
- Slurry seals
- Spot high-friction treatments
- Surface sealing

Alterations include:

- Addition of a new layer(s) of asphalt
- Cape seals
- Hot in-place recycling
- Microsurfacing / thin-lift overylays
- Mill & fill / mill & overlays

If a project is considered an alteration, and there are adjacent pedestrian walkway amenities, then curb ramps and crosswalks must be constructed or improved to current ADA standards as part of the alteration project, except as noted in the following paragraphs.

If a curb ramp was built or altered prior to March 15, 2012, and complies with the requirements for curb ramps in either the 1991 ADA Standards for

Accessible Design or Uniform Federal Accessibility Standards (UFAS), it does not have to be modified to comply with the requirements of the 2010 ADA Standards. However, if that existing curb ramp did not comply with either the 1991 Standards or UFAS as of March 15, 2012, then the “safe harbor” provision does not apply and the curb ramp must be brought into compliance with the requirements of the 2010 ADA Standards concurrent with the road alteration.

Any features disturbed by construction must be replaced so they are accessible, even on maintenance projects. Pedestrian amenities other than curb ramps and crosswalks, such as sidewalks, paths, bus stops, etc., do not require upgrading as part of an alteration project, but should be evaluated for accessibility and any identified deficiencies noted.

When existing curb ramps and crosswalks meeting 1991 ADA Standards or UFAS will remain in place, transmit this information to the Civil Rights Office (CRO). Inform the CRO of any known accessibility deficiencies within the public right-of-way for inclusion into the Transition Plan. The Transition Plan identifies non-compliant features and serves as a guide for future planning and prioritization of ADA improvements.

1140.4.4. Design Study Report (DSR)

Preservation projects do not require a DSR. On 2R projects, safety and capacity analyses are retained in the project design files.

1140.5. References

1. FHWA Guidance on Highway Preservation and Maintenance, dated Feb. 5, 2016
2. US DOJ/US DOT joint technical assistance on requirement to upgrade curb ramps on resurfacing projects:
3. Q & A for Supplement to the 2013 DOJ/DOT Joint Technical Assistance on the Title II of the Americans with Disabilities Act Requirements To Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing (Safe Harbor provisions discussed in Q1/A1)
4. FHWA Office of Civil Rights guidance document. FAQs on ADA and Section 504. Discussion of transition plans, timing of accessibility improvements, and other relevant topics.
5. FHWA Good Practices: Incorporating Safety into Resurfacing and Restoration Projects, dated Dec. 2006.

1150. Urban Streets

1150.1. Urban Streets

Lane configuration at intersections should be determined through capacity analysis procedures presented in the Highway Capacity Manual (HCM). Configure the number and movement assignments for lanes to meet the range of level of service guidelines in the GB, or guidelines adopted by the local transportation authority. Reference the GB to determine the geometry of urban arterials, collectors, and local streets. For urban local streets with ADT < 2000, reference the GDLVR.

Urban streets are defined by roads within an urbanized boundary with a population of 5,000 or above.

For non-NHS Routes other standards and guides may be used if adopted by the local transportation authority and the local transportation authority is the owner of the road and project sponsor. If the project is FHWA funded, the standards and guides must be recognized by FHWA in accordance with 23 USC 109(o)(B). Current FHWA accepted standards are available at: https://www.fhwa.dot.gov/design/altstandards/index.cfm

1150.2. Urban Arterials and Collectors

1150.2.1. Design Considerations

Design of urban arterials on the National Highway System shall begin with the recommendations in the GB and be adjusted within the flexible range of GB guidelines for the context of the area.

1150.2.2. Medians and Two-Way Left-Turn Lane (TWLTLs)

Roads with design speeds of 45 mph or higher and with forecast average daily traffic of 20,000 vehicles per day or less should be designed with non-traversable medians.

Full median openings permit cross traffic and left turns, which conflict with the through traffic on the arterial. Full median openings should be limited to locations that are signalized or may be signalized in the future, such as major shopping centers and intersections with other arterial or collector roadways to minimize delays and crash exposure. Because of the potential for signalization, full median openings should be spaced consistent with signal spacing in 1150.2.3.

Consider directional median openings at minor street intersections or to provide u-turn opportunities where adjacent signal capacity for left turns is limited. These conflicts result in delays and crash exposure, which you can minimize by managing and limiting median openings to those that are critical to access the area.

Median openings should be sufficiently spaced to provide adequate length for storage in the left turn lane and an appropriate length taper. Lane and taper requirements are found in the GB and the Alaska Traffic Manual (ATM).

When restricting mid-block left turns, balance safety and capacity. Consider how much traffic will use alternative routes and how much will become u-turns. When adjacent signals are already at capacity for left turns and u-turns, at least one mid-block opening may be of benefit to maintain signal efficiency. A similar situation exists where a minor street intersects the arterial and does not provide a median opening.

Provide median openings only if the volume of cross- or left-turn traffic is warranted, such as at another arterial or major collector street or, in some cases, at an access point to a major traffic generator, such as a regional shopping center or industrial plant. Because the openings are at major traffic points, assume that at some time, if not immediately, these median opening locations will be signalized. Additionally, where signalized intersections are 0.5 mile or less apart, efficiency and safety require interconnected or synchronized signals to achieve smooth traffic flow along the arterial.

For median widths reference the GB. Provide a minimum width of 4 feet to allow for sign width for separation of traffic in opposing directions. Additional width may need to be provided to accommodate wider signs.

If medians will provide pedestrian refuge, ensure the minimum width meets or exceeds the appropriate ADA standard. Reference the ATM for mid-block crossing for non-motorized users.

In areas with frequent driveways and side streets, and volumes <20,000 vpd, a continuous two-way left-turn lane (TWLTL) can provide additional capacity and reduce crash potential. Perform a capacity analysis to determine the number of thru lanes needed. A 3-lane section can often replace a 4-lane section with minimal impact on travel time while providing space for non-motorized users.

1150.2.3. Signalized Intersections

One of the most critical design criteria for smooth, two-way operation of a signalized arterial is to evenly space signalized intersections along the arterial. It is not necessary that the distance between signalized intersections be exactly even, provided the longer distances are integer multiples of the ultimate minimum spacing. Each traffic signal per mile added to a roadway reduces speeds by 2-3 mph. Ideal signal spacing is 0.5 mile, although 0.25 mile spacing for signals may be necessary in some contexts. As indicated above, assume that every median opening will eventually be signalized and hence, median openings should be evenly spaced or spaced at integer multiples along the arterial. More guidance on signal spacing can be found in the ITE Traffic Engineering Handbook.

The minimum distance between median openings is also critical if reasonable progression speed is to be achieved along the arterial. Analysis of progression is most efficiently performed with software that is specifically designed for that purpose. The longer the distance and/or the shorter the cycle, the better the progression speed.

As a rule, alternating signals should be greater than 0.25 miles apart. Although you may achieve closer spacing between signalized intersections by using simultaneous signal groups with alternating group displays, be aware that when using adjacent simultaneous signals, the available green time for continuous through-movements on the arterial is substantially reduced.

1150.2.4. Auxiliary Lanes

In addition to signal progression considerations, median openings should be sufficiently spaced to provide adequate length for storage in the left turn lane and an appropriate length taper. Turn lane lengths should be designed to meet storage and deceleration requirements presented in Table 1150-1. Storage, or queue lengths, should be determined through methods in the HCM or through simulation software. Deceleration length should be determined through methods presented in the GB.

Space median openings to accommodate the full length of the left turn lane, including taper. Lane and taper requirements are found in the GB and the ATM.

1150.3. Roundabouts First Policy

The Roundabout First Policy requires that a single lane roundabout be considered at all locations where a new traffic signal is being considered. Justification for not installing a roundabout needs to be included in the Design Study Report (See Section 450.5.1).

Table 1150-1
Auxiliary Lane Length Guidelines for Urban Streets

Unsignalized Intersections			**References**
Approach	**Length Component**		*NCHRP 457*
	Left-Turn Bay	**Right-Turn Bay**	
Free-flow, Main Street	Storage & Deceleration	Deceleration	
Stopped, Minor Street	Storage	Storage	
Signalized Intersections			
Approach Speeds	**Left-Turn Bay**	**Right-Turn Bay**[1]	*NCHRP 279*
30-35 mph	Storage	Storage	
40-45 mph	Storage & Deceleration	Storage & Deceleration	
> 50 mph	Storage & Deceleration	Storage & Deceleration	

[1]These guidelines are derived from left-turn recommendations presented in NCHRP 279

References: *NCHRP 457* Evaluating Intersection Improvements- An Engineering Study Guide, *NCHRP 279* Intersection Channelization Design Guide

Notes :

1) It is undesirable for storage to spill out and block access of other lanes to the adjacent signal during green indications for other lanes. However, where constrained, the turning vehicle may enter the turn lane taper at 10 mph less adjacent through lane speeds.

2) The minimum turn lane length shall accommodate at least one design vehicle, but shall be no less than 100 feet.

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1160. Resurfacing, Restoration, & Rehabilitation Projects (3R)

1160.1. Guidelines

1160.1.1. General

This chapter presents the procedures for development of 3R projects in Alaska, which are cost-effective and enhance highway safety. These procedures are required where projects are federally funded or on federal-aid routes. In nonfederal projects, these procedures represent good engineering, but they are not mandatory.

1160.1.2. Background

Prior to 1976, federal-aid highway funds were generally limited to participation in the new construction of highways. Preservation of the existing highways was a state or local agency responsibility.

By 1975, it became evident that many sections of the existing highway system were reaching the end of design life, and the rate of deterioration was exceeding the funding levels available for preservation. In recognition of this problem, Congress, in the 1976 Federal-Aid Highway Act, broadened the scope of the Federal-Aid Highway Program to include preservation work by adding resurfacing, restoration, and rehabilitation (3R) to the definition of construction under Title 23, USC, Section 101(a).

However, since many existing highways do not meet current design standards and have safety deficiencies, the amount of upgrading to current 3R project standards has been a continuing concern. This concern was recognized in the 1982 Surface Transportation Assistance Act, Section 101(a), which emphasizes safety by stating that 3R projects "shall be constructed in accordance with standards that preserve and extend the service life of the highways *and enhance highway safety*." (Emphasis added.)

1160.1.3. Definition

Rehabilitation (3R) projects consist of the resurfacing, restoration, and rehabilitation of an existing roadway on the same alignment or modified alignment. The principal objective of 3R projects is to restore the structural integrity of the existing roadway, thereby extending the service life of the facility. In addition, the safety and capacity of the facility should be enhanced, if required.

Generally, a 3R project consists of the repaving or the asphalt paving of an existing gravel surface. It can also include drainage improvements and reconstruction of the structural section. Safety enhancements include improvement of deficient geometry identified by a performance criterion found in this section. Capacity enhancements include the addition of truck climbing lanes, passing lanes, and slow moving vehicle lanes. Turnouts may be added as safety enhancements where driver fatigue or sightseeing are factors in accidents.

Section 1160.5. describes a modified design procedure for non-NHS road construction projects whose primary purpose is to reduce maintenance costs and improve the quality of life for Alaskans by hard surfacing of gravel roads, but that may include limited shoulder, drainage, and other work related to preserving the road structure.

1160.1.4. Determining the Type of Project

Follow normal project planning and programming procedures for determining the type of improvement: new construction, reconstruction on existing alignment, or restoring the existing facility (3R). This determination is specified on the Design Designation.

Select a design year that at least equals the expected life of the improvement. Designate the design year in five-year increments.

1160.2. Factors

Evaluate the following in determining type and scope of a project:

1. **Pavement Condition:** The existing pavement condition and the scope of needed pavement improvements dictate to a large extent what improvements are feasible. The project analysis should indicate how existing pavement condition and the scope of pavement improvements will interrelate with the scope of geometric improvements and the values used for design of geometric improvements.
2. **Physical Characteristics:** The physical characteristics of a highway and its general location often determine what improvements are necessary, desirable, possible, practical, or cost-effective. Consider topography, climate, adjacent

development, existing alignment (horizontal and vertical), cross-section (pavement width, shoulder width, cross slope, and sideslopes), and similar characteristics in determining the scope of geometric or safety improvements to be made in pavement-type 3R work.

3. **Traffic Volumes:** Traffic data are needed in the design of all highway improvements, including 3R. Traffic volume is an important consideration in determining the appropriate level of improvement (for example, reconstruction versus 3R) and in the selection of values for the various geometric elements.

4. **Traffic Controls and Regulations:** Signing and marking in all highway projects, including 3R, must conform to the *Alaska Traffic Manual* (ATM). Where roadway geometry or other roadway or roadside features do not meet the drivers' expectancy and reconstruction is not appropriate, consider additional signs, markings, and other devices beyond the normal requirements of the ATM. While traffic control devices cannot fully mitigate all problems associated with substandard geometric features, they can compensate for certain operational deficiencies. In addition, judicious use of special traffic regulations, positive guidance techniques, and traffic operational improvements can often forestall expensive reconstruction by minimizing or eliminating possible adverse safety and operational features of existing highways.

5. **Accident Records:** Accident records are an integral part of these 3R standards. It is necessary to reference the state reporting system to evaluate existing geometric features for accident performance. Generally, use a three- to five-year period. When evaluating historical accident records, examine each accident as a whole, regardless of the number of vehicles or people involved. Moose accidents and alcohol-related accidents are eligible. Obtain average accident rates from the January 25, 2002, DOT&PF *Highway Safety Improvement Program Handbook*.

6. **Skid Resistance:** A skid-resistant surface should be an essential part of any pavement surface improvement, regardless of the scope of geometric problems or improvements. The Alaska design method for asphalt pavement provides a skid-resistant surface. Portland cement concrete requires a broom or similar finish.

7. **Economics:** By their purpose and definition, 3R projects reflect and emphasize the economic management of the highway system. The purpose of 3R is to prolong and preserve the service life of existing highways and to enhance highway safety to protect the investment in, and derive the maximum economic benefit from, the existing highway system. Economic considerations should be a major factor in determining the priority and scope of 3R work.

8. **Potential Impact of Various Improvements:** Often, development and effects on the land influence the scope of geometric improvements made by 3R projects. Typically, social, environmental, and economic impacts severely limit the scope of 3R projects, particularly where the existing right-of-way is narrow and there is considerable adjacent development.

1160.3. 3R Geometric Design Standards

1160.3.1. General (Design Exceptions)

Design all 3R-type projects using the 3R design criteria found in this section. Design standards for 3R projects that are not in this section shall be dictated by the remaining applicable sections of Chapter 11 and the current *AASHTO A Policy on the Geometric Design of Highways and Streets 2001*. All signing and pavement markings must conform to the *Alaska Traffic Manual*. Upgrade all warranted guardrail terminals and bridge rail terminal connections to current standards (see Table 1130-12 of this manual for guardrail terminal replacement guidance). If an engineering analysis indicates that a section of existing guardrail is not warranted for obstacle protection or other operational factors, it may be removed. Design exceptions, in accord with Section 1100.3., shall be required when the results or determinations of the 3R design procedures require a feature improvement and the proposed project does not include that improvement.

Continuity may require that routes be analyzed as a whole with respect to lane, shoulder widths, and cross-section geometry. Apply 3R standards to individual projects, but regional policy may be required for minimum acceptable geometry on individual routes.

Urban and Multilane Rural Highways

Less is known about the safety cost-effectiveness of widening urban and multilane rural highways, and minimum values have not been proposed that highway agencies can adopt as standards. Use the minimum widths recommended for rural two-lane highways as a guide to safety cost-effective improvements for multilane rural and urban highways. However, routinely upgrading lane and shoulder widths in urban areas to the minimum widths recommended for rural two-lane highways is likely to produce some widening projects that are not safety cost-effective, particularly when there are physical constraints or high right-of-way costs. In such situations, determine the scope of widening improvements on a case-by-case basis.

Gravel Surfaced Roads

Roads in this class do not have to be analyzed for routine safety enhancement unless a prodigious accident history at specific locations warrants an improvement.

Design Volume

Determine ADT for the design life of the project. The design ADT shall equal the mid-design period ADT. Generally, design life periods for 3R projects are equal to the pavement design periods and should be compatible with the service life of the improvement.

Design Speed

The recommended minimum design speed is the 85th percentile speed. You should consider that the actual 3R improvement may increase the operating or measured 85th percentile speed over that currently posted.

On lower volume roadways, AADT less than 2,000, it may be cost prohibitive to obtain a sample size that provides a statistically valid speed study to define 85th percentile speeds for design. In these cases, the engineer should drive the project and use operating speeds observed during field investigations for the design speed, or use the safe speeds defined by existing geometrics.

Where AADT is greater than or equal to 2,000, it is likely that the Department has speed studies for the roadway on file and these should be used to estimate the 85th percentile speeds for 3R evaluation and design. If not, speed studies at these locations are usually economically feasible. Consider additional speed studies or field observations to estimate speeds in areas where there are significant accident clusters.

1160.3.2. Lane and Shoulder Widths

Rural Two-Lane Paved Highways

Select lane and shoulder width improvements in accordance with a performance evaluation based on historical accident rates versus a predicted rate A. Compilation of actual accident rates and computation of a predicted accident rate A are required. Calculate the actual accident rate for the previous three- to five-year period for comparison to the predicted rate A.

If the historical accident rate is equal to or less than the predicted rate A, then the existing total lane and shoulder width may remain unchanged.

If the historical accident rate exceeds the predicted rate A, widen the total lane and shoulder width, in each direction, by 1 foot on each side for every 10 percent increment the historical accident rate exceeds A. The widening shall not exceed the values required for new construction.

Study accident data to identify accident clusters that may result from high hazard locations atypical to the route or project. You may remove the accident data from these locations for the determination of lane and shoulder widths, but analyze them on an individual basis as required by the 3R Procedure Outline shown in Figures 1160-1 and 2.

When evaluating lane and shoulder widths, consider route continuity. Adjoining projects could have a bearing on the width selection.

$$A = 0.0019\ ADT^{0.882} \times 0.879^{W} \times 0.919^{PA} \times 0.932^{UP} \times 1.236^{H} \times 0.882^{TER1} \times 1.322^{TER2}$$

(Ref. Transportation Research Board Special Report 214, Appendix C)

A = number of run-off road, head-on, opposite-direction sideswipe, and same-direction sideswipe accidents per mile per year. Does not include intersection accidents

ADT = two-directional average daily traffic volume for the study period

W = existing lane width in feet

PA = existing width of paved shoulder in feet

UP = existing width of unpaved (gravel, turf, earth) shoulder, in feet

H = median roadside hazard rating for the highway segment, measured subjectively on a scale from 1 (least hazardous) to 7 (most hazardous). See Figures 1160-1 through 1160-7.

TER1 = 1 for flat terrain, 0 otherwise

TER2 = 1 for mountainous terrain, 0 otherwise

This accident model is limited because it applies only to:

- Lane widths of 8 to 12 feet and shoulder widths of 0 to 10 feet. Combinations of lane and shoulder widths that can be reasonably modeled are limited to those shown in Figure 3-2, Chapter 3 of *TRB Special Report 214.*
- Two-lane, two-way paved rural roads
- Homogeneous roadway sections. It does not include the additional accidents expected at intersections.

Table 1160-1
3R Procedure Outline (Case I)

3R PROCEDURE OUTLINE

CASE I

EXISTING ROADWAY TOP WIDTH IS LESS THAN REQUIRED FOR NEW CONSTRUCTION

Site Specific Accidents or Anomalies

↓

Accident site specific geometry or obstacles shall be evaluated in accord with Section 1160.03.

↓

Lane & Shoulder Width Selection (total top width)

↙ ↘

General accident rate for segment or project equal or less than the predicted accident rate.

↓

Top width widening is not required.

↓

Cross Sectional Elements

↓

Evaluation not required.

General accident rate for segment or project greater than the predicted accident rate.

↓

Widen top width 1 ft each side (2 ft total) for each 10 percent increment that the actual accident rate exceeds the predicted rate up to but not exceeding the width required for new construction.

↓

Cross Sectional Elements

↓

Reduce the actual accident rate by ten percent for each 1 ft of top widening each side (2 ft total).

↙ ↘

If adjusted accident is equal or less than the predicted then the cross sectional evaluation is not required.

If adjusted accident exceeds the predicted then the cross sectional elements require evaluation in accord with Section 1130.

Table 1160-2
3R Procedure Outline (Case II)

3R PROCEDURE OUTLINE

CASE II

EXISTING ROADWAY TOP WIDTH IS EQUAL OR GREATER THAN REQUIRED FOR NEW CONSTRUCTION

Site Specific Accidents or Anomalies

↓

Accident site specific geometry or obstacles shall be evaluated in accord with Section 1160.03.

↓

Lane & Shoulder Width Selection (total top width)

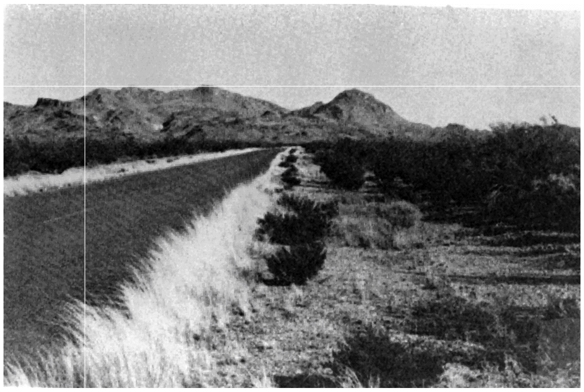
↓

Top width widening is not required.

↙ ↘

General accident rate for segment or project equal or less than the predicted accident rate.	General accident rate for segment or project greater than the predicted accident rate.
↓	↓
Cross Sectional Elements	**Cross Sectional Elements**
↓	↓
Evaluation not required.	The roadside cross sectional elements require evaluation in accord with Section 1130.

Figure 1160-1
Rural Roadside Hazard Rating of 1



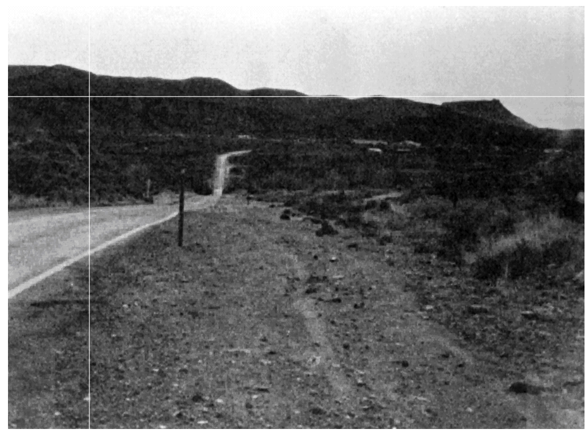


Figure 1160-2
Rural Roadside Hazard Rating of 2

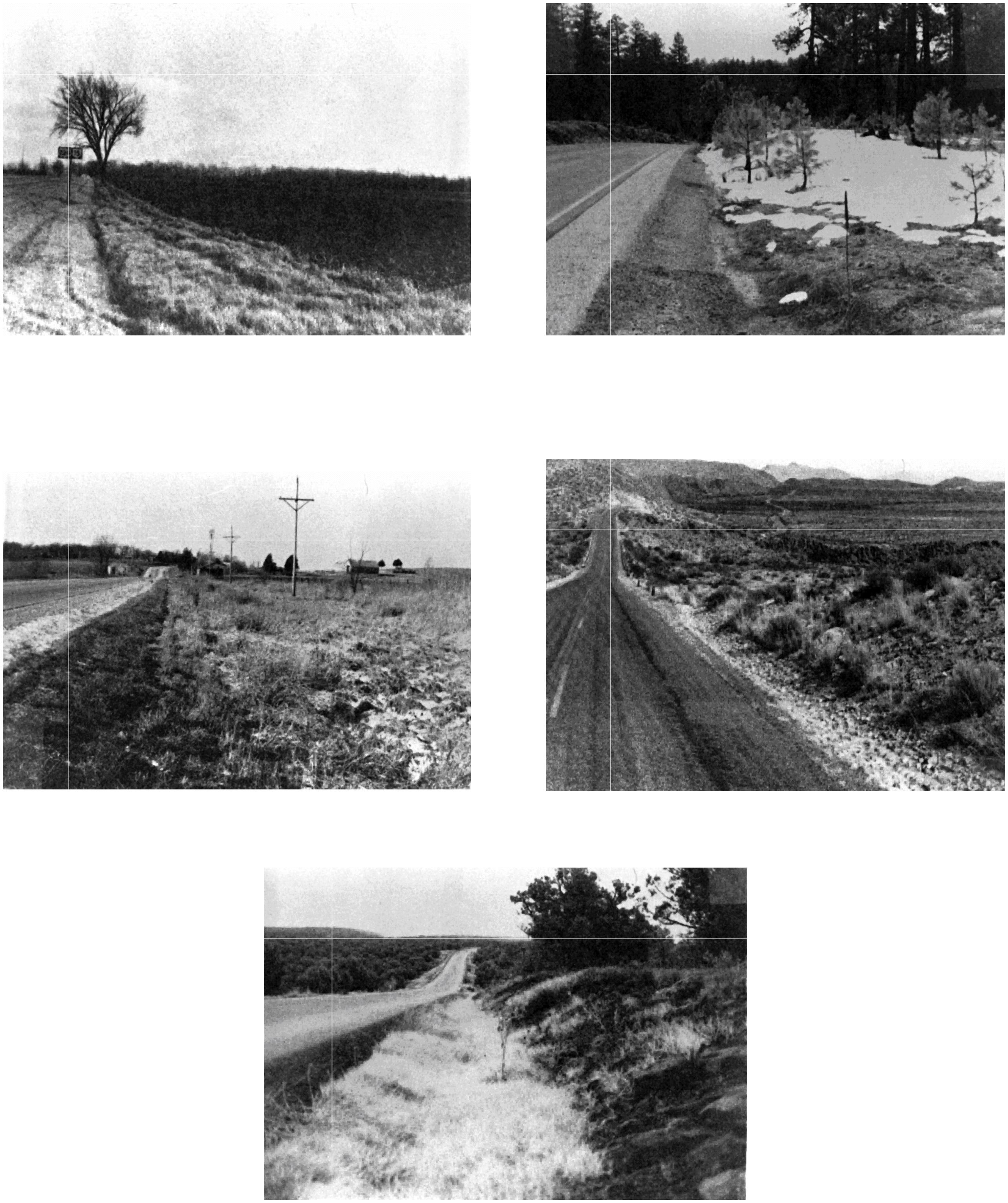


Figure 1160-3
Rural Roadside Hazard Rating of 3

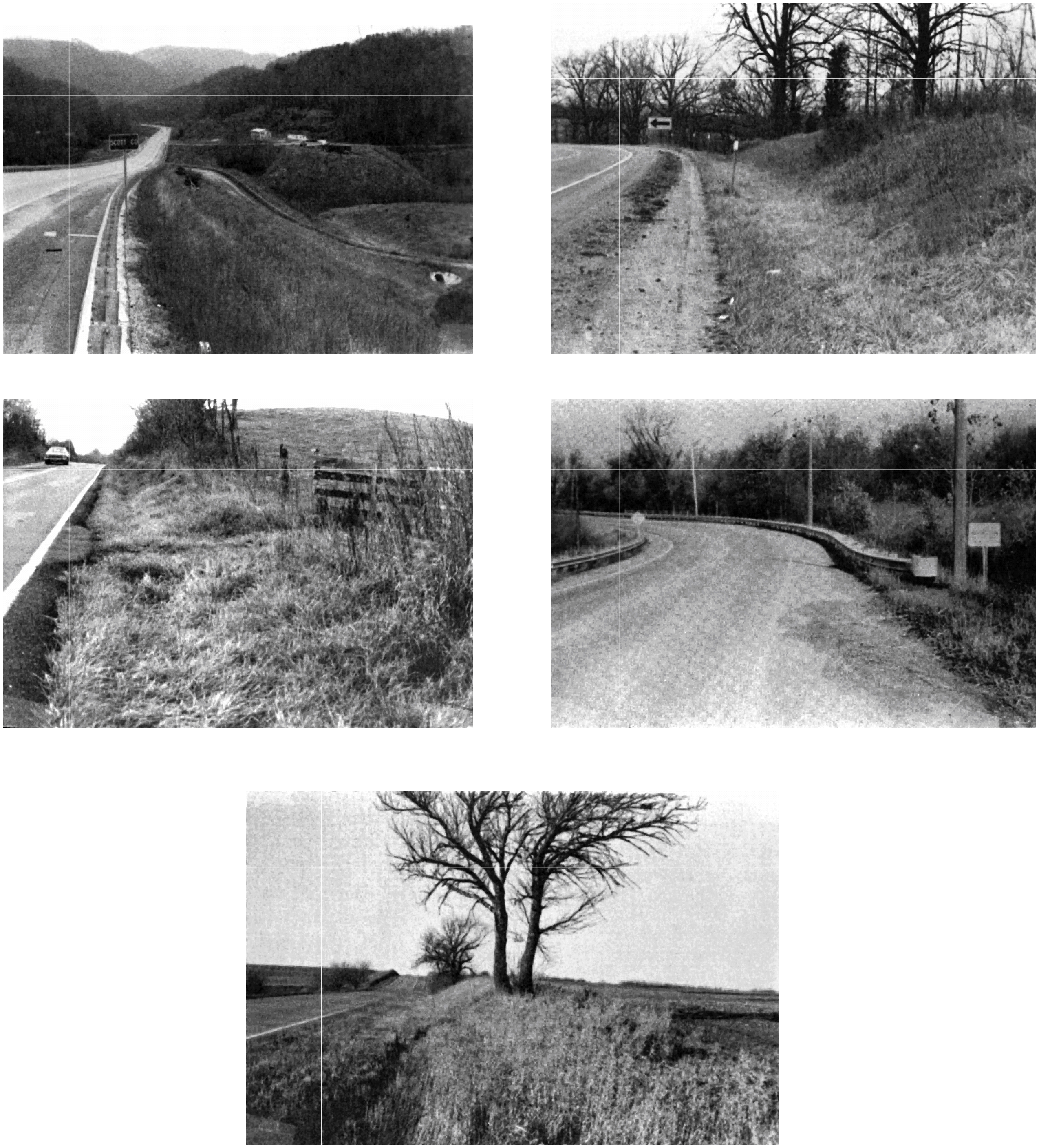


Figure 1160-4
Rural Roadside Hazard Rating of 4

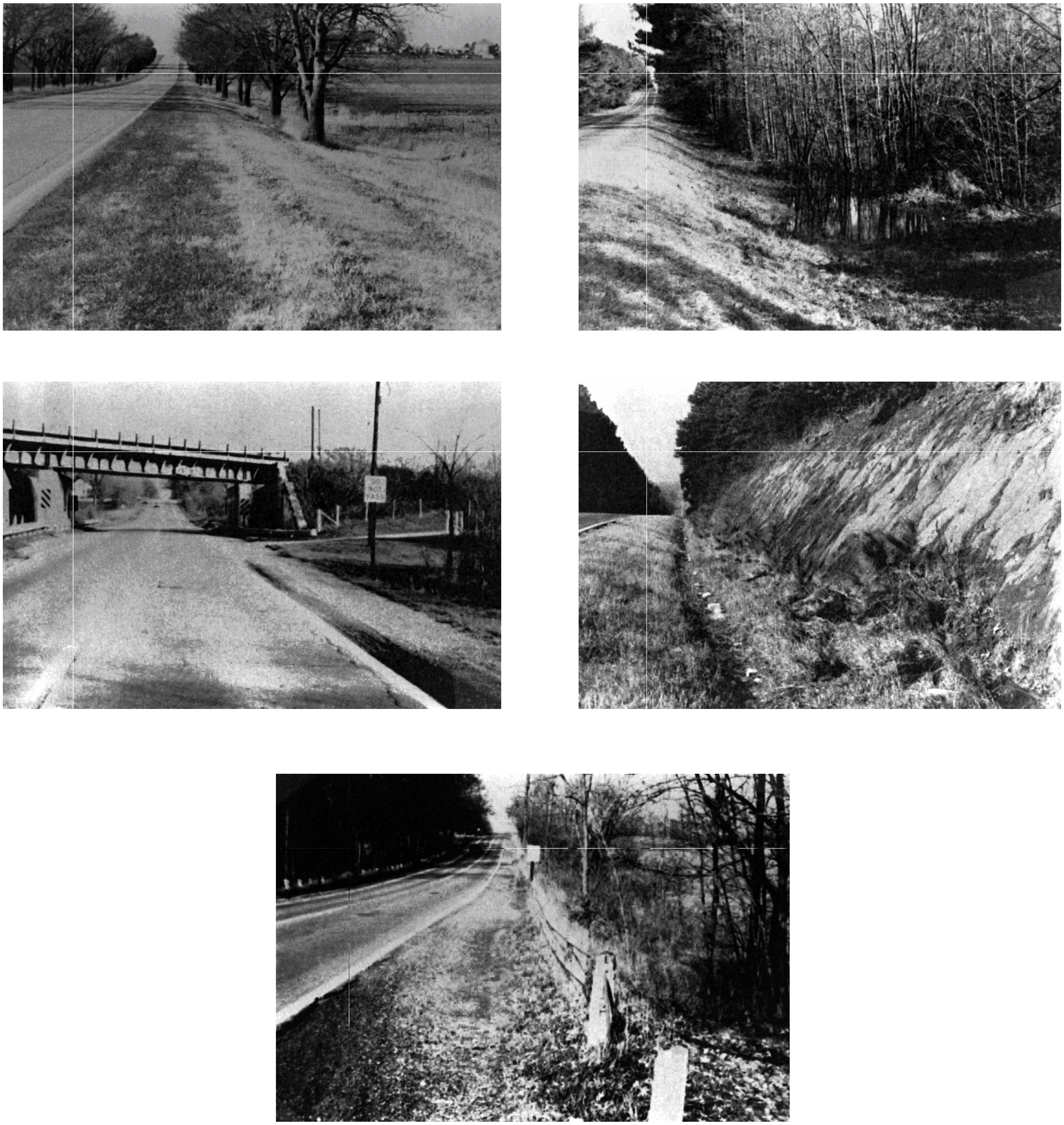


Figure 1160-5
Rural Roadside Hazard Rating of 5

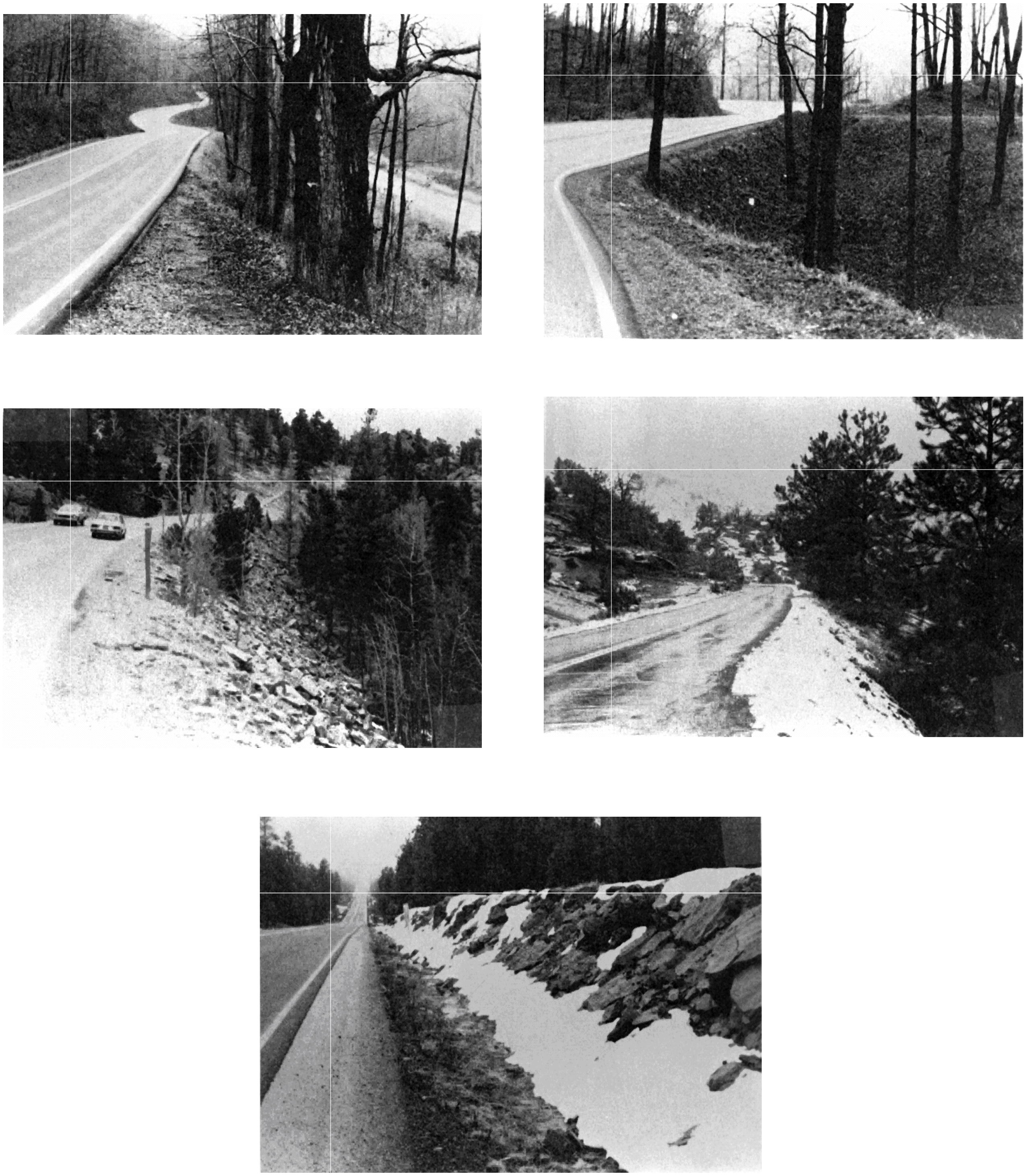


Figure 1160-6
Rural Roadside Hazard Rating of 6

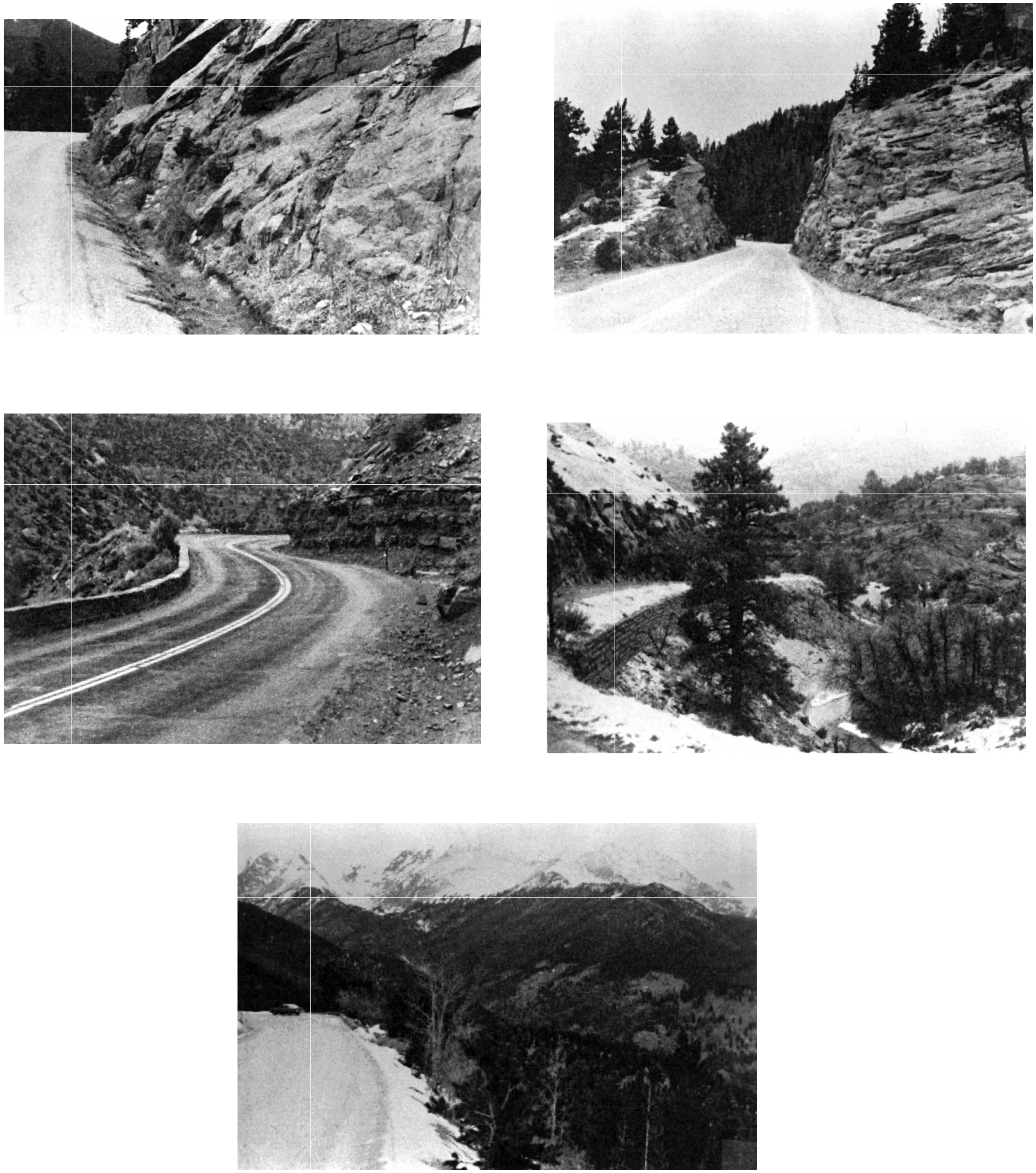


Figure 1160-7
Rural Roadside Hazard Rating of 7

1160.3.3. Horizontal Curves

Radius of Curvature

The existing horizontal curvature may be used if superior (or equal) to the values required for new construction, or if the actual number of accidents for the previous three- to five-year period on the section of road under consideration is less than A_h. If the number of accidents is equal to or greater than A_h, improve the horizontal curvature to the standards of new construction unless it is not cost-effective. Horizontal curves that have no accident history do not require an evaluation and may remain unmodified.

$$A_h = AR_s(L)(V) + [0.0336 * D * V] \quad \text{for } L \geq L_c$$

(Ref. Transportation Research Board, Special Report 214, Appendix C)

where:

A_h = predicted total number of accidents on the segment

AR_s = accident rate on comparable straight segments in accidents per million vehicle miles

L = length of highway segments in miles

V = total traffic volume in millions of vehicles

D = curvature in degrees

L_C = length of curved component in miles

Consider in the cost-effective analysis the historic accident rate for the previous three- to five-year period and the related societal costs (See Example 1160-4). An annual accident cost can be calculated and compared to the annual cost of the improvement.

An annual accident cost savings should be determined as the product of the accident reduction factor (ARF) (Equation 4 in Appendix D, TRB 214; Table D-7, TRB 214; or DOT&PF's Highway Safety Improvement Program Handbook, January 25, 2002) produced by the improvement and the historic annual accident cost over the study period. The improvement is considered cost-effective if the annual accident cost savings exceeds the annual cost of the improvements.

When it is not cost-effective to improve curve alignment, consider other safety improvement measures. These improvements can consist of widening and paving shoulders, widening the clear zone, flattening steep sideslopes, removing or relocating roadside obstacles, and installing traffic control devices such as raised pavement markings or reflective guideposts.

Superelevation

Superelevation may remain unchanged if there are no related accidents. When accidents are related to the existing superelevation, modify it to conform to the requirements for new construction. In unusual cases, it may be possible to show by a cost-effective analysis, based on a three- to five-year accident history, that an existing cross slope may remain.

Superelevation Transition Length

Transition length requirements generally control driver comfort and roadway appearance rather than safety, so existing transition lengths that do not meet the requirements for new construction may remain.

Minimum Length of Curve

Curve length requirements generally control driver comfort and roadway appearances rather than safety, so existing curve lengths that do not meet the requirements for new construction may remain.

1160.3.4. Vertical Curvature and Stopping Sight Distance

Sag Vertical Curves

An analytical method is not available to analyze accidents at sag vertical curves. Generally, sag vertical curves that do not meet AASHTO requirements may remain. If a grouping of accidents at a sag vertical curve appears to be an anomaly when compared to similar curves, an improvement may be needed if cost-effective.

Crest Vertical Curves

Existing crest vertical curvature may be used if superior or equal to the values required for new construction, or if the actual number of accidents for the previous three- to five-year period on the section of road under consideration is less than N_c. If the number of actual accidents is equal to or greater than N_c, then improve the crest vertical curvature to the standards of new construction unless it can be shown not cost-effective. Vertical curves that have no actual accident history do not require an evaluation and may remain unmodified.

$$N_c = AR_h(L_{vc})(V) + AR_h(L_r)(V)(F_{ar})$$

(Ref. Transportation Research Board, Special Report 214, Appendix C) where:

N_c = number of predicted accidents attributable to the crest vertical curve segment

Ar_h = average accident rate for the highway in consideration in accidents per million vehicle miles

L_{vc} = length of vertical curve (highway segment) in miles

V = total traffic volume in millions of vehicles

L_r = length of restricted sight distance in miles (The length of restriction is the distance over which the available sight distance is less than that considered adequate by AASHTO procedures for the actual highway operating speed.)

$$L_r = \frac{[a_0 + (a_1 \times A)]}{5280}$$

A = the absolute value of grade difference in percent

F_{ar} = accident rate factor. See Table 1160-3 and Table 1160-4.

Equation 7 in Appendix E of TRB 214 predicts the change in accidents resulting from lengthening crest vertical curves. An annual cost savings can be estimated using the historic annual accident cost over the study period. The improvement is considered cost-effective if the annual accident cost savings exceeds the annual cost of the improvements.

1160.3.5. Bridges

Width

Improve bridge widths to the minimums established in the *AASHTO A Policy on the Geometric Design of Highways and Streets 2001* when the length is less than 100 feet and the usable width is less than the following values:

Mid Design Period ADT	Usable Bridge Width (ft)[a]
0-750	Width of Approach Lanes
751-2,000	Width of Approach Lanes plus 2 feet
2,001-4,000	Width of Approach Lanes plus 4 feet
Over 4,000	Width of Approach Lanes plus 6 feet
[a]: If lane widening is planned as part of the 3R project, the usable bridge width should be compared with the planned width of the approaches after they are widened.	

You may leave qualified bridges above in place if no improvement is necessary based on a cost-effective analysis considering the previous 10-year accident history.

Bridges longer than 100 feet that are substandard in width generally are not considered for width improvement under 3R standards.

Structural Capacity

If any existing structural member has a design capacity less than HS 15 (HS 20 for interstate bridges), replace that member.

Bridge Rail and Transitions

On projects containing major bridge rehabilitation (widening, strengthening, and/or deck replacement), ensure all bridge rail and rail transitions meet strength and crash test criteria for the appropriate rail performance level. In lesser rehabilitation projects, determine by a cost-effective analysis the appropriate rail upgrade (previously discussed in this chapter). The Bridge Section will be responsible for maintaining the procedures to be used and for applying the current bridge rail upgrade guides.

Earthquake Capacity

All bridges on rural or urban arterials and rural or urban collectors, where there are no feasible detour routes, are essential. In addition, classify bridges as essential if they provide the only feasible access to:

- Military bases, supply depots, and National Guard installations
- Hospitals, medical supply centers, and emergency depots
- Major airports
- Defense industries and those that could easily or logically be converted to them
- Refineries, fuel storage, and distribution centers
- Major railroad terminals, railheads, docks, and truck terminals
- Major power plants, including nuclear power facilities and hydroelectric centers at major dams
- Major communication centers

- Other facilities that the state considers important from a national defense viewpoint or during emergencies resulting from natural disasters or other unforeseen circumstances

Bridges on 3R projects shall be assigned to a Seismic Performance Category in accordance with the current *AASHTO Specifications for Seismic Design of Highway Bridges*.

You do not have to investigate bridges rated SPC “A” for earthquake retrofitting.

Investigate bridges rated SPC “B,” “C,” or “D” for bearing width, bearing height, joint restraint, bearing restraint, support width, and other evident areas of potential seismic motion distress. Retrofit those structures that do not conform to the *AASHTO Specifications for Seismic Design* in the above areas in accord with the Federal Highway Administration publication FHWA-RD-94-052, *Seismic Retrofitting Manual for Highway Bridges.*

The Headquarters Bridge Section will be responsible for the retrofitting investigation. If required, the Bridge Section will also prepare retrofitting plans and specifications for inclusion in the 3R project documents.

The estimated cost of any individual bridge earthquake retrofit shall not exceed 10 percent of the estimated total structure value. If the cost exceeds 10 percent, qualify the structure for retrofitting under another funding source.

1160.3.6. Sideslopes and Clear Zones

Evaluate section geometry and obstacles within the clear zone when required by the 3R Procedure Outline shown in Tables 1160-1 and 2.

1160.3.7. Pavement Edge Drop

Edge drops at the edge of the traveled way are a recognized safety hazard. These drops generally occur with degradation of unpaved shoulders. Paving shoulders is the best solution for eliminating the edge drop. If shoulders won’t be paved, bring the existing shoulders to a grade with new material that matches the top edge of the driving surface.

1160.3.8. Intersections

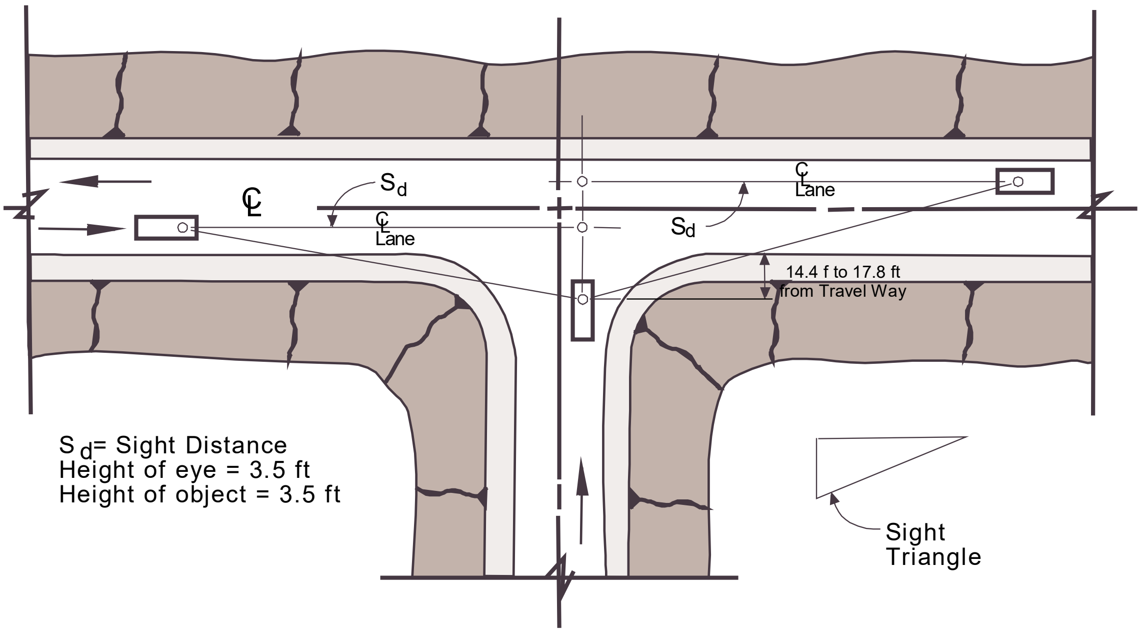
The relative risk of accidents at intersections is high. It is normal to observe accident clustering at intersections. Study the accident history of an intersection to determine if accidents are caused by a design deficiency or operator error. Correct a geometric deficiency related to accidents to the new design standards of this manual or the *AASHTO A Policy on the Geometric Design of Highways and Streets 2001,* if cost-effective or corrected by actions such as signing, signaling, or channelization.

Sight distance is of primary importance at intersections to allow operators sufficient time to observe and react to conflicts. The sight triangle shown in Figure 1160-8 is the minimum allowable at any existing intersection (driveway). The sight distances required (S_d) are the minimum stopping sight distances required by Section 1120.1. of this manual.

1160.3.9. Driveways

Existing driveway geometry may remain except if accident records indicate an anomaly. In that case, the driveway requires an engineering evaluation for improvement to meet the requirements of Section 1190 of this manual.

MINIMUM INTERSECTION SIGHT DISTANCE



DESIGN SPEED or POSTED SPEED LIMIT mph	SD MINIMUM (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645

Note: Minimum sight distances are stopping sight distances for level grades, between -3% and +3%. Refer to AASHTO *A Policy on Geometric Design of Highways and Streets 2001,* for desirable intersection sight distances and for grade adjustments.

Figure 1160-8
Minimum Intersection Sight Distance

Table 1160-3
Accident Rate Factor (F_{ar})

Severity of sight Restriction (mph)	Degree of Hazard in Sight Restricted Area [a] Minor	Significant	Major
0	0	0.4	1.0
5	(0.3)	(0.8)	(1.4)
10	0.5	1.1	1.8
15	1.2	2.0	2.8
20	2.0	3.0	4.0

[a]: See Table 1160-4

Note: Numbers in parentheses were interpolated from J.C. Glennon "Effects of Alignment on Highway Safety: A Synthesis of Prior Research" In TBR State of the Art Report. TRB, National Research Council, Washington D.C.

Table 1160-4
Relative Hazard

Relative Hazard	Geometric condition
Minor	Tangent horizontal alignment Mild curvature (less than 3 degrees) Mild downgrade (less than 3 percent)
Significant	Low-volume intersection Intermediate curvature (3 to 6 degrees) Moderate downgrade (3 to 5 percent) Structure
Major	High-volume intersection Y-diverge on road Sharp curvature (greater than 6 degrees) Steep downgrade (greater than 5 percent) Narrow bridge Narrow pavement

Table 1160-5
Constants for L_r

Operating Speed on Vertical Curve (mph)	Equivalent speed to existing crest Vertical curve stopping sight distance (mph) (1)							
(mph)	60	55	50	45	40	35	30	25
				Values of a_0				
60	-524	-138	-25	113	202	256	305	382
55		-452	-163	11	111	172	221	301
50			-405	-65	45	115	169	248
45				-332	-76	21	82	167
40		No sight restriction			-272	-55	15	110
35						-231	-74	51
30							-193	19
25								-130
				Values of a_1				
	207.3	152.6	120.9	80.2	56.6	38.6	29.4	15.3

$$L_r = \frac{[a_0 + (a_1 \times A)]}{5280}$$

A = the absolute value of grade difference in percent

(1)TRB Special Report 214 uses the definition Highway Design Speed of the existing vertical curve.

1160.3.10. Passing Sight Distance

Operational and passing sight distances are given in Section 3B of the *Alaska Traffic Manual*. Improvements of passing distances are not required within the context of 3R projects.

1160.3.11. Grades

Grades that do not meet new construction standards should be evaluated as a potential contributing factor where there are clusters of accidents on or in the vicinity of the grade section. Grade-related accidents might include single or multiple vehicle accidents where a vehicle lost control and leaves the travel lane or is unable to stop. Countermeasures for steep grades may include warning signs or realignment.

1160.3.12. Safety Mitigation

Even though these 3R standards may not require a geometric improvement, the designer should anticipate circumstances where mitigating improvements could be made at minimum cost. For example, geometric changes at an intersection or horizontal curve to increase sight distance may not be cost-effective, but cutting brush or trees can partially alleviate the problem.

1160.4. Studies

1160.4.1. Design Study Report

Prepare a Design Study Report in accord with Chapter 4, Section 450. In addition to the Section 450 requirements, include the following in the report:

- A list of all existing horizontal and crest vertical curves that do not meet the current minimum design requirements of AASHTO for new construction
- A discussion of the design speed determination in accord with Section 1160.3.3
- A discussion of the determination of lane widths in accord with Section 1160.3.4 and the clear zone requirements as determined by Section 1160.3.8
- A discussion of horizontal curve treatments in accord with Section 1160.3.5
- A discussion of vertical curve treatments in accord with Section 1160.3.6
- A discussion of bridge features that require improvement
- A discussion of accidents at intersections and what improvements may be made

Include supportive calculations for the above items in the report.

1160.5. Gravel to Pavement

1160.5.1. General

Section 1160.5, Gravel to Pavement, applies to non-NHS road construction projects whose primary purpose is reducing maintenance costs and improving the quality of life for Alaskans by hard surfacing of gravel roads, but which may include limited shoulder, drainage, and other work related to preserving the road structure.

The existing alignment, profile, and sideslopes may remain as long as the project does not degrade any existing safety or geometric aspects. Guardrail, guardrail terminals, and bridge rail terminal connections will not routinely be upgraded to more current standards.

Signing and Markings

Inventory and evaluate all existing signing for sign placement and condition. Conform signing to the requirements of the *Alaska Traffic Manual* (ATM) and the *Alaska Sign Design Specifications* (ASDS). Install regulatory speed limit signing conforming to the chosen design speed of the roadway. Install curve, grade, advance intersection, and other warning signs as required to warn of conditions where the safe speed is lower than the posted speed limit. Other regulatory signing requirements include stop signs at side street approaches.

Upgrade signposts that do not conform to current safety standards.

1160.5.2. Design Year

The design year should at least equal the expected surface life of the selected surface type.

1160.5.3. Design Speed

Use the current posted as a minimum design speed. In the absence of posted speeds, use the criteria in *A Policy for the Geometric Design of Highways and Streets 2001,* to establish a minimum design speed.

In selecting the design speed, consider the anticipated speed of traffic traveling on the newly surfaced roadway. You may use the speed limit on paved roads of similar character in selecting design speed.

1160.5.4. Lane and Shoulder Widths

Rural Two-Lane Paved Highways

Table 1160-6 shows minimum lane and shoulder width improvements.

Waiver of Roadway Width

For roadway width less than shown in Table 1160-6, obtain a design waiver in accordance with *Alaska Preconstruction Manual* Section 1100.3. guidelines.

The minimum width for two-lane roads is 18 feet.

1160.5.5. Horizontal Curves

Radius of Curvature

No change is required under these standards.

1160.5.6. Grades

Grades do not require improvement under these standards.

Table 1160-6
Two-Lane – Two-Way Traffic
Combined Roadway Minimum Lane & Shoulder Widths
For Use With Gravel to Pavement Modified Procedure

Design Year ADT 0-2000 vpd Minimum Lane and Shoulder Width (ft)					
Design Year Traffic Volumes (ADT) in vpd					
Design Speed (mph)	0-250	250-400	400-750	750-1500	1500-2000
20	18	20	22	22	22
30	18	20	22	22	22
45	18	22	22	22	22
50	22	22	22	22	22

Superelevation

Superelevation should match the design speed for the project. Follow *AASHTO A Policy on the Geometric Design of Highways and Streets 2001*. Maximum superelevation is 6 percent cross-slope.

Superelevation Transition Length

When possible, provide minimum superelevation transition length in accordance with the *AASHTO A Policy on the Geometric Design of Highways and Streets 2001.*

Minimum Length

No change is required under these standards.

1160.5.7. Vertical Curvature and Stopping Sight Distance

Sag and Crest Vertical Curves

No change is required under these standards.

Stopping Sight Distance

No change is required under these standards.

Intersection Sight Distance for Side Streets

No change is required under these standards.

Consider clearing to the right-of-way limits to improve sight distance that does not meet AASHTO minimum sight distance standards.

Driveway Sight Distance

No change is required under these standards.

Consider clearing to the right-of-way limits to improve sight distance that does not meet AASHTO minimum sight distance standards.

1160.5.8. Bridges

No change to the existing structure or railing is required, except as necessary to keep structures serviceable through the design period.

1160.5.9. Clear Zones

No change is required under these standards.

1160.5.10. Bicycles

No enhancements required.

1160.5.11. ADA

Do not construct anything that will diminish the access to, or use of the facility by, a disabled person.

1160.5.12. Design Study Report

For gravel to pavement projects, the requirements of Chapter 4 of this manual concerning preparation of the Design Study Report are modified to include the following:

- Structural section, addressing embankment suitability. Reference section 1180.8.
- Materials sources
- A copy of the Design Study Report to the regional maintenance director/chief

Example 1160-1
Lane-Shoulders & X-Section

Glacier Highway, North Lena Loop Road to Point Stephens Road

Design Period	20
Current ADT	1027
Design Year ADT	1383
Mid Period ADT	1205
Percent Trucks	6.4%
Average Running Speed	45 mph
Terrain Values	Use "0"

Existing Lanes = 11 feet and Shoulders = 0 feet

Accident Study Period
1977 to 1987
Mid-study Period ADT 900

Cross-Section Elements
Roadside Hazard Rating selected as 6, see Figures 1160-1 through 1160-7

$A = 0.0019\ ADT^{0.882} \times 0.879^{W} \times 0.919^{PA} \times 0.932^{UP} \times 1.236^{H} \times 0.882^{TER1} \times 1.322^{TER2}$

$A = 0.0019\ (900)^{0.882} \times 0.879^{11} \times 0.919^{0} \times 0.932^{0} \times 1.236^{6} \times 0.882^{0} \times 1.322^{0}$

= 0.7 accidents /mi /year

Route No. 296000

CDS mile points from Alaska DOT&PF General Road Log: 22.93 to 21.68 = 1.25 miles

See accidents for Period = 1977 through 1987 (shown on next page)

(*Note:* Category 7, 8, 10, 11, & 12 intersection accidents do not qualify)

Example 1160-1
Lane-Shoulders & X-Section, continued

ACCNBR	ACCDTE YYMMDD	TIME	ROUTE	MI	ACC DIA	NBR VEH	TOT	MAJ INJ	MIN INJ	DAMAGE	ACC TYPE	ROAD CHAR	ROAD COND
7912635	791125 04	1630	296000	21.95	9		1				1,200	17	2
7815249	780509	1539	296000	21.72	9	1			1	800	40	4	01
8012890	801124	0640	296000	22.57	9	2				800	08	1	0
7709900	770707	1630	296000	22.14	9	1			1	2,000	25	5	01
8200598	820110	0230	296000	21.71	9	3				1,400	12	1	04
8202582	820221	1520	296000	21.75	7	3		1	3	9,000	06	1	04
8218451	821129	0750	296000	22.57	2	2				200	07	5	04
8400740	840110	0745	296000	22.55	9	1				900	29	5	05
8521909	851226	1530	296000	21.82	9	1			2	8,000	17	4	04
8606011	860422	2057	296000	21.92	9	1			1	3,000	29	4	02
8606208	860429	1426	296000	22.53	1						40	4	01
8702618	870214	2154	296000	21.71	9	1				4,000	17	1	04
8712934	871104	0825	296000	21.68	9	1					17	5	04
8715589	871216	2249	296000	21.94	9	2				600	08	5	04

Roadway Character

1. Straight and level
2. Straight and grade
3. Straight and hillcrest
4. Curve and level
5. Curve and grade
6. Curve and hillcrest

Roadway Surface Condition

1. Dry
2. Wet
3. Muddy
4. Snow/Ice
5. Slush
6. Other

Type of Accident

Collision With
1. Pedestrian
2. Pedacycle
3. Train
4. Animal
5. Moose

MV in Transport
6. Head on
7. Rear end
8. Angle

MV in Other Roadway
9. Head on
10. Rear end
11. Angle

Parked MV
12. Parked

Fixed Object
13. Bridge/Overpass
14. Building
15. Culvert
16. Curb/Wall
17. Ditch
18. Divider
19. Parking meter
20. Traffic light
21. Light support
22. Sign post
23. Utility post
24. Other support
25. Embankment
26. Fence
27. Guardrail
28. Machinery
29. Tree/Shrub
30. Other object
31. Aircraft

Non-Collision
40. Overturn
41. Fire/Explosion
42. Immersion
43. Gas inhalation
44. Other

Total 14 accidents, 10 accidents qualify.

$$\text{Actual} = \frac{10 \text{ acc}}{(1.25 \text{ mi x } 10 \text{ yrs})} = 0.8 \text{ acc / mi / yr}$$

$$\left(\frac{\text{Actual}}{\text{Predicted}} - 1\right) \text{x } 100 = \left(\frac{0.8}{0.7} - 1\right) \text{ x } 100 = 14.3$$

- Round 14.3 percent to the nearest 10 percent increment, or 10 percent
- The 10 percent increment requires an increased traveled way width by 2 feet.
- Clear zone need not be addressed after 4-foot widening. The widening reduces the accident rate sufficiently to preclude clear zone investigation.

Example 1160-2
Lane-Shoulders & X-Section

Denali Highway Rehabilitation

Design Period	10
Current ADT	100
Design Year ADT	150
Mid Period ADT	125
Percent Trucks	4.0%
Average Running Speed	50 mph
Terrain Values	"0"

Existing Lanes = 10 feet and Shoulders = 2 feet

Accident Study Period

1975 to 1985
Mid-study Period ADT 80

Roadside Hazard Rating selected as 5, see Figures 1160-1 through 1160-7

$A = 0.0019\ (80)^{0.882} \times 0.879^{10} \times 0.919^{2} \times 0.932^{0} \times 1.236^{5} \times 0.882^{0} \times 1.322^{0}$

= 0.1 accidents / mi / year

Route No. 140000
CDS mile points from Alaska DOT&PF General Road Log: 0.0 to 21.5 = 21.5 miles

See below accidents for the Period = 1975 through 1985

ACCNBR	ACCDTE YYMMDD	TIME	ROUTE	MI	ACC DIA	NBR VEH	TOT FAT	MAJ INJ	MIN INJ	DAMAGE	ACC TYPE	ROAD CHAR	ROAD COND
7712183	770722	2340	140000	5.18	9	1	1			2,000	40	4	01
8106618	810704	0901	140000	15.90	9	1				30,000	40	4	01
8106947	810712	1000	140000	21.50	1	2				4,700	07	2	03

Total 3 accidents, 2 accidents qualify (*Note*: Category 7 accident does not qualify)

$$\text{Actual} = \frac{2\ \text{acc}}{(21.5\ \text{mi} \times 10\ \text{yrs})} = 0\ \text{acc/mi/yr}$$

A > Actual Lane $\Rightarrow$ shoulder improvements not required.

Cross-Section Elements
Investigation not required by accident rate, see Tables 1160-1 and 2.

Example 1160-3
Horizontal Curve

Alaska Highway, Mile 1303 to 1285

<u>Project Parameters</u>

Project Length	17.52 miles
Design Speed (as defined in Section 1160.3.3)	60 mph
Design Period	20
ADT 1985	485
ADT 2005	750

<u>Curve Location</u> CDS mile 68.1 to 68.4

<u>Curve Data</u> $D = 5^0 - 45^0$

$L = 1502.07$ ft

<u>Accident Record for curve</u> 10-year period 1975 to 1985, 3 recorded accidents

$A_h = [AR_s \times L \times V] + [0.0336 \times D \times V]$

Solve AR_s

Project Length = 17.5 mi, CDS mile 62.6 to 80.1
Period: 1975 to 1985, 33 qualified accidents
(Total non-intersection accidents on straight roadway segments only)

Mid Period ADT (1980) = 300

Total Vehicle Miles = 300 ADT x 365 days x 10 yrs. x 17.5 mi. = 19.2 mvm

$$AR_s = \frac{33 \text{ accidents}}{19.2 \text{ mvm}} = 1.7 \frac{acc}{mvm}$$

V = 300 ADT x 365 days x 10 yrs. = 1,095,000 vehicles

$A_h = [1.7 \text{ acc/mvm} \times 0.3 \text{ mi} \times 1.095 \text{ Milveh}] + [0.0336 \times 5.75^0 \times 1.095 \text{ Milveh}] = 0.8$ accidents

Actual accidents (3) exceeds predicted A_h $(3 > 0.8)$

Therefore, improve curve to new construction minimums or check with cost-effective analysis
See following Example 1160-4.

Example 1160-4
Cost-Effective Analysis

Horizontal Curve; See Previous Example 1160-3

Given: Typical cut section

Shoulder	6 feet from new typical section
Cut height	50 feet
Horizontal line shift to accommodate new alignment	100 ft
Excavation cost	\$3 per yd^3

First cost: Curve length = 1502.07 ft from previous example 1160-3

Excavation EFC = [1502.07 x 50' x 100'] / [2 x 27]x \$3.00 = \$417,242

CRF = Capital Recovery Factor, to compare present cost of multi-year cost of improvement

$$CRF = \frac{(1.07)^{20} \times 0.07}{(1.07)^{20} - 1} = 0.0944$$

Annual First Cost = 0.0944 X \$417,242 = \$39,388 per yr.

Accident cost:

ACCNBR	ACCDTE YYMMDD	TIME	ROUTE	MI	ACC DIA	NBR VEH	TOT FAT	MAJ INJ	MIN INJ	DAMAGE	ACC TYPE	ROAD CHAR	ROAD COND
7910447	791203	1345	180000	68.25	9	2	1			25,000	06	x	x
8012908	801115	1630	180000	68.25	9	1				3,000	40	5	04
7811753	781002	1145	180000	68.25	9	1			1	800	17	6	04

Fatality	1		=	\$2,600,000
Major injury	0			
Property Damage	3	\$25,000 + \$3,000 + \$800	=	\$28,800
Total accident cost			=	\$2,628,800

10-year period (from Example 1160-3)
Annual accident cost = \$2,628,800/10 = \$262,800

Annual accident cost greater than annual first cost of improvement; therefore, the curve geometry should be changed.

Discussion

There is the question of whether the fatality was an anomaly. Was high speed involved, an object in the traveled way, or some other factor not related to the curvature? In this case, two vehicles were involved, and it is possible that the accident cause was unrelated to the curvature. If the fatality was an anomaly, then it may be reasonable to only consider the remaining accidents. In that case, the annual accident cost would be \$380 ([\$3,000 + \$800]/10), and the curve would not require improvement.

Example 1160-5
Vertical Curve

Unknown Highway, Mile 31 to 44

Project Parameters

Project Length = 13.8 miles, CDS mile 31 to 44.8
Design Speed (as defined in Section 11603.3) = 50 mph
Design Period = 20
ADT 1990 804
ADT 2010 981
Sight Distance = 475 ft (See AASHTO Policy on Design)

Curve Location CDS mile 31.6 to 31.7.

Curve Data $g_1 = 2.00\%$
$g_2 = -3.00\%$
Length = 500.00 ft

Existing Sight Distance

Select the following value for "S" which meets the stated relationship of "S" to "L."

S > L

$$S = \frac{1}{2}\left(L + \frac{1329}{A}\right) = \frac{1}{2}\left(500' + \frac{1329}{5}\right) = 383 \text{ ft}$$

Not OK; less than "L"

S < L

$$S = \left(\frac{1329 \times L}{A}\right)^{\frac{1}{2}} = \left(\frac{1329 \times 500}{5}\right)^{\frac{1}{2}} = 364 \text{ ft}$$

OK; less than "L"

Existing sight distance = 364 ft and is substandard to the required 475 ft.

See Section 1160.3.6, Vertical Curvature and Stopping Sight Distance.

Accident Record for curve 10-year period 1978 to 1987, three recorded accidents

Mid Period ADT(1983) = 600

$$N_c = \left[AR_h \times L_{vc} \times V\right] + AR_h\left(L_r\right)\left(V\right)\left(F_{ar}\right)$$

See 1160.3.6a, Sag Vertical Curves

Determine AR_h

Project Length = 13.80 mi, CDS mileage 31 to 44.8

Period: 1978 to 1987, 27 qualified non-intersection accidents

Mid Period ADT (1983) = 600

(continued on next page)

Example 1160-5
Vertical Curve, continued

Total vehicle miles = (600 ADT x 365 days x 10 yrs x 13.8 mi)/1,000,000 = 30.2 mvm

$$AR_h = \frac{27\ accidents}{30.2\ mvm} = 0.9\ \frac{acc}{mvm}$$

Solve for L_r

Equivalent speed to existing crest vertical curve stopping sight distance of 364 ft = 45 mph (nearest 5 mph) from Table 1160-5, value for a_o

From Table 1160-5, using a design speed of 45 mph

a_o = -65

a_1 = 80.2

$$L_r = (a_0 + (a_1 \times A))\left(\frac{1}{5280}\right) = (-65 + (80.2 \times 5))\left(\frac{1}{5280}\right) = 0.064\ miles$$

Find F_{ar}

From Tables 1160-3 and 4
F_{ar} = 0.8

Severity of sight restriction = (50 mph)-(45 mph) = 5 mph

Moderate down grade @ -3% = significant

Find Vertical Curve Volume

V = (600 ADT x 365 days x 10 yrs)/1,000,000 = 2.190 mv

Solve N (Number of accidents for ten year period in question.)

$$N_c = \left[AR_h\ x\ L_{vc}\ x\ V\right] + AR_h\ (L_r)(V)(F_{ar})$$

$$N_c = \left[0.9\frac{acc}{mvm}\ x\ \frac{500'}{5280\frac{ft}{mi}}\ x\ 2.19mv\right] + 0.9\frac{acc}{mvm}(0.064\ mi)(2.19mv)(0.8) = 0.29\ acc$$

Actual accidents (3) exceeds predicted N_c

Therefore, improve curve to appropriate minimums or check with cost-effective analysis.

1170. Special Design Elements

1170.1. Roadway Illumination

Select and design new roadway lighting systems in conformance with the ANSI/IES RP-8-14 "Roadway Lighting" and the following:

- Do not exceed the allowable veiling luminance ratios, as shown in Table 2-3 of the RPRL.
- Use cutoff or full cutoff luminaires where feasible.
- Avoid staggered light pole arrangements where feasible.

"Small Target Visibility" results (as defined in section 2.3 of RPRL) may be used as a tiebreaker when choosing between systems that otherwise perform similarly.

1170.2. Bus Stops

Bus transit is an integral part of the operation of many urban streets and highways. Follow local transit operator guidance and when none exists following guidance in AASHTO Guide for Transit Facilities (AGTF). Coordinate with existing transit organizations and consider the existing operating policies and the future transit needs of communities where applicable, particularly where bus movements caused by bus stops will affect intersection capacity.

Normally, locate bus stops on the far corner of intersections to free the approach shoulder lane for right-turning vehicles.

Consider other transit facilities for buses, such as bus passenger shelters, park-and-ride lots, and turnouts (separate loading zone). Base the decision to include bus turnouts on the volume and turning movements of both the bus traffic and through traffic, the distance between bus stops, and right-of-way limitations. Base the design features for turnouts on the size and turning radius of the bus. Generally, radii allow buses to remain in the outer lane during the full turn. For ADA access considerations, also see Americans with Disabilities Act Accessibility Guidelines.

1170.3. Bus and HOV (High Occupancy Vehicle) Lane

Include special lanes for buses and HOVs on projects only where such an auxiliary lane is part of an integrated network for buses and/or HOVs. Typically, these lanes are shoulder lanes of sufficient width to accommodate the wider buses. A normal bus/HOV lane is 12 to 14 feet wide, with no additional shoulder provisions.

Bus/HOV lanes should be to the right of normal traffic. This makes the shoulder lane available during off-peak hours for disabled and right-turning vehicles.

1170.4. Board Roads

1170.4.1. General

This section describes criteria for the design of board roads, otherwise considered drivable boardwalks.

The construction and maintenance of roads are sometimes extremely expensive due to natural constraints and the lack of locally available materials. An economical alternative to a road is a drivable board road. These facilities should be designed to accommodate light vehicle use.

1170.4.2. Board Roads

Water, sewer, and solid waste conveyance systems in rural Alaska are not always feasible without great expense due to permafrost and other natural constraints. As an alternative, water may have to be delivered to each home from a community well and sewage collected and hauled to a sewage lagoon. It may be necessary to transport solid waste to a community dumpsite.

It is common practice to handle most of this transport with four-wheel, all-terrain vehicles (ATVs) pulling trailers loaded with tanks. Sizes of vehicles and tanks vary depending on the size of the community. Other transportation systems may be necessary to provide maintenance access. For ADA accessibility considerations, see Section 1120.10. Consider the following in design for a board road:

1. Use a design speed of 5 mph, or as recommended by the regional traffic engineer.
2. Use as the minimum design vehicle a four-wheel, all-terrain vehicle pulling a two-wheel trailer with an 80-gallon tank, with a design load of up to 700 pounds per wheel.
3. Use a minimum design clear width of 8 feet including wheel rails, with a recommended 10.5 feet minimum in locations where larger vehicles, like a Utility-Task Vehicle (UTV), are anticipated.
4. Design and specify horizontal and vertical geometry, if required, on a per project basis. Angled corners may be necessary to ensure adequate turning radii for ATV's using the boardwalks. Ensure board roads adequately span any existing or proposed utility lines or other obstructions on the ground surface.
5. Design turnouts, if required, to accommodate the design vehicle.
6. Space surface planks 1/4" minimum and 1/2" inch maximum apart to enable drainage.
7. Ensure timber treatment complies with the Clean Water Act.
8. Galvanized connecting hardware is preferred. Ensure any hardware is recessed (1/8" max) on the driving surface of boardwalks. Designers should consider using stainless steel hardware in coastal environments.
9. Maintain access to adjacent properties and other facilities.
10. Assess foundation design needs with regional materials section to develop any specific requirements.
11. An anchoring system may be required in areas that are subject to seasonal flooding.
12. Board roads installed in or near tidal areas may need to be built on pilings to avoid flooding during extreme high tides.
13. Engage the community regarding emergency response procedures to ensure access is available.
14. Include the following design elements:
    a. The size of the gap between the boards.
    b. Direction of the boards.
        i. Perpendicular – Required in areas where board roads are designed to serve primarily non-motorized traffic. Must be considered as a design alternative in cases where non-motorized traffic is anticipated. This may require additional transition details.
        ii. Parallel – Preferred where board roads are designed to serve motorized traffic. Consider surface plank spacing of 0.5-inches. Parallel board installations are typically more resilient to snowmachine and ATV traffic and simpler to maintain in remote areas.
    c. Vertical grades.
    d. Wheel curbs and handrail, when applicable. Wheel curbs are not permitted at access points.
    e. Detectable warning tiles when entering vehicular path, when applicable.

    Document ADA compliance and exceptions, as applicable, in the DSR.

1170.5. Boat Ramps

1170.5.1. General

This section describes basic criteria for the design of boat ramps. However, the final design will involve many other engineering factors to provide a safe, efficient facility. Grades, alignment, and surface materials are probably the most important factors.

1170.5.2. Grades

The maneuvering portion of the ramp should be relatively flat at 4 to 8 percent slope. The main ramp slope should be greater than 12 percent and less than 15 percent. Flatter ramps require backing the motorized towing vehicle too far into the water before the boat floats free of the trailer. Steeper grades make it difficult to pull the loaded trailer up the ramp. A 14 percent grade is desirable.

1170.5.3. Alignment

If possible, design the ramp and approaches so that the combination of towing and towed vehicles lines up directly down the ramp. Avoid turning movements while backing if possible.

1170.5.4. Surface

Use concrete planks from two feet above the high-water line to a minimum of three feet below the mean low-water line to permit unloading a boat without the trailer wheels leaving the planking, even at mean lower low-water. The ramp above the planking should be firm and have a surface that provides adequate traction to the towing vehicle when pulling a loaded trailer from the water. Extend and bury the last three to four planks beyond the lowest part of the concrete ramp, extents described above, for scour protection against power loading or prop wash.

1170.5.5. Lanes

Generally, a facility should have one ramp lane for every 20 to 30 boat trailer parking spaces for areas with high-turnover rates. Facilities with low turnover may have a ratio of one ramp lane for every 30 to 50 boat trailer parking spaces. Boat ramp lane width should range from 12 to 20 feet, where 16 feet wide is recommended.

1170.5.6. Other Considerations

Wherever you construct a boat ramp, provide sufficient areas for parking, including for boat trailers. Provide piers or floats adjacent to the ramp for access to the boat after flotation. Consider providing the following based on the use in the area:

1. Staging area adjacent to the ramp to prepare the boat for launching.
2. Tie-Down area adjacent to the ramp to prepare the boat for trailer after it is hauled from the water.
3. Lighting on the float if used frequently at twilight or night.
4. Wash-down location on site. This ensures that invasive species that may be present in the water are not transferred to other locations the boat may be launched at.
5. A spill kit mounted at the top of the float that includes oil absorbents.
6. Small covered sign board for posting of emergency contact information and relevant ramp information.
7. “Kids Don’t Float” life jacket loan station at the launch through the Alaska office of Boating Safety.

1170.5.7. References

1. States Organization for Boating Access (SOBA) design handbook
2. Department of Natural Resources, Alaska State Parks, Design and Construction Section. Recreational Standard Drawings are located here for reference: https://dnr.alaska.gov/parks/designconstruct/standarddrawings.htm

1170.6. Airway-Highway Clearances

Whenever a highway project will involve construction or operations within 1.74 nautical miles (2.00 statute miles) of an airport, airstrip, heliport, or other aircraft facility, be aware of the airspace navigational requirements of the aircraft facility (reference FAA Order 5000.3). 23 CFR, Part 620, Section 620.103 (c) states:

> *“Federal-aid funds shall not participate in projects where substandard clearances are created or will continue to exist.”*

14 CFR Part 77, Federal Aviation Regulations, describes standards used to determine obstructions to air navigation that may affect the safe and efficient use of navigable airspace and the operation of planned or existing air navigation and communication facilities. Conform to these standards whenever any of the following conditions exist:

1. The project is near an FAA-recognized or FAA-controlled aircraft facility
2. The project involves a federal-aid route
3. The project is federally funded in whole or in part.

If a new or existing road is found to be a Part 77 obstruction, an obstruction evaluation study must be performed to determine if the Part 77 obstruction will have an adverse effect that necessitates changing the approach procedures at the nearby airport.

On air strips and other non-FAA facilities, conform to federal regulations or document justification for noncompliance. Furnish a copy of the documentation to the commissioner.

1170.7. Highway Signs, Luminaires Traffic Signals, Poles, and Posts

1170.7.1. General

Sign, electrolier, and signal design must conform to the requirements of the *Alaska Traffic Manual*.

Design highway lighting structures, high tower lighting structures, and traffic signals to conform to the SSSS as indicated in Section 1100.

1170.7.2. Sign Supports

Design sign post supports in accordance with Figures 1170-1 through 1170-11.

Place all new roadside signs and luminaires on breakaway supports on high-speed highways located within the clear zone width, unless you locate them behind a barrier or crash cushion that is necessary for other reasons. Supports outside this suggested clear zone should preferably be breakaway where there is a probability of being struck by errant vehicles.

Replace all existing sign supports that do not comply with the DOT&PF Roadside Hardware Eligibility Program.

1170.7.3. Breakaway Supports

The design of breakaway support mechanisms allows them to function properly when loaded primarily in shear. The design of most mechanisms allows them to be hit at bumper height. If hit at a significantly higher point, the bending moment in the breakaway base may be sufficient to bind the breakaway device.

1170.7.4. Large Roadside Signs

Large roadside signs are greater than 50 square feet. They typically have two or more breakaway support posts. To achieve satisfactory breakaway performance, they should meet the following criteria (see Figure 1170-11):

- Place a hinge at least 7 feet above the ground so no portion of the sign or upper section of the support is likely to penetrate the windshield of an impacting vehicle (see Standard Plan S-31, Sign Post Base and Foundation).
- A single post, if 7 feet or more from another post, or all posts within a 7-foot path, should weigh less than 45 lbs/ft. The total weight below the hinge, but above the shear plate of the breakaway base, should be less than 600 pounds.
- Do not attach supplementary signs below the hinges if such placement is likely to interfere with the breakaway action of the support post or if the supplemental sign is likely to strike the windshield of an impacting vehicle.

1170.7.5. Small Roadside Signs

Small roadside signs are those supported on one or more posts and having a sign panel area less than 50 square feet. Small sign supports are driven directly into the soil, set in drilled holes, or mounted on a separately installed base.

The breakaway mechanisms of small signs supports consist of a base bending fracture or breakaway coupling design (see frangible coupling details on Std Plan S-31). The bottom of a small sign panel should be a minimum of 7 feet above the ground and the top of the panel a minimum of 9 feet above the ground to minimize the possibility of the sign panel and post rotating on impact and striking the windshield of a vehicle.

Fracturing sign supports are wood or steel posts connected at ground level to a separate anchor. Wood posts are typically set in drilled holes and backfilled.

1170.7.6. Multiple Post Supports for Sign Supports

Consider all breakaway supports within a 7-foot width in multiple post sign structures as acting together. This 7-foot criterion is based on a need to minimize the potential for unacceptable performance of breakaway hardware. In some cases, a vehicle could leave the roadway at a sufficiently high angle that it would hit two posts within a 7-foot path. In other cases, a vehicle could yaw in the roadside to such an extent that it would strike two posts within a 7-foot path. In many instances, the greatest change in vehicle velocity occurs when hitting breakaway hardware at slower speeds because less energy is available to activate the breakaway mechanism. Since vehicles leaving the roadway at very high angles or yawing vehicles would likely be traveling at slower speeds, the 7-foot criterion is a reasonable safety factor that you should use in roadside design of breakaway hardware.

Do not use sign installations with 2 or more 2.5” PST posts closer than 7 feet. See Chapter 4 of the Roadside Design Guide (RDG) for more information.

1170.7.7. Signal Poles

Signal poles are obstacles. The mastarm loading overturning moment (due to equipment positioning) and wind loads require substantial poles with fixed bases and foundations. For signal pole installations in urban or restricted environments, refer to Chapter 10 of the RDG for installation considerations.

Where signalization is required for intersection control on high-speed roadways (>45 mph) or in rural areas, place signal poles outside of the clear zone where practical. However, offset location of the pole is constrained by the need to position mastarm equipment over lanes, and because mastarm length is limited to 75 feet. Removal or relocation of the signal pole outside of the clear zone may not be an option. The design loads prohibit breakaway supports, so the only obstacle treatment options are to shield the poles with crash cushions or barriers, or to provide obstacle delineation.

Evaluate signal poles in high-speed, rural locations for cost-effectiveness to determine if a barrier should be installed, or if a pole can stand without treatment (the signals on the structure should provide adequate delineation). Use the procedures and methods in 1130.6 of this manual to complete a cost-effective analysis and determine the appropriate treatment for signal poles located inside the clear zone at high-speed locations.

1170.8. Fencing

1170.8.1. Introduction

Fencing may be required or desirable on some highway projects. The need for fencing can be identified during planning, scoping, environmental document, design, ROW, or construction phases of a project.

This section covers permanent fence installation. Temporary installations, such as during construction, are not covered in this Section.

1170.8.2. Functions

Fencing serves a number of purposes, and often do serve multiple purposes, including:

1. Barrier to human and wildlife encroachment
2. Safety
3. Property boundary delineation
4. Security
5. Channelization
6. Privacy
7. Noise reduction
8. Snow drift abatement

1170.8.3. Types

The *Standard Specifications for Highway Construction* – Section 607 – covers construction of fences. The *Alaska Standard Plans Manual* contains standard plans and details for these types of fences.

1170.8.4. Design Considerations

Install fence consistent with the clear zone concept outlined in Section 1130.2.3 of this manual. Avoid installing fence in drainage collection areas.

Barrier Fence

Barrier fence provides maximum protection against ROW encroachments by pedestrians, bicyclists, wildlife and other motorized vehicles such as snow machines and ATVs.

Consider barrier fence:

- Along fully or partially access controlled highways
- Between freeways or expressways and adjacent frontage roads or business districts
- Near schools, colleges, playgrounds, parks and athletic fields
- Where existing streets dead end at a freeway controlled access line
- In industrial areas or large residential developments
- Adjacent to military reservations

- At other locations were a barrier is needed to protect against vehicular, pedestrian, bicycle, or wildlife encroachment.

Barrier fence is generally installed parallel to centerline and on, or just inside, the ROW line or access control line. Fencing on a continuous alignment usually has a pleasing appearance and is the most economical to construct and maintain.

Safety Fence

Safety fence is installed:

- To protect users of sidewalks and paths located within the ROW from hazards adjacent to or near these transportation features
- To protect the general public and maintenance workers from other readily accessible hazards within the ROW
- To protect adjacent private property from hazards at or near the ROW line

Consider safety fence when:

1. Vertical drop offs equal, or exceed 4 feet
2. Side slope and slope height is steeper than 2H:1V and greater than 8 feet, respectively
3. Permanent bodies of water over 3 feet deep or swift flowing water are present
4. Children or mobility impaired persons are present in significant numbers near the hazard(s)

Other factors such as proximity and likelihood of exposure to hazard from paths and sidewalks, and severity of hazard need consideration. When deciding the necessity for safety fence, engineering judgment should prevail.

Install 4 foot high, minimum, safety fence. In some circumstances, safety rail will serve the same function as safety fence. Safety rail is not part of this Section.

Property Boundary Delineation

Fencing can delineate property boundaries, but this purpose is usually secondary to a primary function such as a barrier or safety fence.

Security Fence

Security fence is commonly used on or adjacent to military reservations.

Channelization Fence

Channelization fence is commonly used for directing and funneling pedestrians or wildlife to, or away from, specific locations or structures. In the case of wildlife, this could be an at-grade crossing or an underpass structure.

Privacy Fence

Privacy fence is used for visual screening. Materials, geometry and alignment are selected to meet the location-specific terrain, vistas and aesthetics.

Plastic coated chain link with vinyl slats, available in a variety of colors, is a cost-effective privacy fence.

Custom privacy fence may be used in special cases where the context of the physical and human environmental dictates it, or when stipulated in ROW agreements.

Noise Barrier

Refer to the Alaska DOT&PF Alaska Environmental Procedures Manual Noise Policy for guidance on when to consider installing noise fence.

http://www.dot.state.ak.us/stwddes/desenviron/resources/noise.shtml

Select alignment, geometry and material for the target level of noise reduction.

Snow Drift Abatement Fence

Consider the use of snow fence where blowing and drifting snow can inhibit maintenance and operations. Also consider fencing where snow removal operations could cause private property damage.

1170.8.5. Other Considerations

Except where warranted for highway applications, fencing is normally the responsibility of the abutting property owner. Existing private fences within the State ROW are considered encroachments that property owners must remove it at their own expense.

If a request by a private property owner, public agency or local government is made for additional fencing during construction, field personnel should confer with Design on its merits. If warranted, provide documentation justifying the need in the change order.

Metallic fencing can interfere with airport traffic control radar. When locating fencing in the vicinity of an airport, contact the Federal Aviation Administration to determine whether metal fence will create radar interference at the airport. If so, use non-metallic fencing.

1170.8.6. References

AASHTO – *An Informational Guide on Fencing Controlled Access Highways* - 3rd Edition November 1990.

1170.9. Rumble Strips

1170.9.1. Introduction

Rumble strips are a cost-effective safety treatment to reduce the number and severity of run-off-road and lane departure crashes. Rumble strips provide an auditory and tactile warning to errant or inattentive drivers that they are leaving their lane.

1170.9.2. Policy

Install rumble strips on rural roads with:

a. Speed limits of 50 mph and above, and

b. 6-foot or wider shoulders without guardrail, or 7-foot or wider shoulders with guardrail

Install gaps on roads where bicycles are allowed.

Do not install rumble strips:

a. On roads with speed limits of 45 mph or lower.

b. On pavements or surface treatments less than 2” thick

c. On pavement with substantial alligator and/or fatigue cracking

d. Between through lanes and turning lanes

e. On bridge decks, bridge approach slabs, or concrete weigh-in-motion slabs

f. On roads programmed for overlay, rehabilitation, or reconstruction in less than three years.

Centerline rumble strips may be installed between opposing lanes of traffic on segments of highway with a history of severe head-on/crossover crashes. Centerline rumble strips are continuous throughout the stretch of highway, whether or not passing is permitted. Consult with the regional traffic and safety engineer when considering installation of centerline rumble strips.

Install rumble strips in accordance with Standard Plan T-25.

1170.10. At-Grade Railroad Crossings

1170.10.1. Introduction

Alaska has two railroads: the Alaska Railroad and the White Pass-Yukon Railroad. These facilities contain nearly 200 at-grade railroad-highway crossings that the railroad companies and Department share responsibility for maintaining and providing traffic control devices for public crossings.

1170.10.2. Policy

Projects with at-grade railroad crossings will bring any existing crossing up to the basic safety standards presented in the Alaska Traffic Manual (ATM).

New crossings must be constructed to meet the ATM, the *American Association of Railroads Rail/Highway Grade Crossing Handbook*, and other State standards for the installation of passive and active warning devices.

At-grade railroad crossings located wholly, or partially, within the limits of a project shall be upgraded to current ATM standards. The limits of an at-grade railroad crossing include the portions of the highway in advance, and on both sides, of the railroad tracks in which traffic control devices (signs, traffic markings, signals, etc.) are located to warn highway users of the track crossing. Project improvements on any portion of the at-grade railroad crossing requires upgrade of traffic control devices for the entire crossing.

1170.10.3. References

See the Traffic and Safety Resources Railroad-

Highway Crossings webpage for further information and resource links.

http://www.dot.state.ak.us/stwddes/dcstraffic/rail-hwy.shtml

The latest guidance from the railroad company should be considered when designing. *Technical Standards* *for Roadways Trails Facilities in the ARRC ROW*, dated January 2014.

1170.11. Landscaping

1170.11.1. Introduction

Comply with DOT&PF Policy and Procedure 5.05.030, Beautification of the Highway Right-of-Way (P&P 5.05.030), when placing landscaping in a project right-of-way. P&P 5.05.030 is available online at:

https://dot.alaska.gov/admsvc/pnp/local/dot-jnu_123693.pdf

If landscaping is determined to be appropriate on a State of Alaska owned or maintained facility, collaborate with the local M&O superintendent, or designee, requirements regarding type of landscaping, maintainability and survivability, and budgetary impacts. This applies even if a maintenance agreement will be utilized for maintaining landscaping.

If the facility is not State of Alaska owned or maintained, consult with the appropriate maintenance entity for that facility.

Document all new landscaping in the project Design Study Report. If landscaping is proposed outside of a capital improvement project, provide similar documentation to that required in a Design Study Report to document the rationale for adding landscaping.

1170.12. Pavement Markings and Delineators

1170.12.1. General

Pavement markings and delineators define the vehicular roadway travel lanes and identify the locations of barriers.

1170.12.2. Durable Pavement Markings

Based on marking type, number of lanes and AADT use durable pavement markings on stable pavements on new construction projects, NHS routes, control routes and numbered routes. Use Table 1170-1 to select minimum requirements for projects that require durable markings. Inlaid preformed symbols are an option in short term low wear situations, however methyl methacrylate (MMA) is preferred. Do not use Preformed marking tape (PMT) in any permanent situation.

1170.12.3. Recessed Pavement Markings

Recessed Pavement Markers (RPMs) are typically used in areas with higher amounts of rainfall to supplement the painted pavement markings. Alaska Standard Plan T-06 provides layout and installation details.

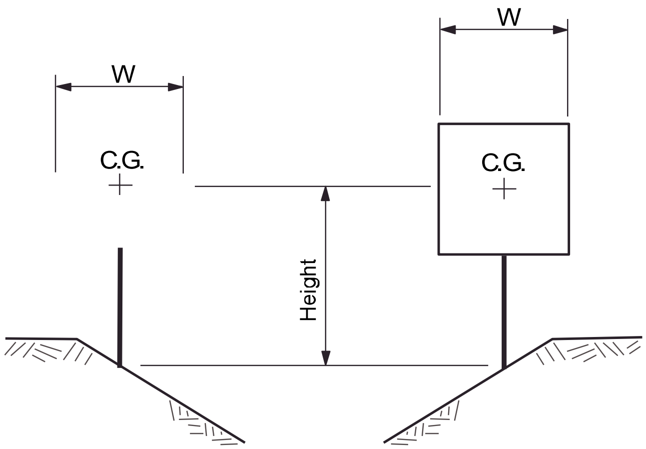
1170.12.4. Delineators

Delineators such as terminal marker posts and snow poles provide travel lane guidance and extend barrier locations, especially during inclement weather. Shoulder snow pole delineators may be applicable in areas with poor winter visibility or in areas with heavy snow accumulation. Chapter 3F of the Alaska Traffic Manual provides guidance on the applicability of delineators.

Table 1170-1
Design Durable Marking Guide for Stable Pavements

<table>
<tr><th colspan="7">Design Durable Marking Guide for Stable Pavements</th></tr>
<tr><td colspan="7">Marking Materials and Application</td></tr>
<tr><td></td><td><3000 AADT</td><td colspan="2">3000 < 6000 AADT</td><td colspan="2">> 6000 AADT</td><td>Any volume: NHS interstate, controlled access routes</td></tr>
<tr><td>Marking Type</td><td>One or Two Thru Lanes, Each Direction</td><td>One Thru Lane Each Direction</td><td>Two Thru Lanes Each Direction</td><td>One Thru Lane Each Direction</td><td>Two Thru Lanes Each Direction</td><td>Three Thru Lanes Each Direction</td></tr>
<tr><td>Longitudinal Lines between Lanes (Skips, Solids): & Unsignalized Sidestreet Stop Bars</td><td rowspan="2">DOT&PF Paint Spec, or Regional Guidance</td><td>Surface MMA 60-125 mils</td><td>Grooved-In MMA 60-125 mils</td><td colspan="3" rowspan="3">Grooved-In MMA 125-250 mils</td></tr>
<tr><td>Transverse Lines for All Way Stops, Signalized Crosswalks, Symbols, Letters</td><td colspan="2" rowspan="2">Grooved-In MMA 250 mils</td></tr>
<tr><td>Transverse Lines and Symbols - Unsignalized School Zones, Railroad Crossbucks</td><td>Grooved-In MMA 60-125 mils</td></tr>
<tr><td>Roundabouts (functional areas)</td><td>Grooved-In MMA 125-250 mils</td><td colspan="5">Grooved-In MMA 250-500 mils</td></tr>
<tr><td colspan="7">Note: When determining marking thickness, the maximum allowable in the range shall be used. If minimum allowable thickness is selected, engineering judgement based on regional and climatic conditions must be used for justification.</td></tr>
</table>

SIGN POST DESIGN SPECIFICATIONS

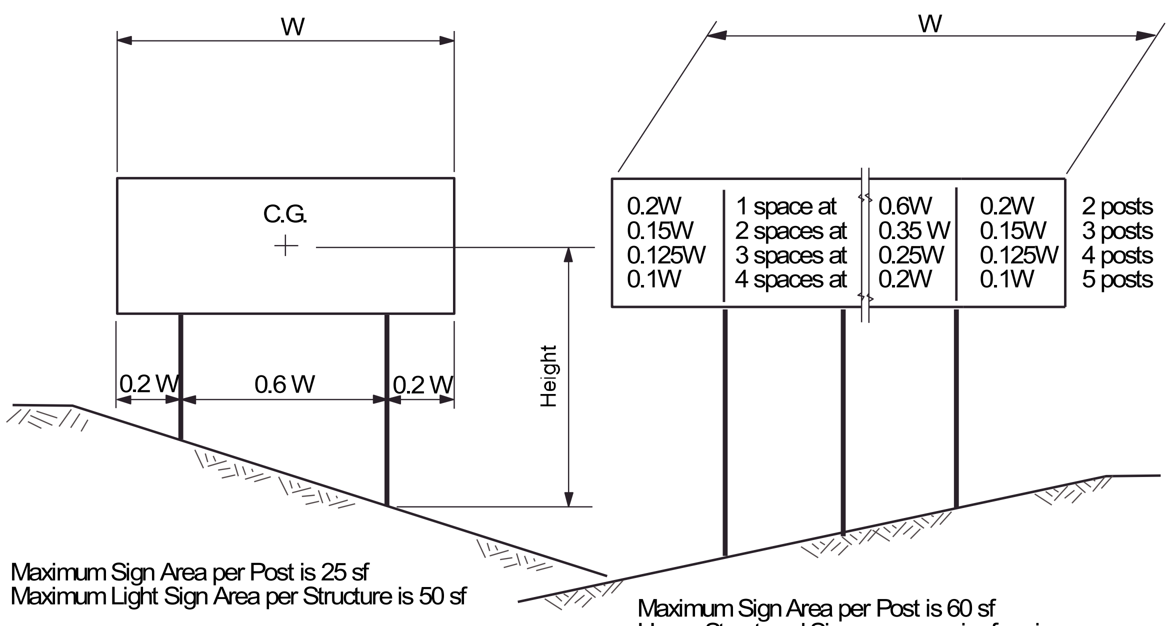


GENERAL NOTES for SIGN POST SELECTION

1. Post Materials are indicated on appropriate Alaska Standard Plans or in Specifications.

2. Solid lines on Figure 1170-5 through 1170-10 indicate maximum use of the indicated post. Any combined value of sign area and height to the right or above the solid line indicates the use of the next larger post.

3. Designer should determine the type of sign support by the following: Wind velocities expected in the project area, location of sign in sheltered or exposed areas, temporary or permanent type sign, expected life of sign, and maintenance cost in relation to construction cost.



Maximum Sign Area per Post is 25 sf
Maximum Light Sign Area per Structure is 50 sf

LIGHT SIGN STRUCTURES
< 50 sf

Maximum Sign Area per Post is 60 sf
Heavy Structured Signs may require framing.
See Standard Plan S.00.

HEAVY SIGN STRUCTURES
≥ 50 sf

Figure 1170-1
Sign Post Design Specifications

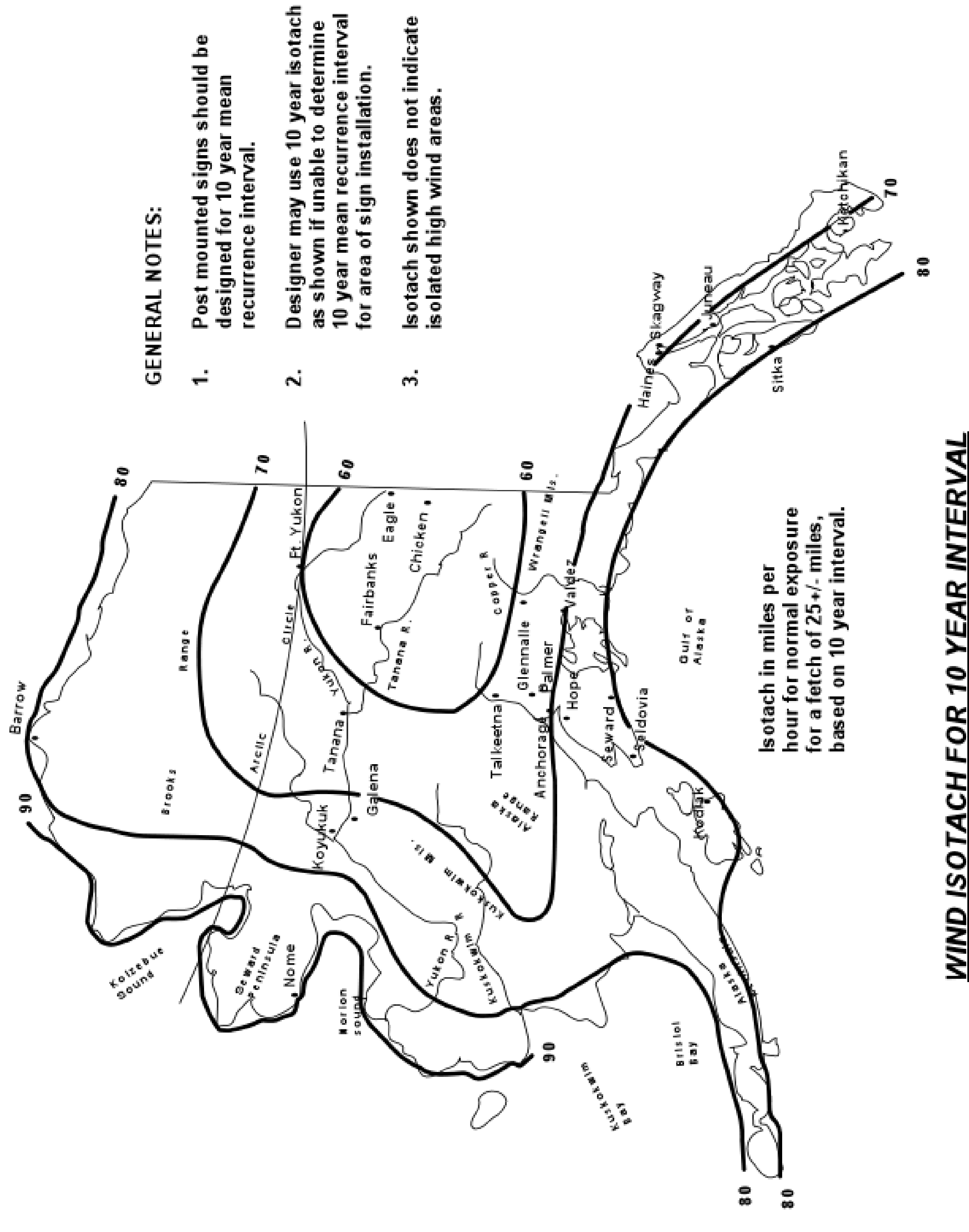


Figure 1170-2
Wind Isotach for 10-Year Interval

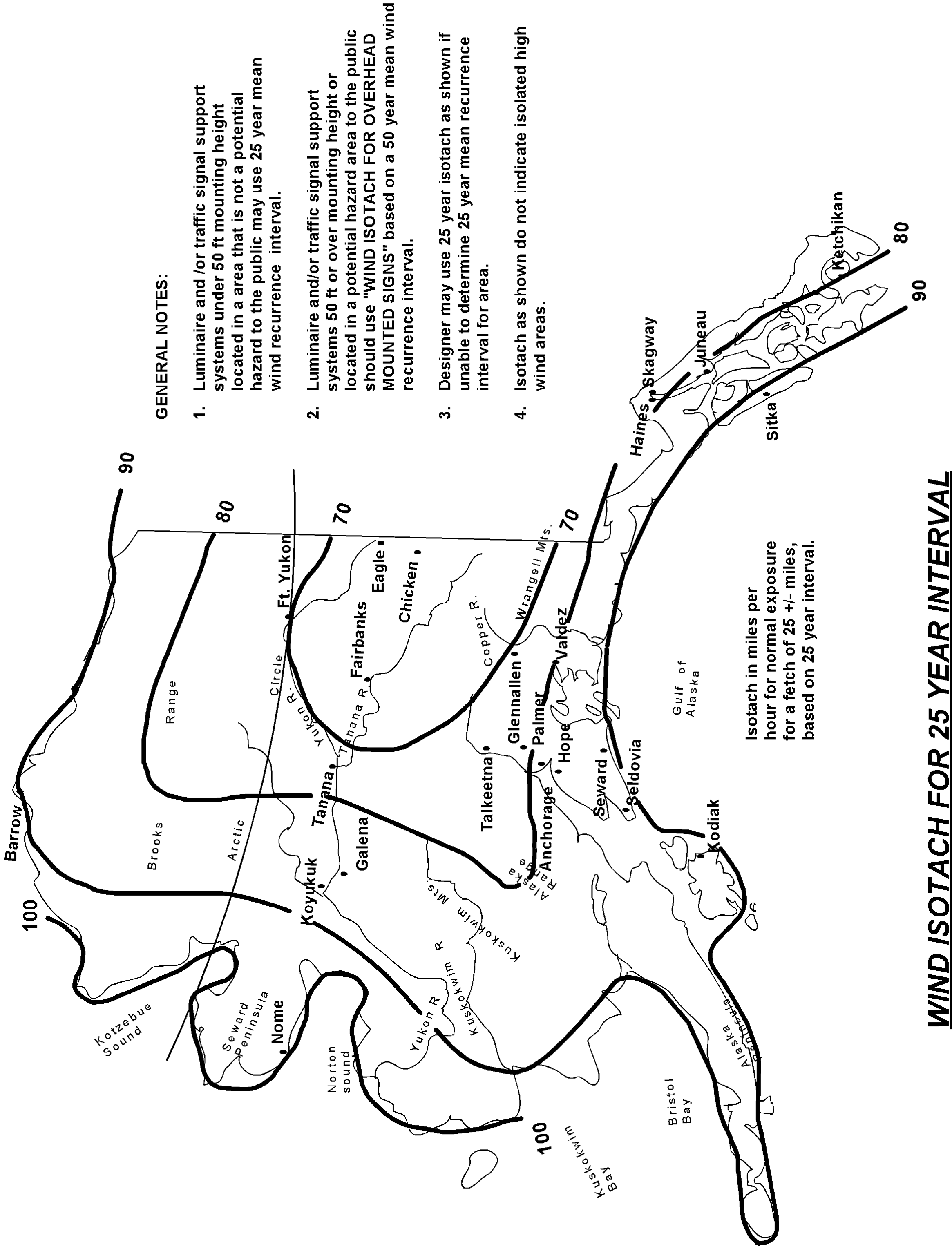


Figure 1170-3
Wind Isotach for 25-Year Interval

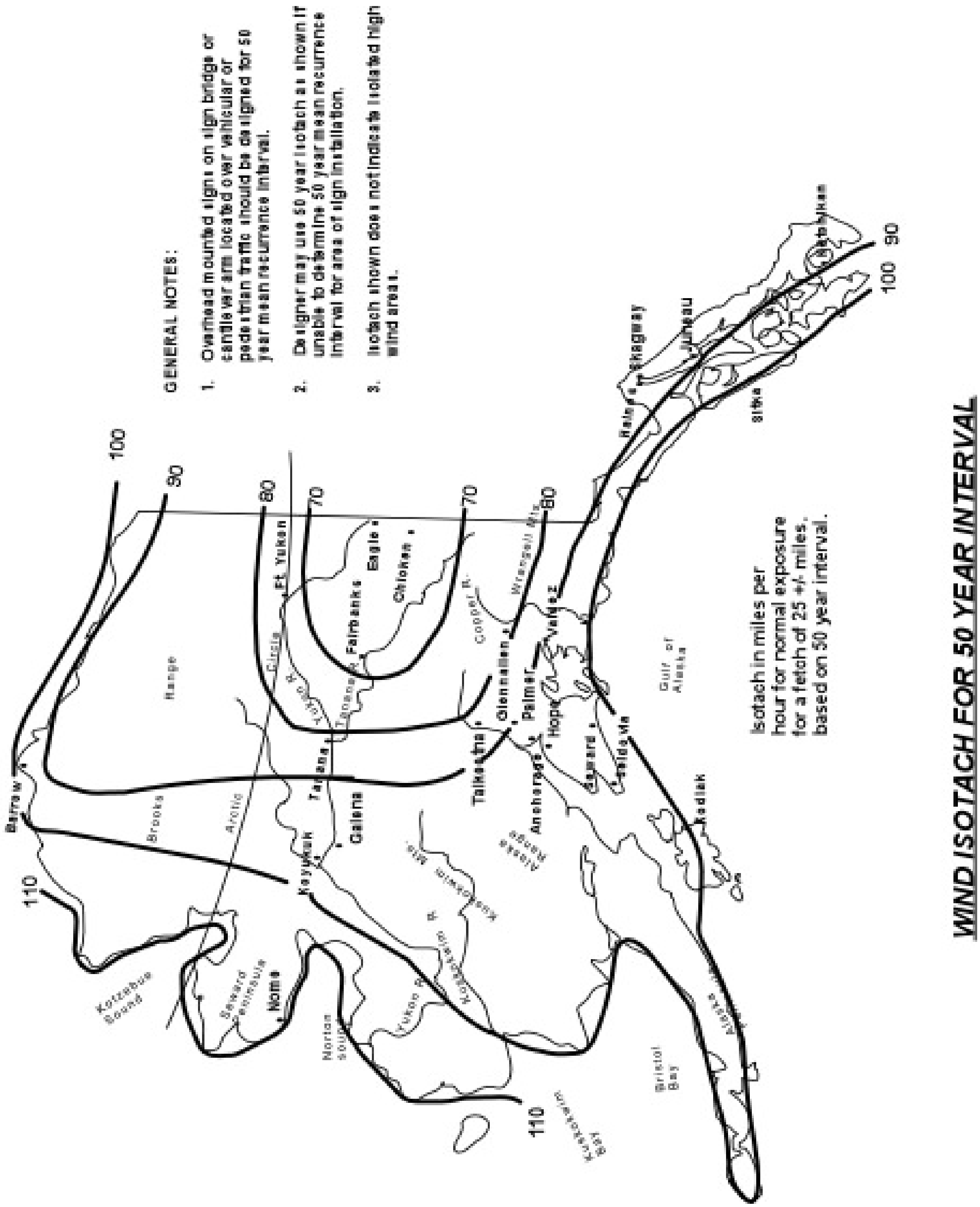
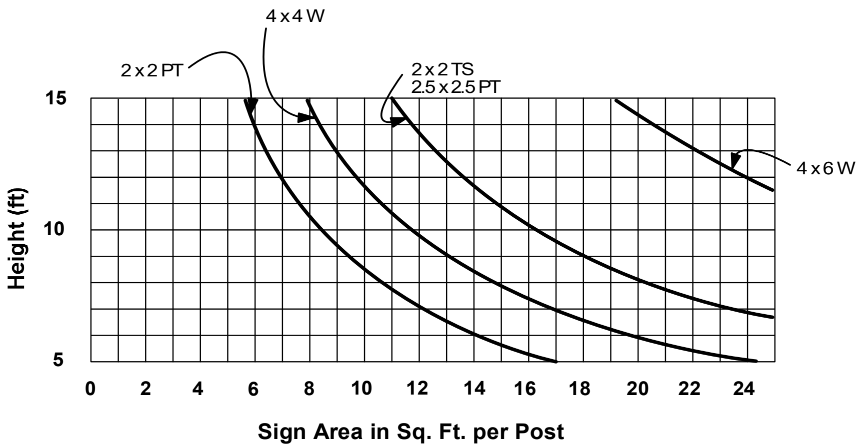
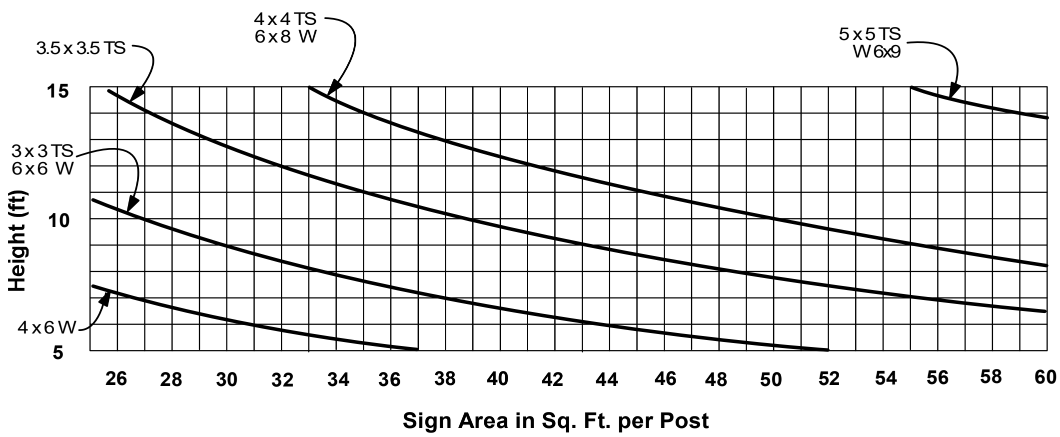


Figure 1170-4
Wind Isotach for 50-Year Interval

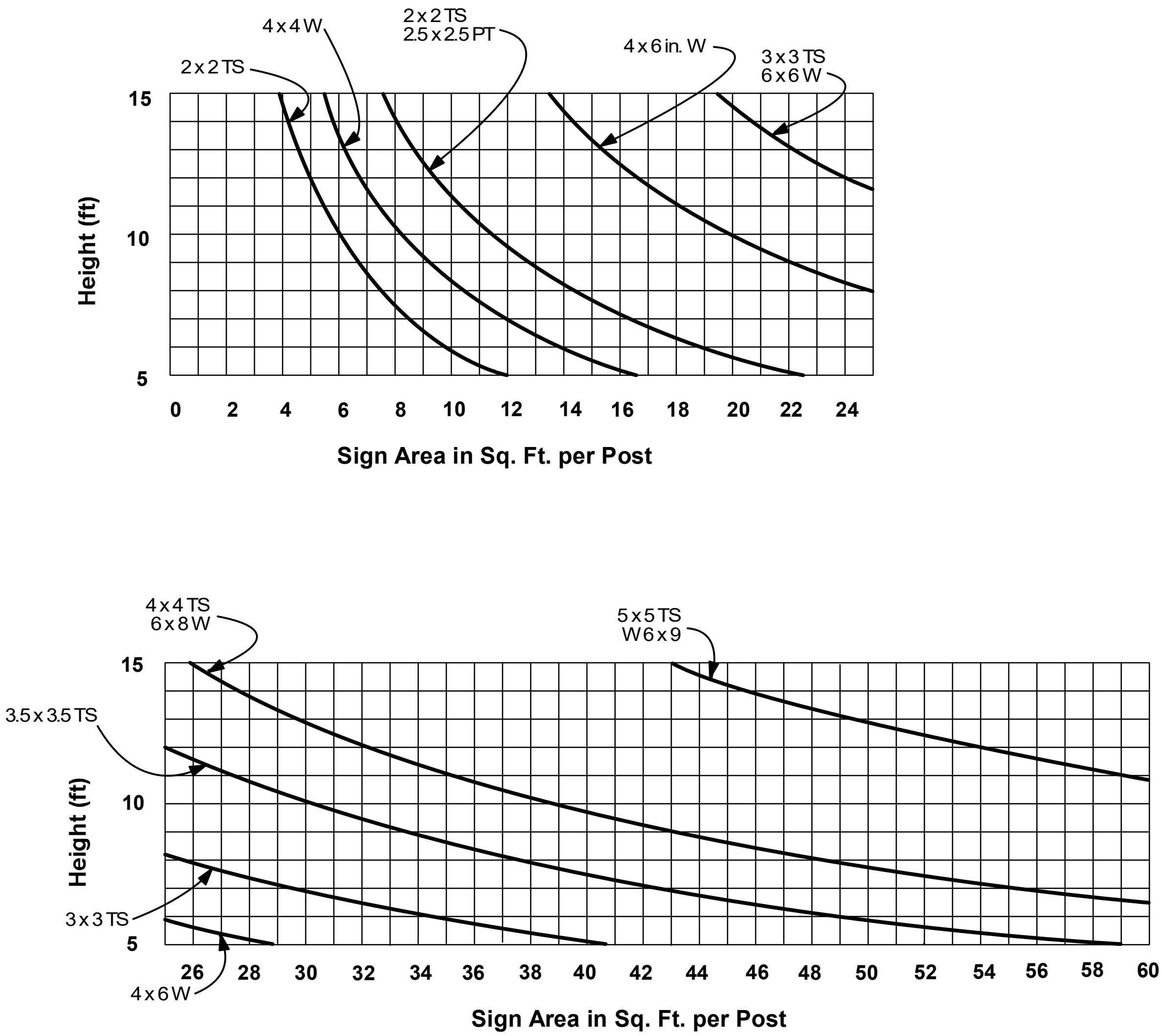




POST MATERIAL

PT....... .Perforated steel tubing (0.105 in. wall)
TS.........Steel tube square (0.1875 in. wall)
_x_ W....Treated wood
W_x_.....Steel W shapes

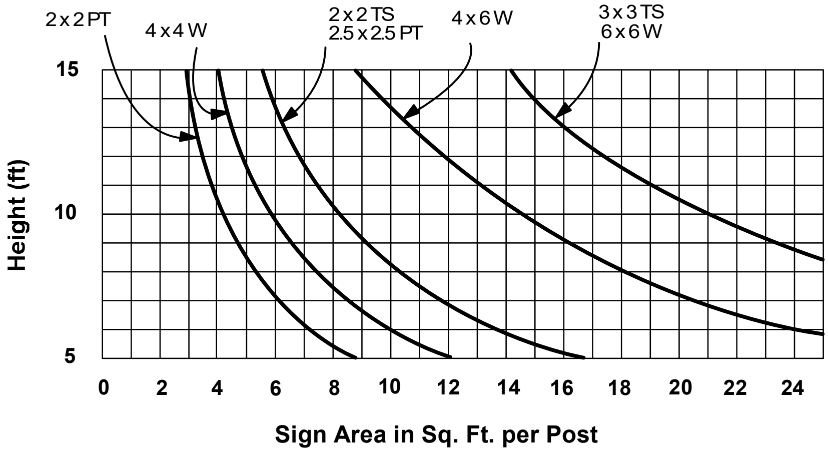
Figure 1170-5
Sign Post Selection for 50 mph Design Wind Speed

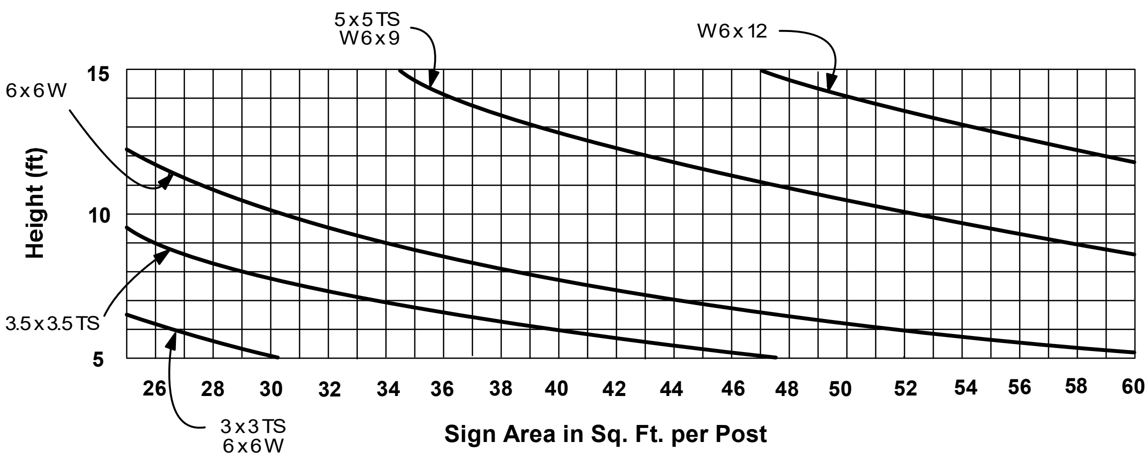


POST MATERIAL

PT.... ....Perforated steel tubing (0.105 in. wall)
TS.........Steel tube square (0.1875 in. wall)
_x_ W....Treated wood
W_x_.....Steel W shapes

Figure 1170-6
Sign Post Selection for 60 mph Design Wind Speed

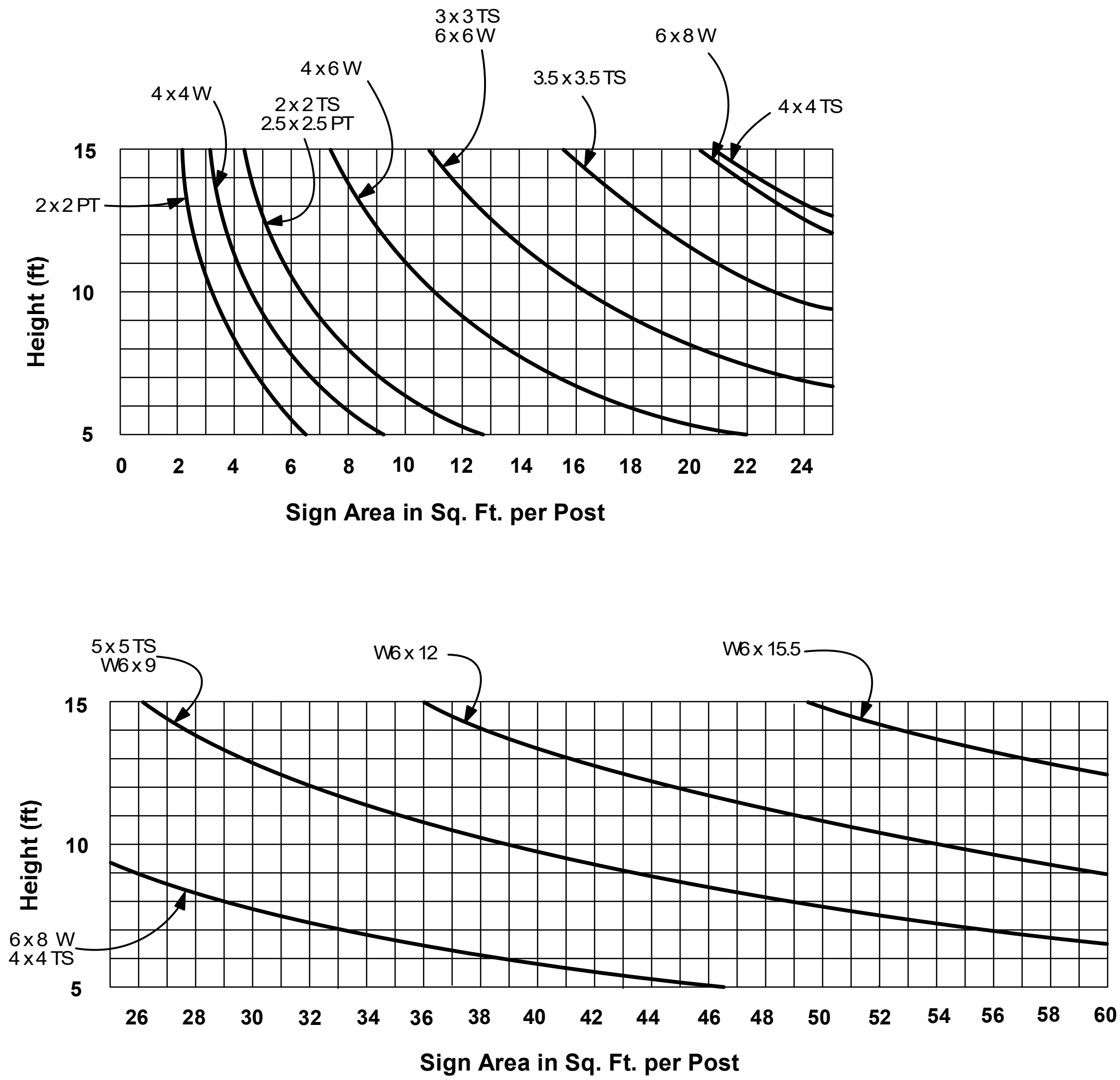




POST MATERIAL

PT....... .Perforated steel tubing (0.105 in. wall)
TS.........Steel tube square (0.1875 in. wall)
_x_ W....Treated wood
W_x_.....Steel W shapes

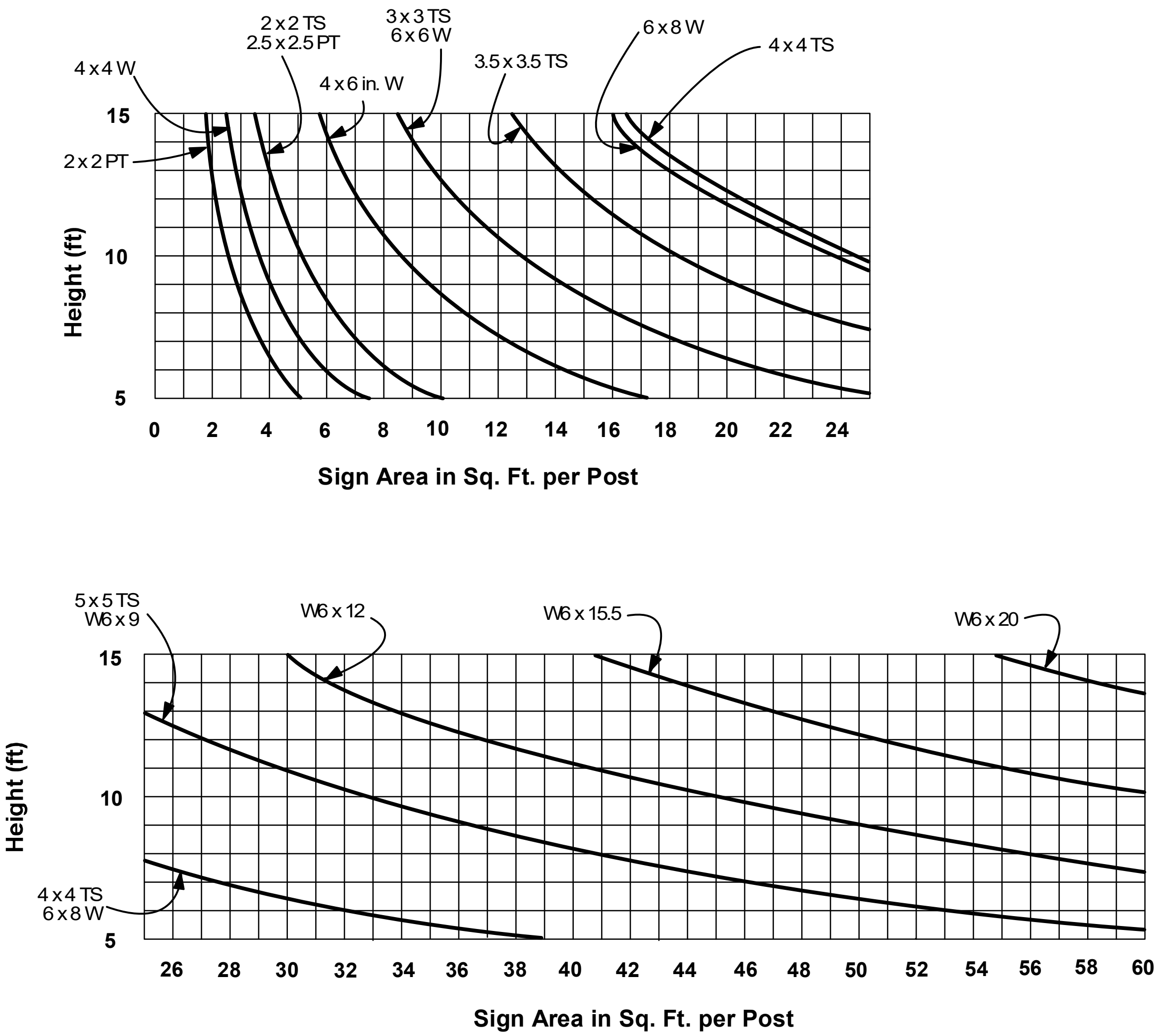
Figure 1170-7
Sign Post Selection for 70 mph Design Wind Speed



POST MATERIAL

PT.........Perforated steel tubing (0.105 in. wall)
TS.........Steel tube square (0.1875 in. wall)
_x_ W....Treated wood
W_x_.....Steel W shapes

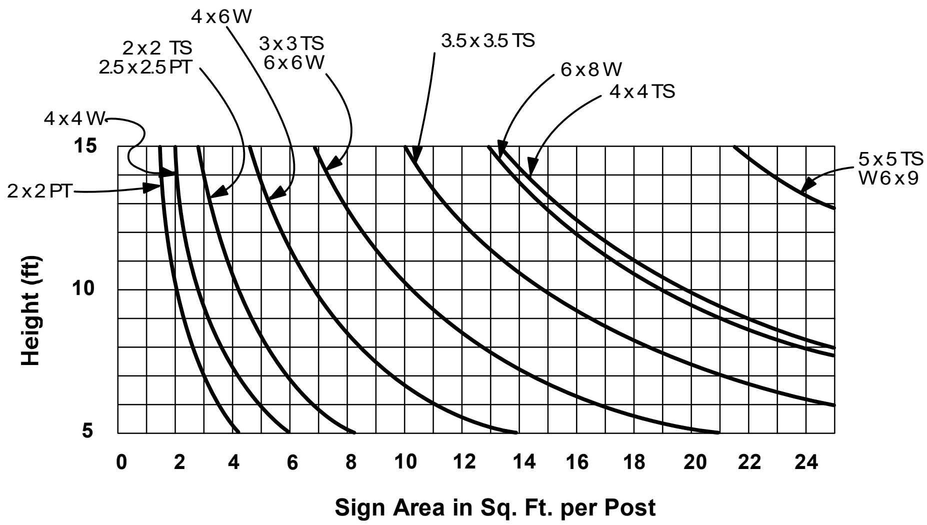
Figure 1170-8
Sign Post Selection for 80 mph Design Wind Speed

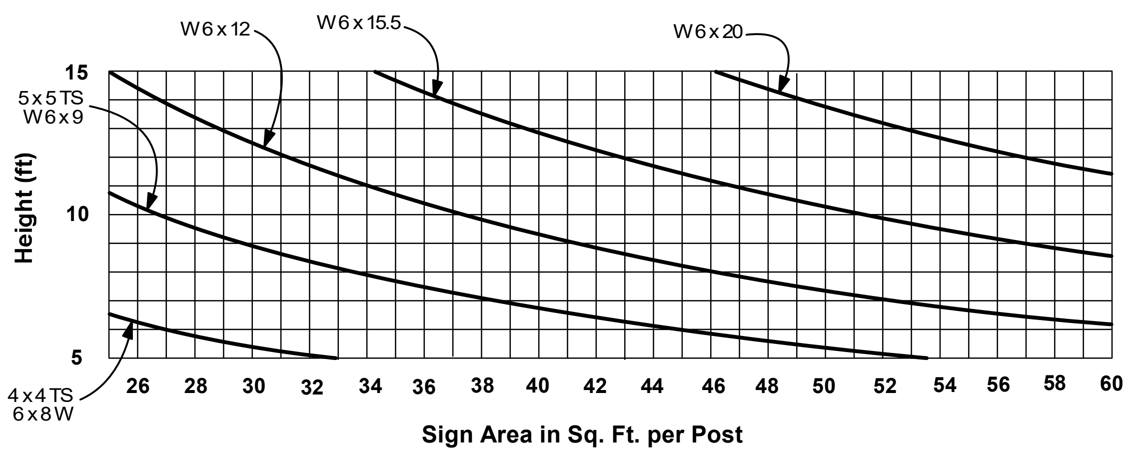


POST MATERIAL

PT.........Perforated steel tubing (0.105 in. wall)
TS.........Steel tube square (0.1875 in. wall)
_x_ W....Treated wood
W_x_.....Steel W shapes

Figure 1170-9
Sign Post Selection for 90 mph Design Wind Speed

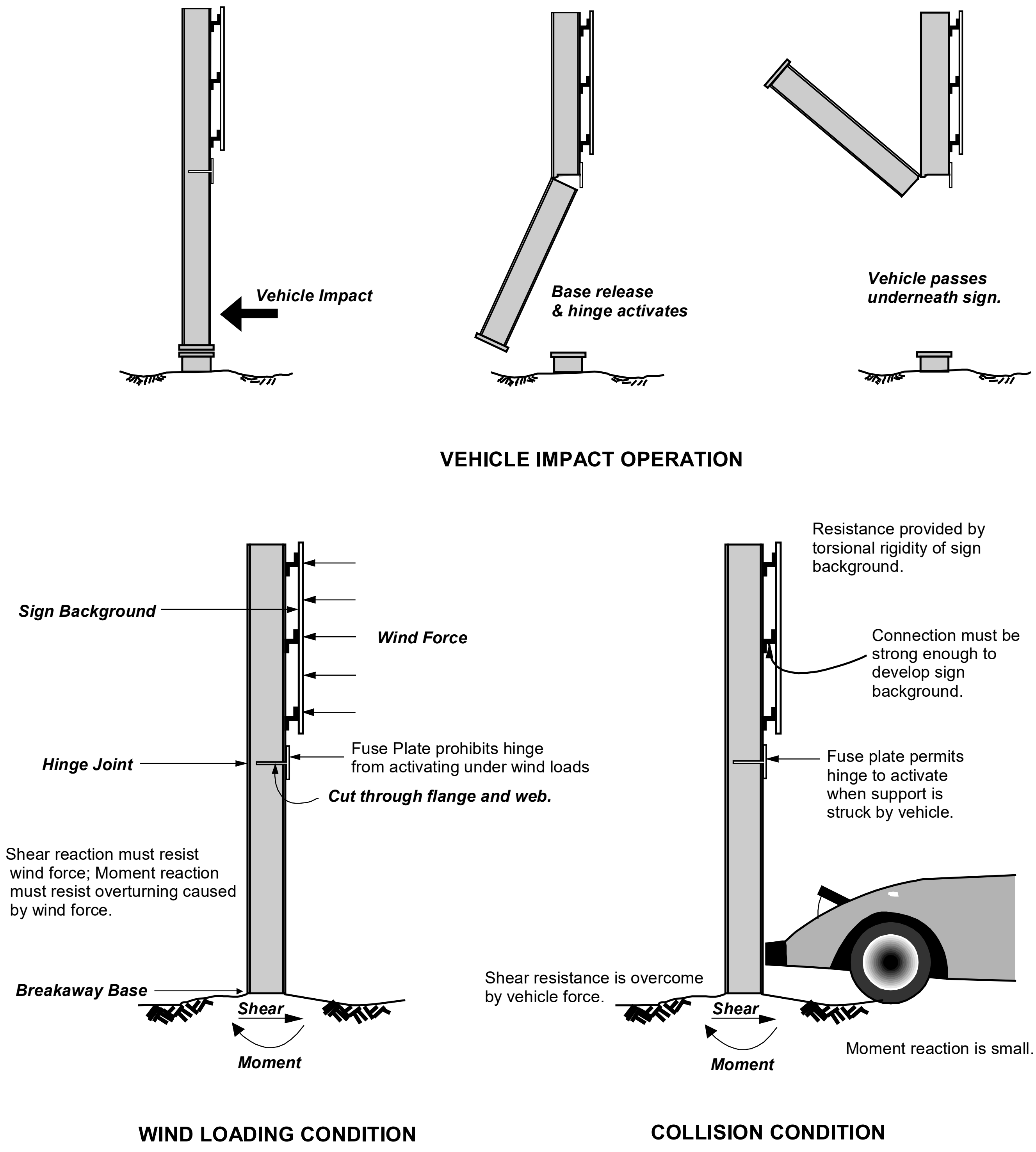




POST MATERIAL

PT..........Perforated steel tubing (0.105 in. wall)
TS.........Steel tube square (0.1875 in. wall)
_x_ W....Treated wood
W_x_.....Steel W shapes

Figure 1170-10
Sign Post Selection for 100 mph Design Wind Speed



LARGE ROADSIDE SIGN SUPPORTS

Figure 1170-11
Large Roadside Sign Supports

1180. Pavement Design

1180.1. Introduction

Alaska's road transportation system is vital to the state's residents and economy. Pavements must:

- withstand a variety of traffic and environmental conditions
- serve the public in a safe and comfortable manner.
- perform over extended periods of time.

This chapter is an overview of the DOT&PF policy and design philosophy for pavements. Detailed policy and procedures that govern Alaska's flexible pavement design are provided in the *Alaska Flexible Pavement Design Manual* (AKFPD Manual) and its companion software.

The *AKFPD Manual* is available online at:

http://www.dot.state.ak.us/stwddes/desmaterials/pop_flexpaveman.shtml

1180.2. Pavement Overview

1180.2.1. Pavement Structure

Pavement structure is a layered system of materials built on top of a prepared subgrade to protect it from excessive deformations due to traffic loads. In general, a pavement structure consists of (top to bottom): wearing course, binder course (if needed – see 1180.4), base course (stabilized or non-stabilized) and subbase or selected material (individually or in combination). The principal function of the layers is to distribute traffic load stresses within the pavement structure, thus protecting the subgrade from excessive deflection. Layer properties (i.e. density, strength, and stiffness) normally decrease from the top to the bottom of the system.

Regional materials staff provide recommendations or reviews of full pavement structure to evaluate frost susceptibility of the section and stability of foundation (subgrade) soils.

1180.2.2. Highway Pavements

Consult with the Regional Materials Section on pavement designs.

Regional materials staff perform this analysis or review proposals from design staff for design recommendations. The Regional Preconstruction Engineer is responsible for final pavement design approval.

1180.2.3. Non-Highway Pavements

Consult regional materials staff for assistance with non-highway pavements, such as parking areas. Pathways and sidewalk sections are outlined in Section 1210.4.3 Shared Use Path, Pavement Structure.

1180.3. Wearing Course

The wearing course is the top layer of a surfacing system that is in direct contact with traffic loads. The wearing course is designed to:

- Provide resistance to abrasion
- Provide a smooth ride
- Resist plastic deformation
- Resist water permeability
- Resist fatigue
- Resist thermal cracking

Available surfacing types are listed in section 7.3 of the *AKFPD* Manual.

See the AKFPD Manual for definition of hard aggregate and guidance.

1180.3.1. Hot Mix Asphalt (HMA)

Hot Mix Asphalt (HMA, or asphalt concrete pavement) is the predominant type of wearing course used on DOT&PF roadways. A pavement that receives such a surfacing is called a flexible pavement. HMA is appropriate for highway and non-highway pavements.

1180.3.2. Asphalt Surface Treatment (AST)

An asphalt surface treatment (AST) is an asphalt/aggregate application to a road surface. Usually less than 1-inch thick, asphalt surface treatments do not increase the load bearing capacity of pavement structures. They provide friction and decrease dust generation. ASTs are appropriate when unstable embankments are present and/or for low-traffic roadways or as a pavement preservation strategy.

Regional Materials Section provides guidance on the selection of project specific surface treatments.

General information on ASTs can be found in-the *Asphalt Surface Treatment Guide,* which is available online at:

http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_01_03.pdf

1180.3.3. Portland Cement Concrete (PCC)

Portland cement concrete (PCC) is rarely used in Alaska pavements. High cost and damage due to foundation settlement preclude its use in roadways.

If a PCC pavement is used, refer to the *AASHTO Guide for Design of Pavement Structures*. Consult the regional materials engineer for special provisions, specific concrete mix designs, and subgrade requirements.

1180.4. Binder Course

The binder course is the bottom layer of pavement below the wearing course. The binder course supports the wearing course. A binder course has all the properties of a wearing course except that resistance to abrasion is not essential. Comply with Alaska Renewable Pavement Policy. See Section 7.4.3 of *AKFPD Manual*.

The wearing course and binder course may be composed of the same material when advantageous; however, the binder course often has a different asphalt content and gradation or hardness of aggregate. A binder course is not necessarily required in a specific pavement design.

1180.5. Base Course

The base course is the layer of material placed on top of the subbase or embankment that supports the wearing and binder courses. A base course can be stabilized or non-stabilized.

Use of a stabilized base is required on all roadway construction, reconstruction, and rehabilitation projects except for projects exempted in writing by the Regional Preconstruction Engineer. Rationale for an exemption may include:

- Projects with a low AADT
- Areas underlain by unstable foundations, such as ice-rich permafrost or compressible soils, where settlement results in frequent maintenance.
- Projects for which a stabilized base will not provide a cost-effective improvement in the pavement performance, reduced maintenance, or reduced future rehabilitation costs through a comprehensive life-cycle cost analysis. The period of the life-cycle cost analysis shall be 30 years.
- Roads designed on behalf of agencies other than DOT&PF. See Section 2.3 of the AKFPD Manual for base course requirements and guidance.

1180.5.1. Stabilized Bases

Stabilized bases are normally defined as standard base course materials containing one or more of the following binder additives:

- Asphalt emulsion
- Asphalt cement
- Foamed asphalt cement
- Lime
- Portland cement
- Reclaimed asphalt pavement (RAP)

Stabilized bases are used to improve long-term pavement performance, reduce maintenance costs, and reduce future rehabilitation costs.

In developing flexible pavement designs using stabilized bases, coordinate with the Regional Materials Section.

In addition, you may also refer to the AKFPD Manual and the *Alaska Soil Stabilization Guide* (Report No. FHWA-AK-RD-01-6B) found online at:

http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_01_06b.pdf

The resilient modulus, M_R, of the stabilized base is determined from regional experience, back calculation, or testing and is a necessary input variable to run the AKFPD analysis program.

Following are stabilized bases used relatively frequently in Alaska:

Asphalt Treated Base

Asphalt treated base (ATB) is a stabilized base course constructed using a minimum of 4 % asphalt cement binder. Refer to Sections 7.4.2 and 7.4.3 of the *AKFPD Manual* for a detailed discussion of ATBs and the Alaska Renewal Pavement.

There is some functional overlap with HMAs, but ATBs have different asphalt content, can use softer aggregate, and are less restrictive on aggregate gradation and in placing and leveling requirements. Asphalt treated base course is addressed in Section 306 of the specifications.

Emulsified Asphalt Treated Base

Emulsified asphalt treated base course (EATB) is addressed in Section 307 of the specifications.

When used with emulsified asphalt, crushed asphalt base course (CABC) is also considered a stabilized base when containing 3% or greater emulsion content. Crushed asphalt base course is covered in Section 308 of the specifications.

Reclaimed Asphalt Pavement

Reclaimed asphalt pavement (RAP) that contains greater than 50 % asphalt concrete pavement or greater than 2 % residual asphalt content is considered a stabilized base.

1180.5.2. Non-Stabilized Bases

Non-stabilized bases comprise materials that do not have any binder additive. Crushed aggregate is the most common type of base course.

Aggregate base course is covered in Section 301 of the specifications. RAP may be used as base course, or blended with aggregate base course. Coordinate with the Regional Materials Section for guidance on incorporating RAP into base course materials.

1180.6. Subbase, Selected Material, and Borrow

The lower pavement structure typically includes subbase or selected material, individually or in combination. Where existing natural material is of adequate quality (meeting frost and foundation requirements), it may serve as the lower portion of the pavement structure.

Subbase is the layer(s) of material placed on a subgrade to support a base course. If the subgrade soil is of adequate quality, it may serve as the subbase. Section 304 of the specifications covers subbase.

Selected Material is material type indicated on the plans used to construct the subgrade embankment, see Section 703-2.07 for material specifications.

Useable excavation material meeting the requirements of the indicated Selected Material type are incorporated in the project embankment prior to utilizing Borrow, see Sections 104-1.04, 106-1.02, and 203. Borrow is embankment material (Selected Material) obtained from sources outside the right-of-way limits of the project.

1180.7. Gravel Roads

1180.7.1. General

Alaska has several existing major gravel roads and gravel surfacing is appropriate for some new, very low-volume roads in rural areas.

Maintenance cost of gravel roads may be considerably higher than that for HMA or AST surfaced roads and is an important consideration when performing a cost-effective or life-cycle cost analysis. Consider applicable dust controls as advised by the Maintenance & Operations (M&O) Section in the cost analysis when determining the appropriate surface material.

1180.7.2. Gravel Surface Structure

New Gravel Roads

The following references provide guidance that will assist in design of gravel roads:

- *AKFPD Manual*
- AASHTO *Guidelines for Geometric Design of Low-Volume Roads (ADT < 2000)*
- AASHTO *Design of Pavement Structures-Part II* (Chapter 4 Low-Volume Road Pavement Design)

When future paving of a gravel road is planned, evaluate the pavement structure in accordance with the design guidance appropriate to the anticipated future pavement.

Consult the Regional Materials Engineer for more specific gravel roadway design guidance.

Consult the Regional M&O Section to determine if adequate personnel and equipment will be available to maintain the roadway prior to selecting gravel as surfacing.

Existing Gravel Roads

The roadway surfacing design process for existing gravel roads is as follows:

1. Evaluate the existing gravel road for previous performance and drainage system adequacy. M&O should participate.
2. Determine the adequacy of the embankment strength. In the determination, consider whether the existing roadway structure has the capacity to support new base and surface course, or if it requires strengthening prior to new surfacing. Consult Regional Materials Section for recommendations.

If the embankment has adequate strength, provide sufficient aggregate surface course to shape cross slope and superelevation as a minimum.

If the embankment does not have adequate strength, follow the guidance provided in the "New Gravel Roads" portion of this subsection.

1180.8. Pavement Smoothness Price Adjustment

Smoothness represents the level of comfort experienced by the traveling public and is an important indicator of pavement performance. Rough or uneven pavement surfaces affect driver safety, vehicle wear and tear, fuel efficiency, and increase pavement deterioration.

Pavement smoothness is measured as the International Roughness Index (IRI), reported as inches/miles at 0.1-mile increments. Section 401 of the Specifications outlines the requirements during construction, evaluation, method of measurement, and basis of payment for the Pavement Smoothness Price Adjustment item.

The smoothness price adjustment does not apply to all conditions such as low volume, low speed, or low tonnage projects. The smoothness price adjustment applicability and method varies based on the region, roadway characteristics, type of project, etc.

Consult the Regional Materials Engineer and Construction Section prior to including on a project.

Method 1 is the preferred method, and should be used for projects that include construction of new base and/or subbase courses.

Method 2 is typically applicable only to resurfacing and minor rehabilitation projects. Method 2 should only be used where reliable pre-construction IRI can be established and improvement to a final IRI of greater than 120 is not anticipated.

Neither method should be used where embankment or foundation conditions are poor and post-construction settlement is anticipated.

1190. Driveway and Approach Road Standards

1190.1. General

Driveways and approach roads that intersect public roadways are a type of at-grade intersection. The numbers of crashes at driveway intersections are disproportionately higher than at public road intersections and consequently, driveway intersection design merits special attention.

Construct or Reconstruct driveways in accordance with the standards established in this Section. Build public road intersections, also known as approach roads, to the standards established for Intersections in the *AASHTO A Policy on the Geometric Design of Highways and Streets* (GB).

For this Section, the terms "driveway" and "approach road" are used interchangeably where the topic does not require a differentiation between them for application.

1190.1.1. Municipal Geometric Standards

Use municipal geometric standards approved for use on Department roadways within a municipality instead of the geometric standards contained in this section for all driveways within the municipality.

The Regional Director will grant approval of municipal driveway geometric standards for use on roadways administered or maintained by the Department after review by the following people:

- Regional Preconstruction Engineer
- Regional Maintenance and Operations Chief
- Statewide Chief Engineer

1190.1.2. Interstate Highway Access

Any new or modified access point, including driveways, to an Interstate must be approved by FHWA under 23 U.S.C. 111. A safety, operational, and engineering analysis is required. The type of access (e.g., driveway or approach road) and type of facility (e.g., traffic volume, design) will determine the level of analysis required. Any modifications to existing access control will require additional FHWA approval in accordance with the Stewardship & Oversight Agreement. For new or modified interchanges and partial interchanges, an Interchange Justification Report (IJR) is required. Develop an Interchange Justification Report (IJR) using the FHWA's *Policy on Access to the Interstate System* and *Framework for Developing and Reviewing Interstate Justifications Reports* as guidance. The policy is available at: https://www.fhwa.dot.gov/design/interstate/170522.cfm

23 CFR 624, effective December 9, 2024, provides final regulatory requirements for Interstate access changes. Compliance is required by December 9, 2025, and may require additional changes to the PCM.

1190.2. Exceptions and Waivers

The Regional Director or their designee may grant exceptions on driveways to be constructed or reconstructed along existing highways built to design standards prior to the *GB*. These exceptions do not supersede FHWA authority under 23 U.S.C. 111 for Interstate Highway access.

Driveways to be constructed or reconstructed along highways built according to the *GB* must follow the procedures of Section 1100.3 in the consideration of waivers from the driveway standards.

1190.3. Definitions

(See Figures 1190-1 through 1190-7b).

Angle of Intersection: The horizontal angle of 90 degrees or less between the driveway centerline and the edge of the traveled way of the public roadway.

Buffer Area: The border area along the property frontage between the edge of traveled way and the right-of-way line bounded at each end by the frontage boundary lines.

Corner Clearance: The distance along the edge of traveled way of a public road or street from the near edge of traveled way of another public road or street to the tangent projection of the nearest edge of any driveway, not including transition slopes, tapers, or return-radii.

Distance Between Driveways: The distance measured parallel to the centerline of roadway between intersection of the inside edges of two adjacent driveways and the right-of-way line.

Driveway Foreslope: In cross-section, that portion of the driveway embankment that slopes downward from the driveway.

Edge Clearance: The distance measured along the edge of traveled way between the frontage boundary line and the tangent projection of the nearest edge of driveway, not including returns, flares, or transition.

Frontage: The length along the road or street right-of-way line of a single property tract, measured parallel to the centerline of the road or street, between the edges of the property. Corner property at a road or street intersection has a separate frontage along each road or street.

Frontage Boundary Line: A line perpendicular or radial to the public road or street centerline at each end of the frontage, extending from the right-of-way line to the edge of traveled way.

Return: The curbed or uncurbed edge of the road, street, or driveway intersection that connects the edge of the public roadway with the adjacent edge of the driveway or another public roadway; usually as a single radius.

Right-of-Way (ROW): A strip of land owned by a municipality or the state upon which a public road is constructed.

Setback: The distance measured perpendicular or radial to the right-of-way line and the nearest building, pump island, display stand, or other manmade object over 6 inches in height within the property

Width: The distance across the driveway at its narrow point within the right-of-way measured at right angles to the centerline of the driveway

1190.4. Functional Classifications

Highways, roads, and streets are classified according to their intended function as arterials, collectors, or local roads or streets. Arterials are primarily, if not exclusively, for through traffic along the roadway. Local roads and streets are primarily, if not exclusively, to provide access to the public road system from the property adjacent to the roadway. Collectors serve as limited through traffic ways and provide access from the adjacent property. For safety and efficiency, arterials should have few, if any, private driveways.

Freeways and expressways are special, high-design-type arterials that are exclusively for through traffic. Access is legally controlled along the arterial and no private driveways are permitted.

Driveways will not be allowed on other arterials if other access is available. The Department's primary concern is the safe, efficient movement of through traffic. If driveways directly accessing the arterial are necessary, then their number, location, and design will be controlled to minimize the effect on through traffic.

On local roads and streets, the roadway's primary purpose is to provide access to adjacent lands. Consequently, the Department only exercises driveway controls that are necessary to a safe roadway. Collector roadways require more driveway controls than local roads and streets, but less than arterials.

Where there are differences in the required degree of control for driveway design and placement due to variance in functional classes, we provide differing criteria. If a particular roadway is not classified, the Regional Director or their designee will determine the interim classification for administering the driveway design standards.

1190.5. General Principles

1. **Buffer Area:** Buffer areas should be graded and landscaped to ensure adequate sight distance along the roadway, proper drainage, adequate clear zones, and a good appearance.

2. **Sight Distance:** The profile grade of a driveway and the treatment of the buffer area should allow the driver on the driveway to see sufficiently along the roadway to enable entry to the roadway without creating a hazard, and without encroaching into the traveled way (See Figure 1190-1).

3. **Setbacks:** The location of improvements on private property adjacent to the right-of-way line should not require parking, stopping, and maneuvering of vehicles within the right-of-way for vehicles or patrons to be properly served.

4. **Location of Driveways:** The location of driveways must minimize interference with the free movement of normal roadway traffic. This will reduce the hazards caused by congestion. Do not place driveways adjacent to or within an intersection's functional area. They also should not be located on a separate turning roadway, auxiliary speed change lane, or exclusive turning lane. Driveway placement must not provide direct access to the through roadways, ramps, or collector-distributor roadways of a freeway or expressway.

5. **Number and Arrangement of Driveways:** The number of driveways provided to a property should be the minimum required to adequately serve the needs of that property. Frontages of 50 feet or less must be limited to one driveway per frontage. Not more than two driveways should be provided to any single property tract or business establishment, but where the single ownership frontage exceeds 1,000 feet, additional driveways may be allowed provided they are required for servicing the property, and the distance between adjacent driveways is at least 330 feet.

   Where two driveways are provided for one frontage less than 1,000 feet long, the clear distance between driveways should not be less than the minimum distances presented in Section 1190.6. Corner clearances at intersections should also be in accordance with the distance shown in 1190.5.

   Develop driveways and adjacent property so that vehicles entering any arterial or collector roadway are not required to do so by backing into the right-of-way. Develop all frontages having two or more driveways and all commercial developments so that backing into a public roadway isn't necessary. Multi-family residential developments of more than four units per lot are considered commercial development as far as driveway standards are concerned.

6. **Curbs:** Where the posted speed limit on an existing roadway or the design speed on a proposed roadway is 50 mph or greater, driveway curbs, if used, must be the mountable type and you must place them no closer to the edge of through traveled way than the outside edge of shoulder or 8 feet, whichever is greater. On rural roadways with speed limits or design speeds less than 50 mph, curbs, if used, should be mountable and placed at the outside edge of shoulder, but no closer than 4 feet from the edge of traveled way. Surface all roadway areas between the edge of traveled way and curbs placed parallel to the edge of traveled way with the same material as the traveled way.

7. **Drainage:** Construct all driveways and buffer areas so that there will be no right-of-way surface drainage onto the traveled way of the public roadway. Where driveways are on the high side of a superelevated roadway, or are otherwise on a descending grade into the edge of traveled way, special drainage structures, including drop inlets or slotted drains, may be required to prevent non-right-of-way drainage from flowing into or across the public roadway traveled way. It is the responsibility of the property owner or permittee to maintain these drainage structures.

   In addition, design and construction of the driveway and buffer must not impair or alter drainage within the right-of-way, which may damage or threaten the stability of the public roadway. All drainage facilities within the right-of-way must conform to any applicable Department standards.

8. **Embankment (Transverse Slopes):** Driveway foreslopes, when constructed in a roadway ditch section on high-speed roadways, should have a 6:1 or flatter slope within the roadway's clear zone. Low-speed roadways or urban areas may have transverse foreslopes steeper than 6:1. Refer to Section 1130 and the *AASHTO Roadside Design Guide* (RDG), Transverse Slopes, for additional information on driveway transverse slopes within the clear zone.

9. **Lighting:** The Department will not provide roadway illumination solely for private driveways. The adjacent property owner may, except as stated here, install such lighting as long as it conforms to accepted highway lighting criteria indicated in Section 1100. A property owner may not illuminate a driveway if it is within 500 feet of an unlit public road intersection.

10. **Anticipated Traffic:** It is not necessary to estimate the volume of traffic for the majority of driveways. However, for larger developments

and approach roads, it may be desirable, if not necessary, to do so to determine the number, size, and design needed to serve the development. A few well-designed driveways are preferable to many smaller driveways.

When the volume of traffic is expected to exceed 100 vehicles during the peak hour, a competent licensed professional engineer should conduct an analysis of the vehicle trip generation characteristics of the development. If such an analysis is not available, you may use the average trip generation factors in the Institute of Transportation Engineers Informational Report, *Trip Generation,* to determine anticipated traffic for establishing the number, size, and design needed to accommodate the development.

"Peak hour" is the peak traffic-generating hour of the off-street facility.

11. **Median Openings:** Where a median exists or is to be constructed on a public roadway, driveways should be designed and controlled to allow right turns only. Median openings should not be provided unless all the following conditions exist:

    a. There is a sufficient volume of traffic using the subject location to warrant intersection design as an approach road.

    b. The intersection is evenly spaced between adjacent arterial or collector intersections.

    c. Installation of a signal at present or in the future at the subject driveway intersection will not adversely affect the capacity of the public roadway.

    To minimize wrong way movements on the divided public roadway, driveways planned near a median opening should be placed either directly opposite the median opening or at least 200 feet from the median opening. See Section 1150 for additional considerations.

12. **Design Vehicles:** Refer to the GB*,* Chapter 2, Design Vehicles General Characteristics, for guidance in selecting the appropriate design vehicle for the driveway. At least one driveway shall have widths, intersection alignments, and corner radii designed to accommodate the turning paths of the largest vehicles generated by the site. This would include large single units or tractor-trailer combination vehicles that deliver freight.

1190.6. Control Dimensions

Specific control dimensions implement the general principles. Exceed minimum dimensions as much as possible. Due to differing conditions in rural and urban areas, different dimensions are provided. Where appropriate, the control dimensions also reflect the difference between differing functional classes of roadways.

In administering these driveway standards, urban areas have populations of 500 or more within a defined compact area. The defined area need not be incorporated, but an incorporated place containing 500 people would be an urban area. Unincorporated places that have the characteristics of an incorporated community of 500 should be considered urban. In addition, if a roadway has urban characteristics such as small lot frontages, you may use the urban control dimensions.

1. **Sight Distances:** Figure 1190-1 illustrates the unobstructed sight distance along the public roadway, which should be available to a motorist entering the roadway. On arterial collector roadways, if the appropriate sight distance cannot be reasonably achieved, relocate the driveway.

   The sight line used to set sight distance is from the entering height of eye (3.5 feet above the driveway surface) to the driver eye height of the design vehicle (3.5 feet above the surface of the public roadway at the required distance from the driveway). The driver's eye is assumed to be between 14.4 to 17.8 feet from the edge of the nearest through traveled way, and the triangle formed by the sight lines left and right from this point to the required sight distances left and right along the public roadway is the sight distances triangle. Nothing should substantially obstruct the entering driver's view of public roadway traffic anywhere within this triangle.

2. **Width:** Residential driveways, rural and urban, should be a minimum of 14 feet wide and a maximum of 20 feet wide. Rural farm driveways should be a minimum of 14 feet wide and a maximum of 24 feet wide to accommodate machinery. Commercial driveways should be a minimum of 24 feet wide for traffic volume up

to 100 vehicles per hour and may be a maximum of 34 feet wide for up to 200 vehicles per hour. Where repetitive peak hour traffic is expected to exceed 200 vehicles per hour, the driveway should be designed as an approach road intersection in accordance with the *GB* and Chapter 11.

3. **Driveway Angle:** The driveway angle should be 90 degrees. It must not be less than 60 degrees except where designed as a one-way, one-lane, right-turn-only ramp, in which case it should be designed in accordance with the GB.

4. **Return Radii:** Curb or edge of pavement returns should connect the edge of the driveway with the face of curb on curbed roadways and with the edge of a 9-foot paved shoulder on uncurbed roadways. Where uncurbed roadways have paved shoulders less than 9 feet wide, the return should terminate 8 feet from the edge of traveled way and be connected to the edge of pavement (traveled way or paved shoulder) with a 10:1 taper (10 feet longitudinally along the roadway for each 1 foot transversely).

   The return radii for driveways using returns, curbed or uncurbed, should conform to Table 1190-1.

5. **Curb Cuts:** The bottom width of curb cuts should equal the width of driveway and should match the flow line (or bottom of curb face line) of the curb section at the edge of roadway. Transitional slopes should begin at the edge of driveway and slope upward to reach the top of a 6-inch-high curb face in 6 feet. The transitional slopes behind the curb face may have a constant width with a variable slope or a constant slope with a variable width.

6. **Distance between Driveways:** The minimum distance between two adjacent driveways, on the same parcel, measured along the right-of-way line between the adjacent edges, should conform to Table 1190-2.

7. **Setback:** Setback distances must conform to local zoning requirements. Where local zoning ordinances do not provide a minimum setback, the minimum setback should be 16.5 feet, and where angle parking is permitted adjacent to the right-of-way line, the setback should be 50 feet.

8. **Edge Clearance:** The property line edge clearance should be equal to the return radius for driveways using returns and should be 16.5 feet for driveways using curb cuts with transitional slopes. *Exception:* Where a common-use driveway is to serve two adjoining properties, the approximate centerline of the driveway may be on the frontage boundary line.

9. **Corner Clearance:** The minimum distance from the nearest face of the curb, or nearest edge of traveled way for uncurbed roadways, of an intersecting public roadway to the nearest edge of driveway should conform to Table 1190-3.

10. **Driveway Profiles:** The maximum access grade for a residential driveway should be 15 percent. Commercial driveways should have a maximum algebraic difference of 8 percent between access grade and landing grade. The maximum landing grade is ± 2 percent for all driveways. Driveway profiles must conform to the following descriptions.

    a. **Driveway with Uncurbed Returns:** Public roadway with a negative cross-slope (i.e. outer edge of traveled way lower than lane or centerline):

       From the outer edge of the traveled way to the edge of the shoulder or 9 feet, whichever is greater, the driveway profile grade should be the same as the traveled way or shoulder cross-slope.

       From the outer edge of the shoulder, a vertical curve should connect the profile to a positive or negative grade, which will bring the driveway profile to the adjacent property grade.

    b. **Driveway with Curbed Returns:** Public roadway with a negative cross-slope (i.e. outer edge of traveled way lower than lane or centerline):

       1.) Beginning with an angle point at the flow line (bottom of face of curb) along the roadway, the driveway profile should rise at a gradient such that the algebraic difference in grade between the cross-slope of the roadway and the grade of the driveway does not exceed 8 percent.

2.) A landing zone must begin after a rise of 6 inches.

c. **Driveway with Returns:** Public roadway with positive cross-slope (i.e., on high side of superelevated section):

From the outer edge of traveled way to the edge of the shoulder or 8 feet, whichever is greater, the driveway profile grade should be the same as the traveled way superelevation rate.

From the outer edge of the shoulder, a vertical curve should connect the profile to a positive or negative grade, which will bring the driveway profile to the adjacent property grade.

d. **Driveway with Curb Cuts**

From the bottom face of curb or flow line, the driveway profile grade should slope uniformly upward at a grade not to exceed an algebraic difference of 8 percent with the adjacent lane or shoulder cross-slope.

If a sidewalk or portion thereof remains to be crossed, the driveway profile may match the surface of the sidewalk.

The profile should then follow a vertical curve or have an angle point, if necessary, to connect with a positive or negative grade, which will bring the driveway profile to the adjacent property grade.

e. **Vertical Curves:** Vertical curve should be symmetrical and as flat as feasible. Crest vertical curves should not exceed a 3…-inch hump in a 12-foot chord, and sag vertical curves should not exceed a 2-inch depression in a 12-foot chord. Vertical curves must not have humps or depressions exceeding 3.6 inches in a 12-foot chord.

f. **Landings:** All driveways are to have landing zones. Landing length depends on anticipated traffic. Passenger cars require 10 feet minimum while semi-tractor trailers require 30 feet based on wheel bases.

g. **Pedestrian Areas:** Where curbed returns intersect a pedestrian way, provide appropriate ADA compliant curb ramps.

11. **Speed Change Lane and Left-Turn Lanes:** On high-speed (50 mph or over) or high-volume arterial roadways, speed change lanes may be required for the acceleration or deceleration of vehicles entering or leaving the public roadway from or to a higher-volume traffic generation (greater than or equal to 100 vehicles per hour) or attracting development. Use Figure 4-23 of NCHRP 279 Intersection Channelization Design Guide as a guideline for the right-turn treatments. On a one-way street, the above criteria also apply to the left through lane. For guidelines on the need for left-turn lanes on a main street or road at a driveway, refer to Figure 1190-8.

Table 1190-1
Driveway Return Radii (feet)

Driveway	**Residential**		**Farm**		**Commercial**	
Width (ft)	Curbed	Uncurbed	Curbed	Uncurbed	Curbed	Uncurbed
14 - 20	*20	20	-	20	-	-
24 - 34	-	-	-	40	*40	40

* For curbed roadways where residential driveways or commercial driveway have a 100-vehicles-per-hour or fewer repetitive peak, use a curb cut rather than a return.

Table 1190-2
Distance Between Driveways
(*On Same Parcel*)

Hourly Volume: Greater than 10 vph				**Hourly Volume: Less than or equal to 10 vph**	
Speed (mph)	**Rural: Arterials and Collectors**	**Urban: Arterials and Collectors**	**Urban & Rural: Local**	**Functional Classification**	**Distance**
30	370 feet	200 feet	200 feet	Arterials	75 feet
35	400 feet	260 feet	250 feet	Collectors	50 feet
40	440 feet	340 feet	310 feet	Local	35 feet
45	540 feet	430 feet	390 feet	-	-
50	690 feet	510 feet	490 feet	-	-

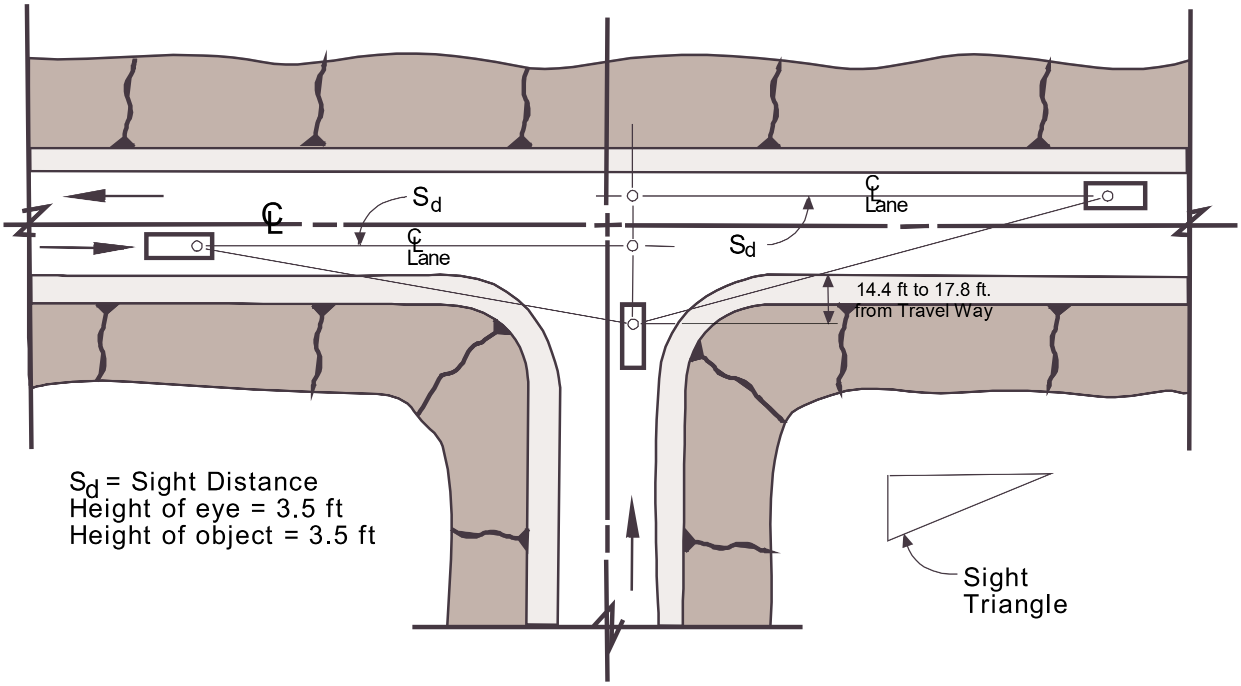
Note: This assumes level terrain.

Table 1190-3
Corner Clearance

Hourly Volume: Greater than 10 vph			
Speed (mph)	**>250 vph**	**100 - 250 vph**	**10 - 100 vph**
30	200 feet	150 feet	80 feet
35	260 feet	210 feet	110 feet
40	330 feet	260 feet	150 feet
45	390 feet	310 feet	180 feet
50	460 feet	340 feet	230 feet

Hourly Volume: Less than or equal to 10 vph			
Functional Classification	**Curbed Crossroad**	**Uncurbed Crossroad**	
		Urban	**Rural**
Arterials	60 feet	70 feet	100 feet
Collectors	50 feet	60 feet	60 feet
Local	40 feet	50 feet	60 feet

DRIVEWAY SIGHT DISTANCE



DESIGN SPEED or POSTED SPEED LIMIT mph	SD MINIMUM (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645

Note: Minimum sight distances are stopping sight distances for level grades, between –3% and +3%. Refer to the *GB*, for desirable intersection sight distances and for grade adjustments.

Figure 1190-1
Driveway Sight Distance

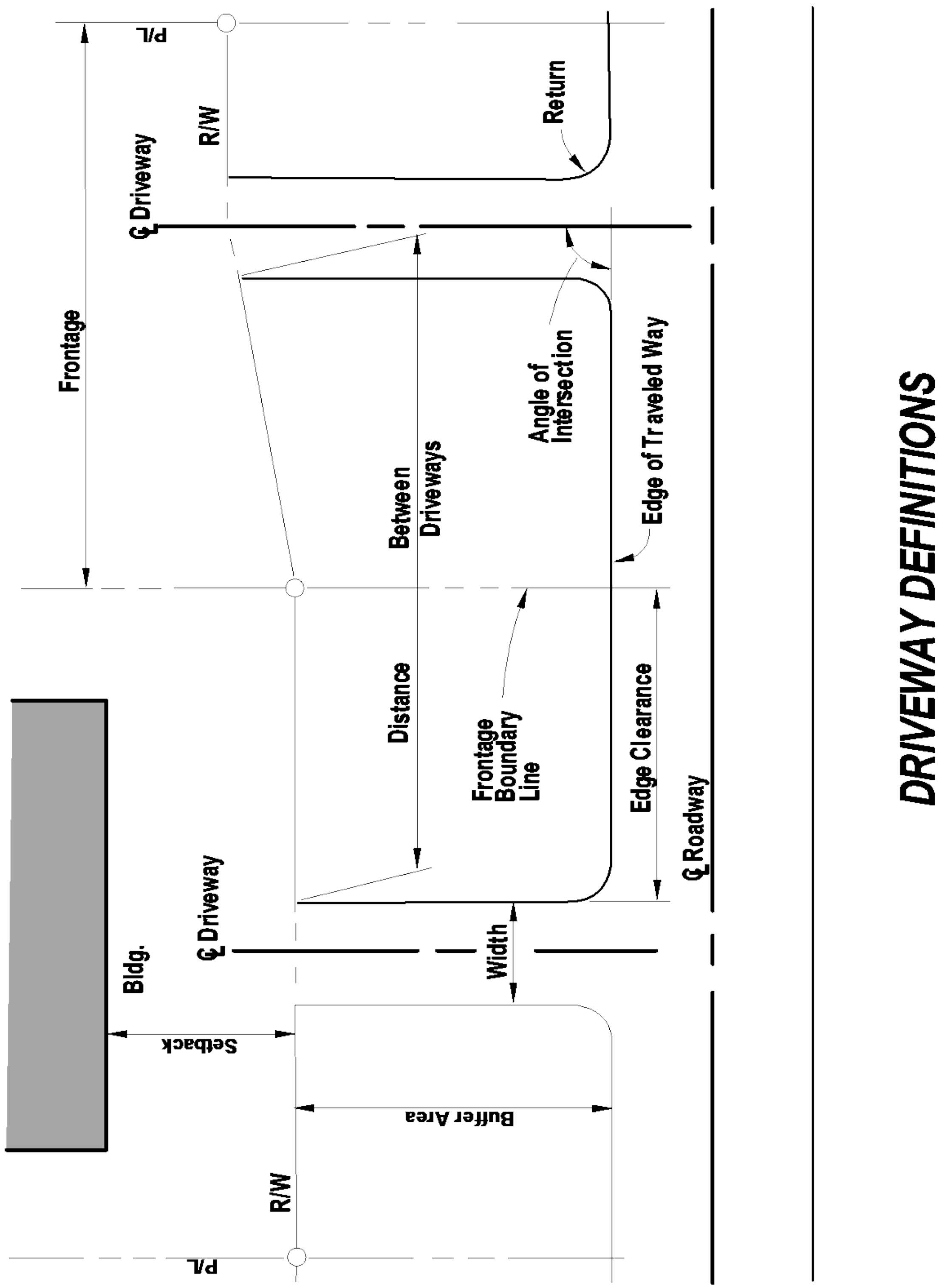


Figure 1190-2
Driveway Definitions

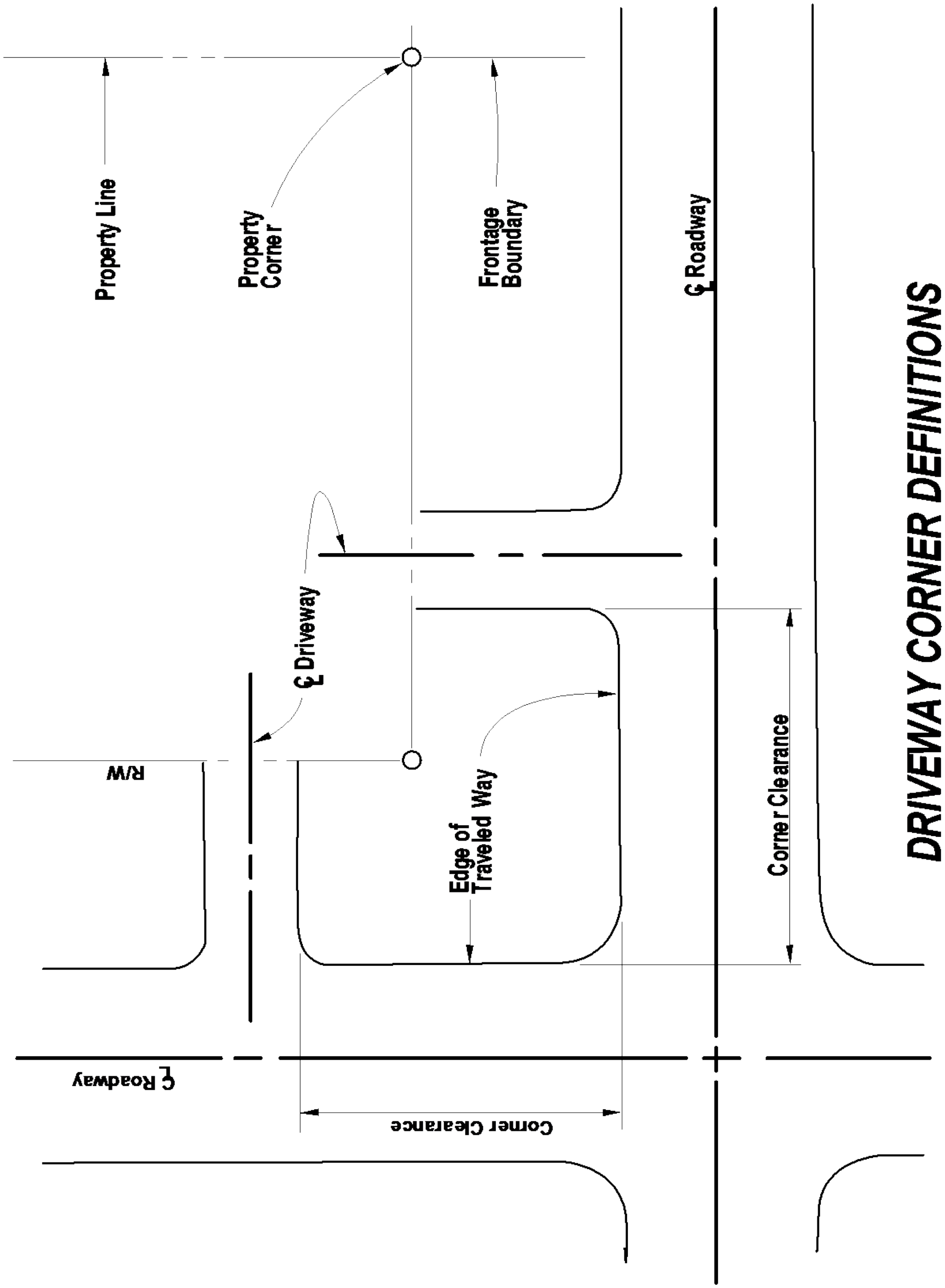


Figure 1190-3
Driveway Corner Definitions

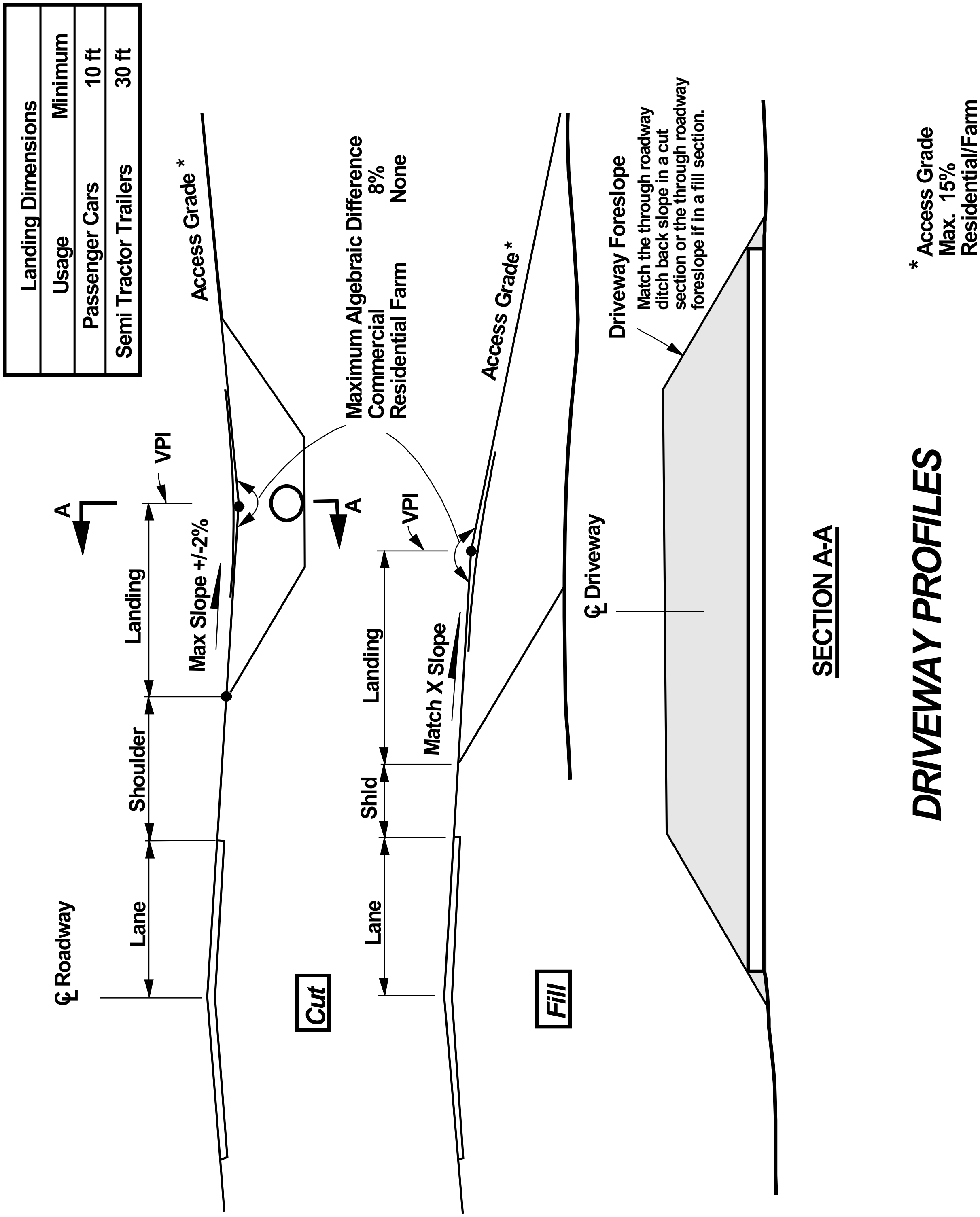
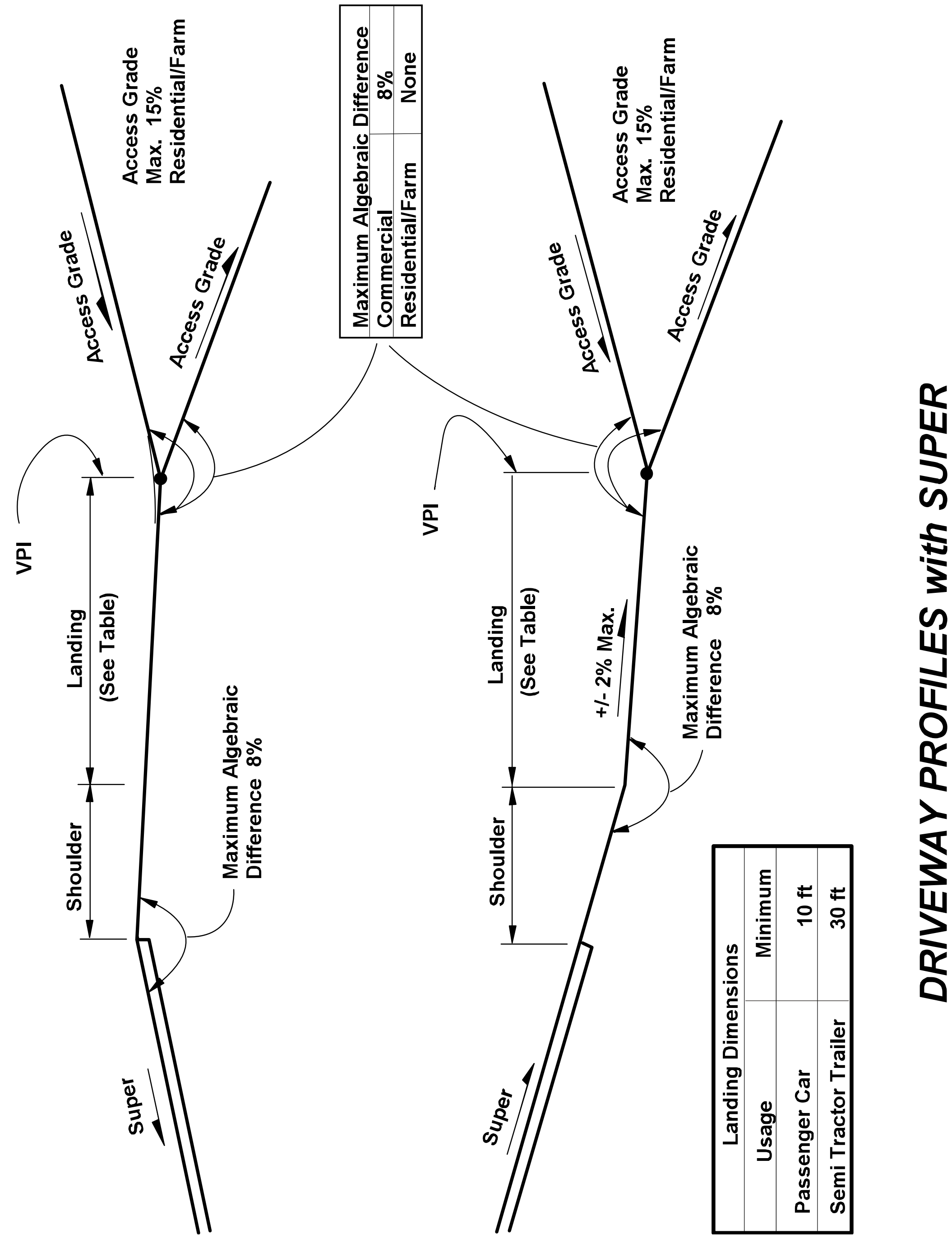
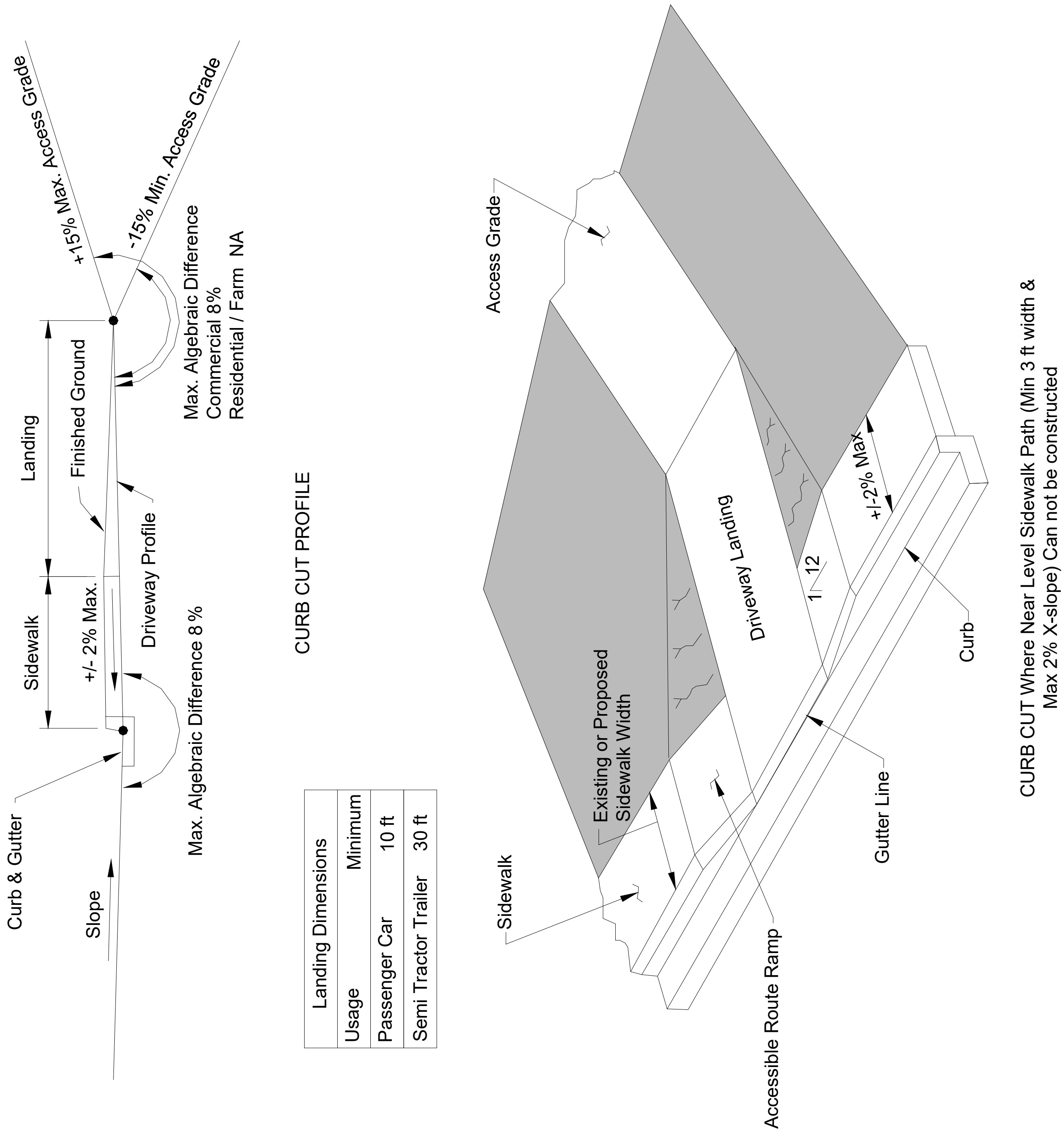


Figure 1190-4
Driveway Profiles



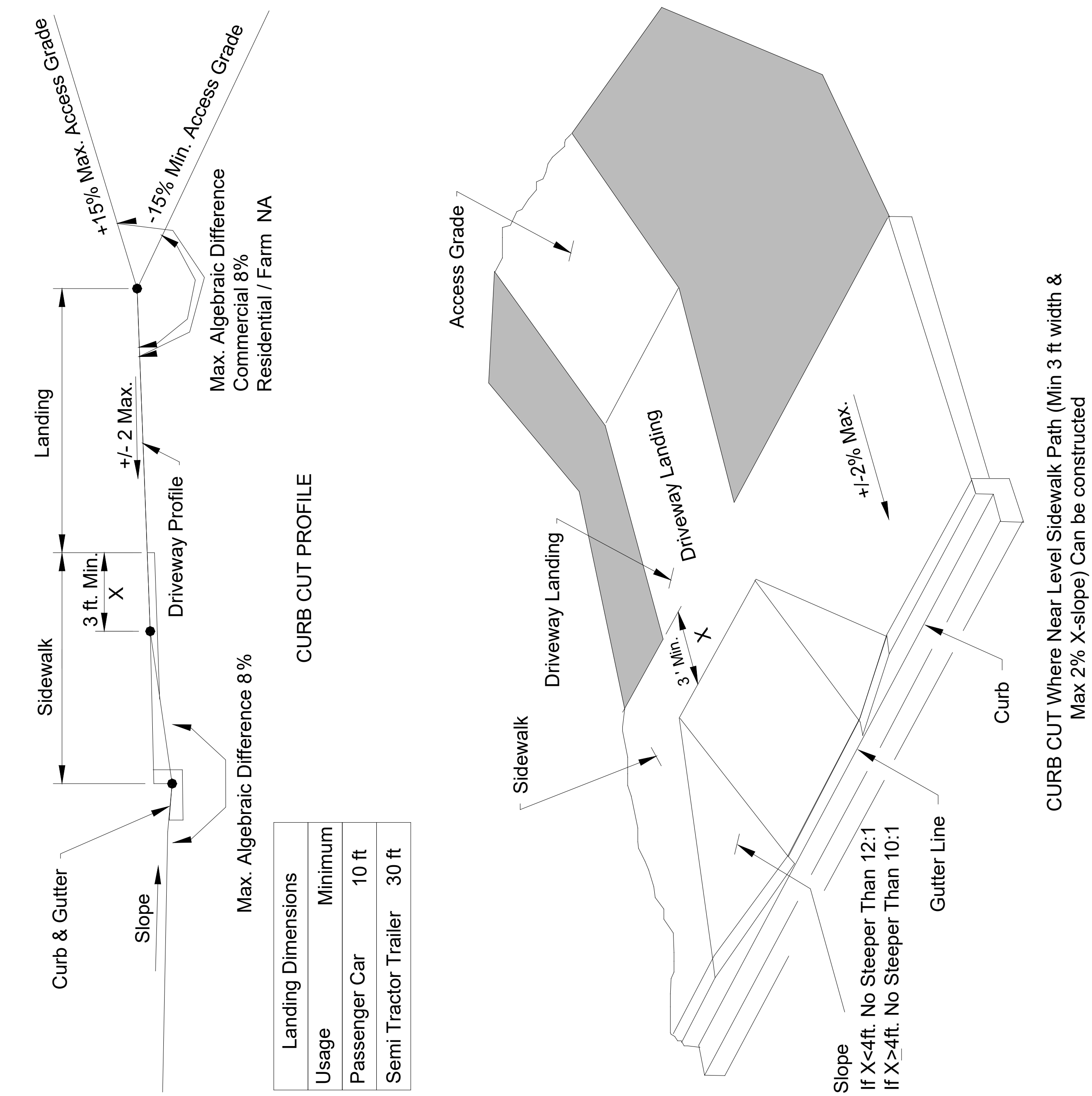
Note: Consider vehicles that will use driveway to ensure grades will accommodate needs.

Figure 1190-5
Driveway Profiles With Super



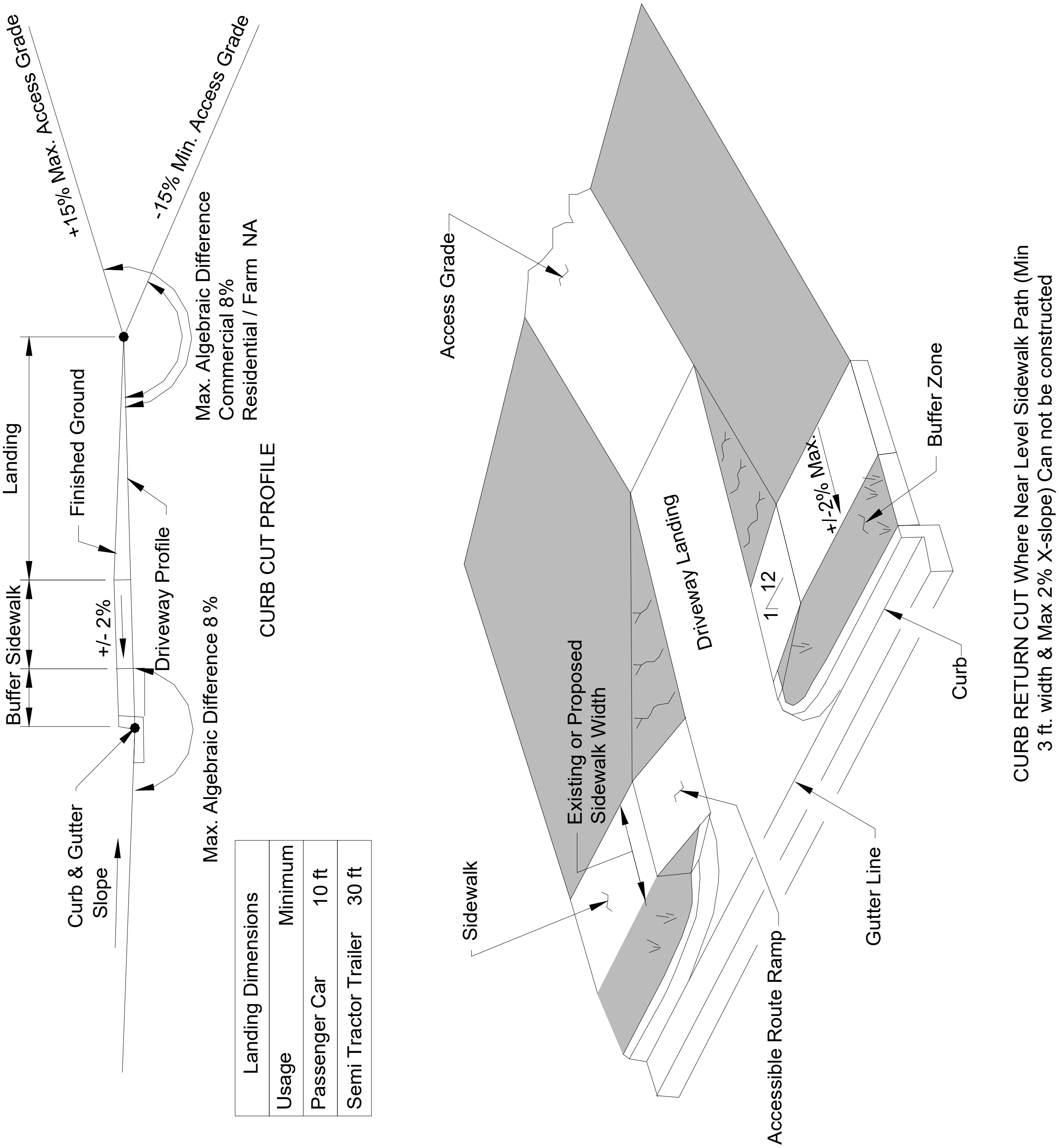
Landing Dimensions	
Usage	Minimum
Passenger Car	10 ft
Semi Tractor Trailer	30 ft

Figure 1190-6a
Curb Cut Profile



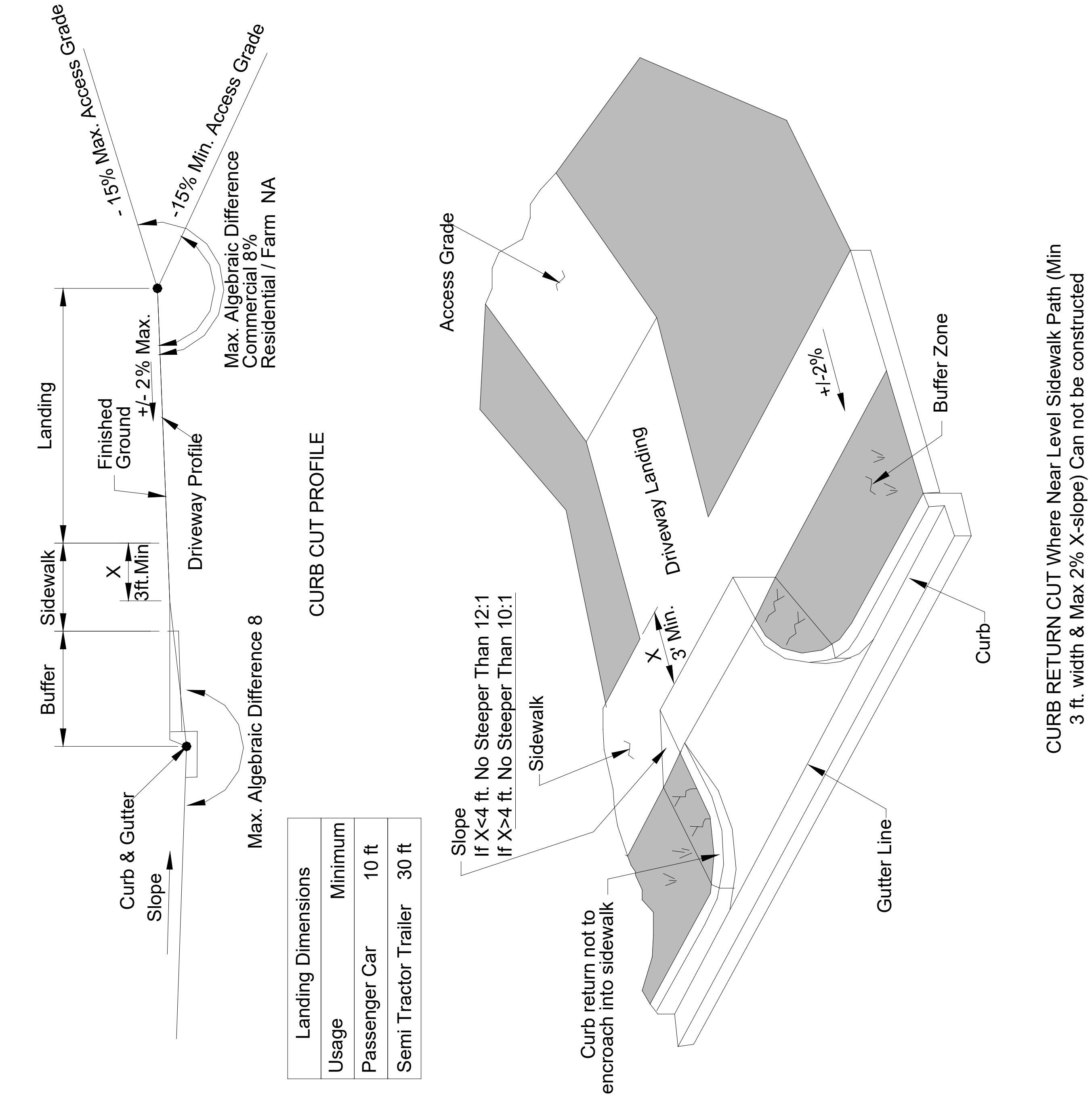
Landing Dimensions	
Usage	Minimum
Passenger Car	10 ft
Semi Tractor Trailer	30 ft

Figure 1190-6b
Curb Cut Profile



Landing Dimensions	
Usage	Minimum
Passenger Car	10 ft
Semi Tractor Trailer	30 ft

Figure 1190-7a
Curb Cut Profile



Landing Dimensions	
Usage	Minimum
Passenger Car	10 ft
Semi Tractor Trailer	30 ft

Figure 1190-7b
Curb Cut Profile

Metric					US Customary				
Opposing volume (veh/h)	Advancing volume (veh/h)				Opposing volume (veh/h)	Advancing volume (veh/h)			
	5% left turns	10% left turns	20% left turns	30% left turns		5% left turns	10% left turns	20% left turns	30% left turns
60-km/h operating speed					40-mph operating speed				
800	330	240	180	160	800	330	240	180	160
600	410	305	225	200	600	410	305	225	200
400	510	380	275	245	400	510	380	275	245
200	640	470	350	305	200	640	470	350	305
100	720	515	390	340	100	720	515	390	340
80-km/h operating speed					50-mph operating speed				
800	280	210	165	135	800	280	210	165	135
600	350	260	195	170	600	350	260	195	170
400	430	320	240	210	400	430	320	240	210
200	550	400	300	270	200	550	400	300	270
100	615	445	335	295	100	615	445	335	295
100-km/h operating speed					60-mph operating speed				
800	230	170	125	115	800	230	170	125	115
600	290	210	160	140	600	290	210	160	140
400	365	270	200	175	400	365	270	200	175
200	450	330	250	215	200	450	330	250	215
100	505	370	275	240	100	505	370	275	240

Source: 2004 GB, Exhibit 9-75

Figure 1190-8
Guide for Left-Turn Lanes on Two-Lane Highways