Chapter 18

3R PROJECTS
(Non-Freeways)

SOUTH CAROLINA ROADWAY DESIGN MANUAL

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3R PROJECTS
(Non-Freeways)

A significant percentage of the Department's current and future highway program involves work on existing highways. The Department's responsibility is to realize the greatest overall benefit from the available funds. Therefore, the geometric design of projects on existing highways must be viewed from a different perspective than the design of new construction/reconstruction projects. Resurfacing, restoration and rehabilitation (3R) projects are often initiated for reasons other than geometric design deficiencies (e.g., pavement deterioration), and are often designed with right of way, financial and environmental constraints. Therefore, the design criteria for new construction are often not attainable without major and, frequently, unacceptable adverse impacts. At the same time, however, the Department must take the opportunity to make cost-effective, practical improvements to the geometric design of existing highways and streets.

For these reasons, the Department has adopted procedures and geometric design criteria for 3R non-freeway projects. They are based on a sound engineering assessment of the underlying principles behind geometric design and on how the criteria for new construction/reconstruction can legitimately be modified to apply to existing highways without sacrificing highway safety. The revised design criteria are intended to find the balance among many competing and conflicting objectives. These include the objectives of improving South Carolina's existing highways, minimizing the adverse impacts of highway construction on existing highways, and improving the greatest number of miles with the available funds.

The overall objective of the Department's criteria is to fulfill the requirements of the FHWA regulations and Technical Advisory, which govern the 3R program. These objectives are summarized as follows:

- 3R projects are intended to extend the service life of the existing facility and to return its features to a condition of structural or functional adequacy.
- 3R projects are intended to enhance highway safety.
- 3R projects are intended to incorporate cost-effective, practical improvements to the geometric design of the existing facility.

18.1 3R PROCEDURES

18.1.1 <u>Background</u>

For guidance on the background of 3R projects, the designer should review the following documents:

1. Title 23, *Code of Federal Regulations*, Part 625;
2. June 10, 1982, *Federal Register,* "Design Standards for Highways: Resurfacing, Restoration and Rehabilitation of Streets and Highways Other Than Freeways";

3. Transportation Research Board Special Report 214, *Designing Safer Roads: Practices for Resurfacing, Restoration, and Rehabilitation*;

4. FHWA Technical Advisory T5040.28, “Developing Geometric Design Criteria and Processes for Non-Freeway RRR Projects”; and

5. NCHRP Synthesis 417, *Geometric Design Practice for Resurfacing, Restoration, and Rehabilitation.*

18.1.2 Project Types

From an overall perspective, the 3R program is intended to improve the greatest number of highway miles within the available funds for highway projects. 3R projects may include any number of the following types of improvements. This list is not all inclusive:

- providing pavement resurfacing, pavement rehabilitation and/or pavement reconstruction;
- providing lane and/or shoulder widening (without adding through lanes);
- paving shoulders;
- correcting skid hazards;
- adding a two-way, left-turn lane (TWLTL);
- adding a bike lane;
- providing intersection improvements (e.g., adding or extending turn lanes, flattening turning radii, adding channelization, realigning minor road, improving corner sight distance);
- flattening a horizontal or vertical curve;
- adding curb and gutter to an existing urban street;
- removing, widening and/or resurfacing parking lanes;
- upgrading at-grade highway/railroad crossings;
- revising the location, spacing or design of existing driveways along the mainline;
- roadway approach work associated with a bridge rehabilitation and/or widening;
- upgrading bridge rails;
- upgrading guardrail and other roadside safety appurtenances to meet current criteria;
- relocating utility poles;
- removing, providing and/or upgrading traffic control devices;

- adjusting the roadside clear zone;
- flattening side slopes;
- providing drainage improvements;
- adding or removing transit stops;
- implementing improvements to meet the Department's accessibility criteria (e.g., sidewalks and sidewalk curb ramps);
- upgrading to current access management policies; and/or
- incorporating multimodal operations.

18.1.3 Approach

The Department's approach to the geometric design of 3R projects is to adopt, where justifiable, a revised set of numerical criteria. The design criteria throughout other chapters in this *Manual* provide a frame of reference for the 3R criteria. The following summarizes the approach that has been adopted:

1. Design Speed. Section 18.2 presents guidelines for selecting 3R design speeds for arterials and collectors on the State Highway System.

2. Speed-Related Criteria. Many geometric design values are calculated directly from the design speed (e.g., vertical curves, curve radii, sight distance). The 3R design speed is used to determine these speed-related criteria. For many speed-related elements, Section 18.2 presents an acceptable threshold value for the element that is considerably below the 3R design speed. For example, if the calculated design speed of an existing crest vertical curve is within 15 mph of the 3R project design speed, the AADT is not greater than 1500 vehicles per day and there is not an adverse safety history, the existing crest vertical curve may be retained in the project design without further supporting documentation.

3. Cross Section Widths. The criteria in Chapter 15 "Collector Roads and Streets" and Chapter 16 "Rural and Urban Arterials" have been evaluated relative to the typical constraints of 3R projects. Where justifiable, the values of the cross section width criteria have been reduced. See Section 18.2 for additional discussion on cross section widths.

4. Other Design Criteria. This *Manual* contains many other details on proper geometric design techniques. These criteria are applicable to new construction and reconstruction. For 3R projects, these criteria have been evaluated and a judgment has been made on their proper application to 3R projects. Unless stated otherwise in this chapter, the criteria in other chapters of this *Manual* apply to 3R projects and should be incorporated, if practical.

18.1.4 3R Project Evaluation

The designer should evaluate available data when determining the geometric design of 3R non-freeway projects. The necessary following evaluations presented for 3R projects are based on the FHWA guidance Technical Advisory T5040.28 “Developing Geometric Design Criteria and Processes for Non-freeway RRR Projects:

1. Conduct Field Review. The designer should typically schedule a thorough field review of the proposed 3R project. One objective of the field review will be to identify potential safety concerns and potential safety improvements to the facility.

2. Document Existing Geometrics. The designer should typically review the as-built plans and combine this with the field review to determine the existing geometrics within the project limits. This review includes lane and shoulder widths, horizontal and vertical alignment, intersection geometrics and the roadside safety design.

3. Safety Analysis. The designer should conduct a safety analysis within the limits of the 3R project. Crash data is available from the Traffic Engineering Division. The designer should evaluate the following crash data analyses:

    a. Crash Rate versus Statewide Average (for that type facility). This may provide an overall indication of safety problems within the 3R project limits.

    b. Crash Analysis by Type. This may indicate if certain types of crashes are a particular problem. For example, a disproportionate number of head-on and/or sideswipe crashes may indicate inadequate roadway width. A disproportionate number of fixed-object crashes may indicate an inadequate roadside clear zone.

    c. Crash Analysis by Location. Crashes may cluster about certain locations (e.g., horizontal curve or intersection). In particular, the analysis should check to see if any sites on the Department’s list of high-crash locations, as identified by the Department’s crash data system, fall within the proposed project limits.

    d. *Highway Safety Manual*. The AASHTO *Highway Safety Manual* provides analytical tools and techniques for quantifying the potential effects on crashes for various improvements. The *Highway Safety Manual* also identifies factors contributing to crashes and associated potential countermeasure to address these issues.

4. FHWA Analysis Tools. FHWA provides and supports a wide range of data and safety analysis tools for State and local practitioners; see FHWA’s safety website. These tools are designed to assist practitioners in understanding safety problems, link crashes to their roadway environments, and select and apply appropriate countermeasures. The tools’ capabilities range from simple to complex. Some tools provide general information, while others provide complex analysis of crashes under specific conditions and/or with specific roadway features.

5. Speed Studies. It may be appropriate to review existing speed studies near the project and, if necessary, conduct a speed study to assist in determining the design speed of the 3R project. In addition, it may be desirable to conduct spot speed studies at specific

locations (e.g., in advance of a horizontal or vertical curve) to assist in the determination of geometric design improvements.

6. Traffic Volumes. The designer should examine the current and design year traffic volumes within the limits of the 3R project. This may influence the decisions on the extent of geometric improvement.

7. Early Coordination for Right-of-Way Acquisition. Significant right-of-way acquisitions are typically outside the scope of 3R projects. However, if additional right of way is required for selective safety improvements, the designer should, as early as feasible, determine which improvements will be incorporated into the project design and initiate the right-of-way acquisition process.

8. Pavement Condition. 3R projects are often programmed because of a significant deterioration of the pavement structure. The extent of pavement improvement will influence the decision on whether the project should be designed using 3R or reconstruction criteria. In addition, all 3R projects will include a pavement design that meets the Department’s requirements.

   Whenever the proposed pavement improvement is major, it may be practical to include geometric improvements (e.g., lane and shoulder widening) in the project design. However, the proper level of geometric improvement is often determined by many factors other than the extent of pavement improvement. These include available right of way, traffic volumes, crash history and available funds for the project. Therefore, it may be appropriate for the 3R project to include, for example, full-depth pavement reconstruction and minimal geometric improvement, if deemed proper to meet the safety and operational objectives of the 3R program.

   Coordinate with the Director of Maintenance Office to determine acceptable pavement improvements using preventive maintenance guidelines.

9. Geometric Design of Contiguous Highway Sections. The designer should examine the geometric features and operating speeds of highway sections contiguous to the 3R project. This includes investigating whether or not any highway improvements are in the planning stages. The 3R project should provide design continuity with the contiguous sections. This involves a consideration of factors such as driver expectancy, geometric design consistency and proper transitions between sections of different geometric designs.

10. Physical Constraints. The physical constraints within the limits of the 3R project will often determine what geometric improvements are practical and cost effective. These include topography, adjacent development, available right of way, utilities and environmental constraints (e.g., wetlands, historical, culturally-sensitive areas).

11. Traffic Control Devices. All signing and pavement markings on 3R projects must meet the criteria of the *Manual on Uniform Traffic Control Devices* (MUTCD). The traffic designer is responsible for selecting and locating the traffic control devices on the project. The designer will work with the traffic designer to identify possible geometric and safety deficiencies that will remain in place and, therefore, may warrant the use of a traffic control device (e.g., a warning sign).

12. Identify Potential Countermeasures. Once potential problems have been identified, the next step involves selecting the appropriate countermeasure that will improve safety. The designer should also consider other road safety solutions beyond engineering countermeasures that can help improve safety (e.g., high visibility enforcement, public outreach, education).

13. Economics. 3R projects are intended to protect the existing economic investment and to derive the maximum economic benefit from the Department's existing highway system. Therefore, economic factors (i.e., the cost of improvement versus the anticipated benefit) are a major consideration in determining which geometric design improvements are practical and reasonable. For example, the installation of signage and rumble stripes may be an acceptable alternative to flattening a horizontal curve.

14. Potential Impacts of Various Types of Improvements. 3R projects may impact the social, economic and environmental nature of the surrounding land and development. In particular, the existing right of way may severely restrict the practical extent of geometric improvements.

Once the project evaluation is completed, the Project Manager will prepare the Project Planning Report that will recommend the proposed improvements for the 3R project.

18.2 3R GEOMETRIC DESIGN CRITERIA

18.2.1 Design Exceptions

Reference: Section 3.2

The discussion in Section 3.2 on design exceptions and variances applies equally to the geometric design of 3R projects. The only difference is that the designer will be evaluating the proposed design against the criteria presented in this chapter.

18.2.2 Design Speed

Reference: Section 3.5

Design speed is a selected speed used to determine the various geometric design features of the roadway. The designer should coordinate with the District Traffic Engineer in selecting the design speed for the 3R project. The following factors should be considered when selecting the design speed:

- new construction/reconstruction design speeds presented in Chapter 14 "Local Roads and Streets," Chapter 15 "Collector Roads and Streets" and Chapter 16 "Rural and Urban Arterials";
- original design speed for the roadway;
- design speeds shown the FHWA *Mitigation Strategies for Design Exceptions*; and
- context speed (e.g., urbanized areas, school zones).

18.2.3 Design Year

Reference: Section 3.6

Desirably, the design year should be 10 years from the PS&E letting date. At a minimum, it may be the current year.

18.2.4 Highway Capacity

Reference: Section 3.6

The following major factors affect the capacity analysis:

1. Design Volume. The designer should evaluate the current and design year traffic volumes within the limits of the 3R project. Give special attention to traffic movements relocated or restricted by the project.

2. Level of Service. Figure 18.2-A provides the LOS criteria for roadway segments. Depending on the project type, only the specific LOS for the traffic movements impacted may need to be evaluated. In general, the highway facility should maintain or improve the LOS for the current DHV and/or AADT.

3. Operational improvements. In some cases, 3R projects may provide operational improvements (e.g., queue length or turning radii that are not measured by LOS). In these cases, the designer will work with traffic designer regarding any highway capacity criteria for the project.

Functional Classification	Level of Service
Rural Collectors	Desirable: C Minimum: D
Urban Collectors	Desirable: C
Rural Arterials	Level/Rolling: C Mountainous: D
Urban Arterials	Desirable: C

RECOMMENDED LEVEL OF SERVICE
(3R Projects)
Figure 18.2-A

18.2.5 Cross Sections

Reference: Chapter 7 "Cross Section Elements"

18.2.5.1 Roadway Widths

Reference: Chapters 15 "Collector Roads and Streets" and 16 "Rural and Urban Arterials"

Figure 18.2-B presents lane and shoulder widths for 3R projects. In general, these widths have been established considering the minimum acceptable width from an operational and safety perspective; considering what is available for a practical improvement based on right of way and environmental impacts; and considering that, in general, it is better to improve more miles to a lower level than to improve fewer miles to a higher level. All of these considerations are consistent with the overall objectives of the Department's 3R program.

The designer should evaluate the existing roadway width with the criteria in Figure 18.2-B. If the existing width does not meet the 3R criteria, the designer should consider widening the lane and/or shoulder. If the decision is made to widen the lane or shoulder width, ensure that the width at least meets the 3R criteria. This will be sufficient for the majority of 3R projects. However, if practical, it may be appropriate to widen the roadway width to meet the new construction/reconstruction lane and shoulder width criteria in Chapters 15 "Collector Roads and Streets" and 16 "Rural and Urban Arterials."

<table>
<tr><th rowspan="2">Design Year ADT</th><th rowspan="2">Design Speed (mph)</th><th colspan="2">Rural Collectors</th><th colspan="2">Urban Collectors</th><th colspan="2">Rural Arterials</th><th colspan="2">Urban Arterials</th></tr>
<tr><th>Lane Width(1)</th><th>Shoulder Width(1)</th><th>Lane Width(1)</th><th>Shoulder Width(1)</th><th>Lane Width(1)</th><th>Shoulder Width(1)</th><th>Lane Width(1)</th><th>Shoulder Width(1)</th></tr>
<tr><td rowspan="2">1 – 750</td><td>≤ 45</td><td>10 ft</td><td>2 ft</td><td rowspan="4">D: 12 ft
M: 10 ft</td><td rowspan="5">D: 8 ft
M: 2 ft or Curb and Gutter</td><td>11 ft</td><td rowspan="4">3 ft</td><td rowspan="5">D: 12 ft
M: 11 ft</td><td rowspan="5">D: 10 ft
M: 6 ft or Curb and Gutter</td></tr>
<tr><td>> 45</td><td>10 ft</td><td>2 ft</td><td>12 ft (2)(3)</td></tr>
<tr><td rowspan="2">751 – 2000</td><td>≤ 45</td><td>11 ft (2)</td><td>2 ft</td><td>11 ft</td></tr>
<tr><td>> 45</td><td>12 ft (2)</td><td>2 ft</td><td>12 ft (2)(3)</td></tr>
<tr><td>> 2000</td><td>all</td><td>12 ft (2)</td><td>3 ft</td><td>D: 12 ft
M: 11 ft</td><td>12 ft</td><td>6 ft</td></tr>
</table>

(1) Retain existing width if existing width is greater than the value shown.
(2) Lane widths may be 1-foot less if there are less than 10 percent trucks.
(3) An existing 22-foot traveled way may be retained where the alignment is satisfactory and there is no crash pattern suggesting the need for widening.
D = Desirable M = Minimum

LANE AND SHOULDER WIDTHS
(3R Projects)
Figure 18.2-B

18.2.5.2 Cross Slopes

Reference: Chapter 7 “Cross Section Elements”

On 3R projects, it generally will be acceptable to retain the existing cross slopes. If there is an adverse crash history that indicates a problem, use the cross slope criteria for new construction/ reconstruction projects.

18.2.5.3 Bridges

Reference: Section 7.5

18.2.5.3.1 Scope of Work

Several bridges may be within the limits of the 3R project. Consult with the Bridge Maintenance Office to determine the condition and load capacity of existing bridges. The scope of work for bridges may be any of the following:

1. Bridge Replacement. Depending upon the extent of the structural deficiencies, if any, it may be economical to replace the entire bridge (i.e., superstructure, substructure and foundation).

2. Bridge Reconstruction/Bridge Deck Rehabilitation. If the existing superstructure or bridge deck is structurally deficient, but the substructure/foundation is structurally sound, the superstructure and/or bridge deck may be reconstructed or replaced as part of the 3R project. If the bridge deck is structurally sound, but its width is inadequate (i.e., the bridge is functionally deficient), the bridge deck may be rehabilitated solely to widen the bridge

deck. Bridge deck widening may then require work to the superstructure and/or substructure.

3. Existing Bridge to Remain in Place. If an existing bridge is structurally sound and if it meets the Department's design loading capacity, it is unlikely to be cost effective to improve the geometrics of the bridge. These are considered existing bridges to remain in place. However, if the geometric deficiencies are severe and/or if there has been an adverse safety experience at the bridge, it may be warranted to widen the bridge or to make other improvements.

   In some cases, only the bridge substructure (e.g., abutments, piers) and/or foundation (e.g., footings, piles) may require rehabilitative work. For applying the 3R geometric design criteria, these may be considered existing bridges to remain in place.

4. Bridge Rail Transitions. The roadway designer will evaluate the adequacy of the existing approaching guardrail transition for any needed upgrading.

18.2.5.3.2 Bridge Width

The following will apply to the evaluation and improvement to the width of bridges within the limits of a 3R project:

1. Bridge Replacement. For this scope of work, provide the full approach roadway width using new construction criteria across the bridge.

2. Bridge Reconstruction/Bridge Deck Rehabilitation. For these scopes of work, provide the full approach 3R roadway width across the bridge.

3. Existing Bridge to Remain in Place. Evaluate the existing width of bridges proposed to remain in place using the criteria from Section 7.5.1. If the existing width does not meet these criteria, the designer must either widen the bridge as part of the 3R project or pursue supporting documentation.

Evaluate all bridges that are narrower than the approach roadway width (including shoulders) for special narrow bridge treatments. At a minimum, the signing and pavement markings must meet the criteria of the MUTCD. In addition, the FHWA publication, *Mitigation Strategies for Design Exceptions* provides several mitigation strategies specifically for narrow bridges. The designer, in coordination with the traffic designer, should evaluate the value of these additional treatments at the bridge site.

18.2.5.3.3 Horizontal/Vertical Alignment

Except for bridge replacements, it is unlikely to be cost effective to improve the existing horizontal or vertical alignment for a bridge within the limits of a 3R project.

18.2.5.4 Fill or Cut Slopes

The following will apply to fill or cut slopes:

1. No Roadway Widening. Existing fill or cut slopes of 2H:1V or flatter may be retained.

2. Roadway Widening. If the lanes or shoulders are widened, this will produce a steeper fill slope or ditch foreslope, assuming the toe of fill slope or toe of backslope remains in the same location. The roadside design should be modified to provide a configuration that is the same as or flatter than the roadside cross section before the 3R project limits. At a minimum, the following will apply:

    a. Embankment Slope. Desirably, use a 6H:1V within the clear zone where a 6H:1V or flatter slope currently exists, or where the length of the improvement is greater than 0.5 mile. If a steeper slope is required, consider using a 4H:1V slope before implementing a 2H:V1 slope. Locations or situations that may warrant a 2H:1V slope are as follows:

        - roadway widening that encroaches into a wetland;
        - an area with restrictive or very costly right of way; or
        - a slope at the end of a large culvert, bridge spill slope or other location where it is desirable to protect the slope with riprap.

        The designer should analyze each location individually and use engineering judgment in selecting the slope rate.

    b. Ditch. If right of way is available, consider moving the existing ditch line and flatting slopes as much as practical. A drainage ditch in the 3R clear zone should be regraded as practical to make it traversable for an errant vehicle.

18.2.6 Right of Way

The acquisition of significant amounts of right of way is usually outside the scope of a 3R project. Where practical, secure additional right of way to allow cost-effective geometric and roadside safety improvements.

18.2.7 Horizontal Alignment

Reference: Chapter 5 “Horizontal Alignment”

The designer should determine the design speed of each existing horizontal curve within the 3R project limits. To determine the existing horizontal curve design speed, the designer should determine the applicable maximum superelevation rate for the project location. For a rural highway or an urban facility where $V \geq 50$ miles per hour, use an e_{max} of 8 percent (see Figure 5.3-B). For an urban facility where $V \leq 45$ miles per hour, use an e_{max} up to 6 percent (see Figure 5.3-C). An existing horizontal curve may be retained if the following conditions exist:

- a safety analysis does not indicate a problem at the curve site;
- the calculated curve design speed is not more than 15 miles per hour below the 3R design speed; and
- the AADT is not greater than 750 vehicles per day.

The existing radius will be retained on a curve where the above conditions are satisfied (i.e., the curve need not be evaluated further). However, proper signs and pavement markings may be necessary. Once the decision has been made to improve the curve, the designer should use the criteria in Chapter 5 “Horizontal Alignment” to determine the proper combination of radii and superelevation using the 3R design speed.

18.2.8 Superelevation

Reference: Chapter 5 “Horizontal Alignment”

Desirably, the curve superelevation should meet criteria for new construction; see Chapter 5 “Horizontal Alignment.” On 3R projects, constraints of excessive costs often preclude the use of desirable superelevation rates. If the curve is to remain and minimum superelevation rates cannot be achieved, provide proper signing and pavement markings for the appropriate speed in accordance with the MUTCD. In some cases, reconstruction of substandard horizontal curves to larger radii may be feasible in lieu of increasing the superelevation.

18.2.9 Vertical Alignment

Reference: Chapter 6 “Vertical Alignment”

18.2.9.1 Grades

Reference: Section 6.3

Unless a safety analysis indicates otherwise, the maximum grade on a 3R project may be up to 2 percent steeper in level terrain or 1 percent steeper in rolling terrain than the criteria for new construction and reconstruction projects. In mountainous terrain, an existing grade may be retained.

18.2.9.2 Crest Vertical Curves

Reference: Section 6.5.1

Section 6.5.1 presents the Department’s criteria for the design of crest vertical curves for new construction and reconstruction projects. The designer should use this information to determine the calculated design speed of an existing crest vertical curve and compare the calculated speed to the selected 3R design speed. The following summarizes the 3R design criteria for crest vertical curves:

1. AADT < 1500. In the absence of an adverse crash history, all existing crest vertical curves are acceptable without further evaluation regardless of the design speed of the vertical curve.

2. AADT > 1500. In the absence of an adverse crash history, all existing crest vertical curves with a calculated design speed within 15 miles per hour of the 3R design speed are acceptable. The designer should evaluate the reconstruction of the crest vertical curve if its calculated design speed is more than 15 miles per hour less than the 3R design speed

and if the crest hides from view major hazards (e.g., intersections, sharp horizontal curves, narrow bridges).

3. Angle Points. It is acceptable to retain an existing angle point (i.e., no vertical curve) where the algebraic difference between the two grades is 0.5 percent or less.

If the existing crest vertical curve satisfies these criteria, the designer typically will not need to check other details of the vertical curve (e.g., minimum length of vertical curve).

If the decision is made to flatten the crest vertical curve, the designer will desirably design the reconstructed curve to meet the criteria for new construction/reconstruction in Section 6.5.1. However, at a minimum, it is acceptable to design the crest vertical curve using a speed that is 15 miles per hour less than the 3R design speed.

In addition, consider flattening crest curves if the stopping sight distance is met, but the intersection sight distance is not available.

18.2.9.3 Sag Vertical Curves

Reference: Section 6.5.2

Section 6.5.2 presents the Department's criteria for the design of sag vertical curves for new construction and reconstruction. These criteria are based on designing the sag to allow the vehicle's headlights to illuminate the pavement for a distance equal to the stopping sight distance for the design speed. For 3R projects, the following will apply:

1. Evaluation. The comfort criteria represent the minimum criteria for the retention of an existing sag vertical curve if lighting is included. Section 6.5.2.3 presents the comfort criteria. If an existing sag does not meet the comfort criteria, then the designer should consider flattening the sag vertical curve.

2. Corrective Action. If the decision is made to flatten the sag, the designer should desirably meet the criteria for headlight sight distance in Section 6.5.2.2. At a minimum, it is acceptable to design the sag to meet the comfort criteria if lighting is included.

3. Angle Points. It is acceptable to retain an existing angle point (i.e., no vertical curve) where the algebraic difference between the two grades is 0.5 percent or less.

If the existing sag vertical curve satisfies the above criteria, the designer typically will not need to check other details of the vertical curve (e.g., minimum length of vertical curve).

18.2.9.4 Vertical Clearance

Reference: Section 6.6

Existing vertical clearance may be retained if the structure is not being reconstructed. If the bridge is being reconstructed, use the vertical clearance criteria presented in Section 6.6.

18.2.10 Intersections At-Grade

Reference: Chapter 9 "Intersections"

18.2.10.1 Intersection Sight Distance

Reference: Section 4.4

Section 4.4 presents the intersection sight distance (ISD) criteria for new construction/ reconstruction projects, which applies to 3R projects. However, for 3R projects on low-speed urban streets ($V \leq 45$ miles per hour), the location of the eye may be assumed to be 10 feet from the edge of traveled way.

18.2.11 Special Design Elements

Reference: Chapter 11 "Special Design Elements"

Chapter 11 "Special Design Elements" addresses the application of several special design elements (e.g., landscaping, mailboxes, etc.). The designer should review Chapter 11 to determine if these elements apply to the 3R project.

18.2.12 Roadside Safety

Reference: AASHTO *Roadside Design Guide*

The roadside safety criteria in the reference documents has been developed explicitly for new construction and reconstruction. This includes criteria for clear zones and barrier layout details (e.g., length of need). These criteria will apply, as practical, to the roadside safety design on 3R projects.

Achieving a roadside clear zone on a 3R project may be impractical. The roadside environment along existing highways is typically cluttered with any number of natural and man-made obstacles. To remove or relocate these obstacles can present formidable problems and public opposition, and it can be very costly. On the other hand, the designer cannot ignore the consequences for a run-off-the-road vehicle. Therefore, the designer should exercise considerable judgment when determining the appropriate clear zone on the 3R project. The most desirable objective for 3R projects will be to provide a clear zone equal to the criteria for new construction and reconstruction projects.

18.2.13 Multimodal Transportation

Reference: Chapter 13 "Multimodal Transportation"

Chapter 13 "Multimodal Transportation" provides the Department's criteria and design details for multimodal transportation design elements (e.g., pedestrian and bicycle accommodations, bus stops and turnouts, etc.). The designer should review Chapter 13 to determine if these criteria apply to the 3R project. See the SCDOT "Americans with Disabilities Act Transition Plan" for items related to accessibility.

18.3 REFERENCES

1. *Designing Safer Roads: Practices for Resurfacing, Restoration, and Rehabilitation*, Special Report 214, TRB, 1987.

2. *Developing Geometric Design Criteria and Processes for Non-Freeway RRR Projects*, Technical Advisory T5040.28, FHWA, 1988.

3. *NCHRP Synthesis 417, Geometric Design Practices for Resurfacing, Restoration, and Rehabilitation*, TRB, 2011.

4. *Mitigation Strategies for Design Exceptions*, FHWA, 2007.

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

6. *Roadside Design Guide*, AASHTO, 2011.

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