## 1 - Introduction

Federal regulations specify the term 3R projects. The term refers to resurfacing, restoration and rehabilitation projects. 3R projects are intended to preserve and extend the service life of existing highways and enhance highway safety. Refer to FDM 11-44-1 for definition of the 3R's. The typical scope of such projects exceeds routine maintenance but is less than new construction or reconstruction. Examples of 3R work include:

- Resurfacing
- Pavement replacement
- Pavement structural and joint restoration
- Widening of lanes and shoulders
- Selected alterations to vertical and horizontal alignment
- Intersection improvements
- Bridge rehabilitation
- Traffic control improvements
- Removal, modification or shielding of roadside hazards

It's important that 3R projects preserve the safety benefits gained from previous construction by not worsening existing roadway geometrics or clear zone. However, upgrading 3R projects to comply with the minimum geometric design criteria intended for new construction and reconstruction is often impractical. Constraints include cost to benefit considerations, the need to acquire extensive right of way, and unacceptable social or environmental impacts. Therefore, the following minimum geometric design criteria were developed for 3R projects. They are intended to provide the lower limit for applying engineering judgment in designing 3R projects. Do not use them automatically, but only when higher values are not practical.

These criteria were developed in accordance with Part 625 of Title 23, Code of Federal Regulations, "Highways" and FHWA Technical Advisory T 5040.28, "Developing Geometric Design Criteria and Processes for Nonfreeway RRR Projects. " [1]

The principal sources of information used to develop these criteria were the FHWA Technical Advisory and Transportation Research Board's Special Report 214, "Designing Safer Roads. " [2]

## 2 - Application

The 3R design criteria apply to both Federal-aid projects and state funded projects except freeways and expressways. For 3R design exceptions involving FHWA's controlling criteria (see FDM 11-1-2), use the "Programmatic Exception to Standards (PES) Process described in FDM 11-1-4, where applicable. For those 3R design exceptions where the PES process is not used, or where it doesn't apply, requests for design exceptions shall be prepared and processed in accordance with FDM 11-1-2.

## 3 - Six Year Program Relationship

The improvement levels of resurfacing, pavement replacement, reconditioning used in TRANS 209 and the Six Year Program relate directly to the 3R's as used in these design criteria with the following qualification: Any segment of a reconditioning improvement that will be on centerline realignment outside the existing roadway width (pavement and shoulders) for more than one half mile or will result in a change in subgrade profile to correct vertical alignment for a length for more than one half mile shall be developed to comply with the design criteria for new construction except 3R design criteria may be used for vertical and horizontal alignment. Whenever the accumulated length of relocations and vertical alignment corrections (regardless of their individual lengths) exceeds fifty percent of the overall project length, design criteria for new construction shall be used to the maximum extent practical and the project reprogrammed as a Reconstruct rather than a Recondition.

Coordinate Development of 3R projects with bridge improvements planned in the six year program.

Spot Safety Improvements address safety issues within existing sections of roadway that are not programmed for immediate reconstruction. These types of improvements are typically short (less than one half mile) and may or may not be combined with 3R improvements. Spot Safety Improvement work ranges from bridge replacement or rehabilitation to correction of horizontal and vertical alignment, or intersection improvements. The design criteria applied to this type of improvement must be determined on the basis of engineering judgment taking into account improvements planned for adjacent sections of the highway for the purpose of achieving design consistency. Where the prevailing type of work programmed for a stretch of highway is of a 3R nature, any spot safety improvements may be designed using 3R criteria. Conversely, the use of 3R criteria would not be appropriate if the highway were programmed for reconstruction within the Six-Year Highway Improvement Program. For guidance on bridges and 3R projects, see the subsection entitled "Bridge Width and Structural Capacity" in this procedure.

**4 - Scope of 3R Projects**

Design development of 3R projects shall be in accordance with the Facilities Development Process described in Chapter 3. Carry out design investigations and develop design concepts to satisfy the primary objectives of 3R.

The addition of passing lanes and climbing lanes may be applicable in order to provide the desired frequency of safe passing zones. See FDM 11-15-10 for additional warrant and design guidance.

Funding constraints and practical limitations to modernizing existing highways, especially where additional right of way is required, are also major factors in determining the scope of 3R work.

Highway safety must be systematically designed into each project even though it may not be the primary reason for the 3R project. A review of crash history is an essential part of project development for all 3R improvements. Cost effective 3R improvements may require some variation in application of design criteria. Transitions between sections of highway of different design, especially where the roadway dimensions change, must be carefully designed to assure safe and appropriate driver response. Locate these transitional sections where they are clearly visible to drivers and provide appropriate delineation and advance signing.

The 3R work often provides an opportunity to incorporate safety improvements into a project in conjunction with the pavement and geometric work. Safety improvements can include the following.

1. Intersection and access point adjustments that increase sight distance and reduce vehicle conflicts.
2. Improvement of pavement crown and superelevation.
3. Spot re-grading to correct alignment.
4. Replacement or rehabilitation of obsolete bridge rails and guardrails.
5. Removal of roadside obstacles and unnecessary guardrails.
6. Slope flattening.
7. Ditch relocation or regrading.
8. Upgrading roadside safety hardware.
9. New or improved signing, pavement marking and other traffic control devices. Correct identified high crash locations whenever possible. Alternatively, corrective work must be separately but concurrently programmed to be completed at an early date. Refer to Attachment 1 for a list of safety mitigation measures that may be used when warranted as alternatives to correction of geometric deficiencies.

**5 - Design Controls**

The principal controls that determine the selection of 3R design criteria are traffic characteristics of the highway and vehicle speeds.

**5.1 - Traffic Data**

Collect and analyze traffic information as necessary to allow determination of a design traffic volume, composition of traffic, and crash experience. Determine turning movements at major intersections and traffic generators when warranted by the scope of the project. The design traffic volume should represent the future traffic expected at the end of the service life of the pavement improvement, typically 15 years minimum. Use Long truck turning radii when a significant volume of long truck traffic is expected.

**5.2 - Design Speed**

The design speed for rural 2-lane projects shall be 55 mph minimum except on those projects or project segments which are posted for less than 55 mph. In those areas the design speed may be the same as the posted speed. Generally, design urban and suburban projects for the regulatory speed expected following completion of the project.

### 5.3 - Horizontal Curves and Superelevation

(See Attachment 7 for a decision tree flow chart on the treatment of existing horizontal curves)The safety effect of sharp horizontal curvature is influenced by superelevation and the geometry of adjacent highway segments. The hazard becomes more severe when the curve is unexpected such as when it follows a long straight approach, is a sharp curve in a series of gentle curves, or when the curve is hidden from view by a hill crest. Compound curves where the second curve is tighter than the first are difficult to maneuver and can be a safety concern.

Identify potentially hazardous curves through crash analysis and safety reviews. (The Programmatic Exception to Standards Process described in FDM 11-1-4 can be used for STHs. Evaluate these for reconstruction or application of other safety measures. Even if a location doesn't have a high crash rate, improvements may still be desirable. Superelevation rates in excess of 8% shall be reduced to 8%, or less (see FDM 11-10-5).

High hazard locations, regardless of AADT, need to be identified and corrected, as noted above. In addition, deficient horizontal curves or superelevation shall be upgraded on highways where the design traffic volume exceeds 750 AADT and where any of the following conditions exist:

- If the existing curve radius equals or exceeds that required for the project design speed, but the superelevation is less than required, then increase the superelevation to the required rate.
- If the existing curve radius is less than, but within 15 mph of, that required for the project design speed, but the superelevation is less than e max, then increase the superelevation to the e max rate (see FDM 11-10-5).
- If the existing curve radius is less than, and not within 15 mph of that required for the project design speed, then realign the curve. Curve realignment, when warranted, is desirably to new construction standards, but as a minimum shall provide a design speed through the curve that is within 10 mph of the overall project design speed.

Proposed curve or superelevation modifications that aren't warranted, as described above, will desirably be consistent with adjacent sections of road, and will minimally not reduce the existing curve speed rating. If a deficient curve is either not reconstructed or is reconstructed to less than new construction standards, then apply appropriate safety mitigation measures (see Attachment 1).

### 5.4 - Stopping Sight Distance for Vertical Curves

All crest vertical curves with an existing design speed, based on the stopping sight distance provided, not within 15 mph of the overall project design speed shall be upgraded on highways with a design traffic volume over 1,500 AADT. Curve realignment, when warranted, is desirably to new construction standards, but as a minimum shall provide a design speed through the curve that is within 10 mph of the overall project design speed. If the curve is not reconstructed or is reconstructed to less than new construction standards, apply appropriate safety mitigation measures (See Attachment 1).

Whether or not an upgrading is required, examine the nature of potential hazards. Potential hazards such as intersections, sharp horizontal curves or narrow bridges hidden by a substandard vertical curve may warrant reconstruction or other less costly appropriate safety measures including relocating or correcting the hazard or providing warning signs.

Investigate substandard sag vertical curves to insure that potential hazards do not exist, especially ones that become apparent when weather conditions or nighttime reduces visibility.

### 5.5 - Passing Sight Distance for Vertical Curves

There is no existing policy or criteria specifying the percentage of the length of a roadway to be provided for passing opportunities. The decision to improve passing opportunities is made individually for each project considering the terrain, AADT, design class and existing percent passing. The following text about non-striping distances is advisory, and is to be used to evaluate when an improvement in passing opportunities is desirable.

The earthwork required to flatten vertical curves to achieve safe passing sight distance is usually beyond the scope of a typical 3R project. However, recondition projects with grading may provide an opportunity to provide a generous sight distance at crest vertical curves that at least exceeds by a good margin the minimum sight distance criteria used for marking no-passing zones. Table 1 shows the minimum non-striping sight distance to provide when the passing sight distances for new construction in FDM 11-10-5, Attachment 1 and FDM 11-10-5, Attachment 5 cannot be achieved with a 3R improvement. Use this table sparingly because, although the use of a non-striping sight distance avoids the need for a no-passing zone marking, the distance provided is not the same as minimum passing sight distance for new construction standards. Because the non-striping distances are considerably less than the minimum passing sight distances used for new construction, fewer vehicles will be able to pass within any single passing zone. Therefore, it is safer, more cost effective and improves traffic operations more to re-grade one or two vertical curves to the sight distance values for new construction than it is to re-grade a series of curves to the non-striping distance. If employing this philosophy, ensure that the spacing between successive passing opportunities both within and beyond the ends of the project is reasonable.

***Table 1. Non-Striping Sight Distances***

| Design Speed (mph)[1] | Non-Striping Distance (ft) | No-Passing Zone Distance (ft)[2] |
|---|---|---|
| 30 | 800 | 528 |
| 35 | 950 | 686 |
| 40 | 1100 | 686 |
| 45 | 1240 | 845 |
| 50 | 1380 | 845 |
| 55 | 1540 | 1108 |
| 60 | 1700 | --- |

[1] Speed limit is used to determine no-passing zone distances.

[2] The Manual on Uniform Traffic Control Devices is the source of no-passing zone distances.

These distances are used to determine where No-passing zones are marked on the highway. Do not use no-passing zone distances for design.

### 5.6 - Grades

Grades generally do not need to be flattened on 3R projects. Steep grades and restricted horizontal or vertical curvature in combination however, may warrant corrective action.

### 5.7 - Intersection Sight Distance (ISD) and Vision Triangles

Guidance for Intersection Sight Distance (ISD) can be found in FDM 11-10-5. Although ISD is not a controlling criterion, a Safety Screening Analysis, as described in FDM 11-1-4, can be used to identify whether substandard ISD is contributing to crash problems. If it is contributing to crash problems then provide ISD per the guidance in FDM 11-10-5. Even if substandard ISD is not contributing to crash problems, it is recommended that it be brought up to standards, unless this would result in excessive impacts to community or environmentally sensitive areas. Consider mitigation if substandard ISD is not brought up to standards.

Provide Vision Triangles per the guidance in FDM 11-10-5.

## 6 - Cross Section

### 6.1 - Lane and Shoulder Widths

Lane and shoulder widths for rural two lane highways shall be the greater of either existing or as provided on Attachments 2, 3, 4, 5 and 6.

Rural highways with four lanes or a median shall have lane widths of 12 feet minimum and shoulder widths of 6 feet minimum on the right and 4 feet minimum on the left. Shoulders shall be paved in accordance with the requirements provided in FDM 11-15-1.

The median lane of a five-lane highway shall be 14 feet minimum. See FDM 11-25-5 for additional guidance about two-way left turn lanes.

The minimum width of turning or auxiliary lanes shall be 10 feet (but not less than existing). The minimum shoulder width required along auxiliary (turning or climbing) lanes shall be 3 feet minimum.

For urban cross sections, widening of lanes is frequently not practical because of right of way restrictions. The following guidelines apply to urban 3R projects.

1. Through lane widths shall meet the requirements in FDM 11-20-1, Attachment 1 and FDM 11-20-1, Attachment 5. Federally designated truck routes shall contain at least one 12-foot lane in each direction of travel.
2. Minimum curb offsets are 1 foot when the design speed is 40 mph or less.
3. Turning lane widths shall meet the requirements in FDM 11-25-5, Attachment 1) (but not be less than existing).

4. Parking lanes widths shall meet the requirements of FDM 11-20-1.
5. Transitions from rural to urban cross section are desirably located on tangent where drivers have an unobstructed view. Introduce curbs at the edge of the shoulder and then continue with a tapered urban cross section to transition to the standard urban section. In general, use sloping curbs where the design speed is more than 45 mph.

### 6.2 - Pavement and Shoulder Cross Slope

When 3R projects include new pavement or pavement resurfacing, provide a pavement cross slope of 2%. A cross slope of 1.5% minimum may be provided when resurfacing P.C. concrete pavements which have a cross slope of 1% or flatter. The existing pavement cross slope may be retained on projects involving patching only or patching and grinding.

Shoulder cross slopes shall be as provided in FDM 11-15-1, except that on tangent sections and crown runoff sections, a maximum slope of 6% downward from the adjacent pavement edge may be used, provided that the rollover rate between the travel lane and shoulder doesn't exceed 8%.

Superelevation is addressed under Horizontal Curves and Superelevation

### 7 - Bridge Width and Structural Capacity

Bridges on 3R projects shall be evaluated to determine their structural and operational adequacy and whether or not replacement or widening of the bridge would be safety cost-effective. As part of this analysis consider the expected life of the 3R improvement, the adequacy of bridges on abutting sections of highway and whether the bridge may be replaced in the foreseeable future. The disposition of all bridges with listed structural or functional deficiencies shall be coordinated with Bureau of Structures.

Bridges within the limits of a 3R project which are identified as either structurally deficient or functionally obsolete shall be treated in one of the following ways:

1. Replaced or rehabilitated as part of the 3R project or
2. Added to the current Six-Year Highway Improvement Program.

Bridge replacement, whether as part of a 3R project or as another project, shall be done to new construction standards for design loading and clear roadway width.

Bridge rehabilitation, whether as part of a 3R project or as another project, must result in a bridge that is neither structurally deficient nor functionally obsolete. The work must result in removing all deficiencies, unless this requirement is waived for reasons of safety and public interest.

Refer to the Wisconsin Bridge Information System dotnet site for the Inventory Rating and Sufficiency Rating of individual bridges See Reference [7] for details of how these ratings are determined.

As a minimum, schedule bridge replacement or widening for all bridges less than 100 feet in length and with a usable width less than shown in Table 2 unless such work is shown not to be cost effective.

***Table 2. Minimum Roadway width for 2-Lane Bridges, With Lengths < 100 feet, to Remain in Place****

| Design AADT | State Trunk Highways and County Trunk Highways[2] | Town Roads[2] |
|---|---|---|
| 0 – 100 | The greater of either 18 ft[1] or Traveled Way width | The greater of either 18 ft[1] or Traveled Way width |
| 101 - 400 | The greater of either 20 ft[1] or Traveled Way width | The greater of either 20 ft[1] or Traveled Way width |
| 401 - 750 | The greater of either 22 ft[1] or Traveled Way width | The greater of either 22 ft[1] or Traveled Way width + 1 ft on each side |
| 751 - 1000 | The greater of either 22 ft[1] or Traveled Way width + 1 ft on each side | The greater of either 22 ft[1] or Traveled Way width + 2 ft on each side |
| 1001 - 2000 | The greater of either 24 ft[1] or Traveled Way width + 1 ft on each side | The greater of either 24 ft[1] or Traveled Way width + 2 ft on each side |
| 2001 - 4000 | The greater of either 28 ft[1] or Traveled Way width + 2 ft on each side | The greater of either 28 ft[1] or Traveled Way width + 2 ft on each side |
| 4001 - 5000 | The greater of either 28 ft[1] or Traveled Way width + 3 ft on each side | The greater of either 28 ft[1] or Traveled Way width + 2 ft on each side |
| >5000 | The greater of either 32 ft[1] or Traveled Way width + 3 ft on each side | The greater of either 32 ft[1] or Traveled Way width + 2 ft on each side |

* Widths shown may not meet bridge roadway width requirements for bridge reconstruction or bridge rehabilitation

[1] Minimum Bridge Roadway Width, Curb-To-Curb, To NOT Be Considered Functionally Obsolete Reference [7] - Item 68, Table 2A - Rating Code 4

[2] If lane widening is planned as part of the 3R project, the minimum usable bridge width is the paved roadway (traveled way plus paved shoulders).

Use only approved crash tested bridge rails. If an existing bridge is to be retained and the current AADT is greater than or equal to 300, upgrade substandard bridge rail to current standards and eliminate curb projections of more than nine inches in width which can cause vehicles to vault the rail. Such upgrades are not required but are still encouraged where current AADT is less that 300 vpd or where no work other than adding screening is being done to the bridge.

### 7.1 - Vertical Clearance

The minimum vertical clearance for bridges to remain in place shall be as shown in FDM 11-35-1, Attachment 9

## 8 - Pavement

### 8.1 - Pavement Structure Design

Pavement and shoulder design shall be in accordance with FDM 11-15-1 and Section 10 of Chapter 14. A skid resistant surface is required on all pavement surface improvements regardless of the scope of geometric problems.

### 8.2 - Pavement Edge Drops

Pavement edge drops are undesirable, no matter how they develop, because of safety implications associated with the vehicle recovery maneuver. Pavement edge drops can develop between the pavement surface and the adjacent unpaved shoulder or roadside. Avoid potential edge drops by including with 3R projects:

1. Paving the shoulders when warranted by policy or
2. Selectively paving shoulders at points where encroachments are likely to create pavement edge drops, such as on the inside of horizontal curves.

## 9 - Traffic Control Devices

Where roadway geometry or roadside design is less than standard, and reconstruction is not appropriate, consider providing additional signs, markings, delineation and other devices beyond normal requirements of the Manual on Uniform Traffic Control Devices. Refer to Attachment 1 for safety mitigation measures.

## 10 - Roadside Design

Roadside characteristics are important in determining the overall level of safety provided by a highway. Improve roadside border areas to the extent practicable to provide gentle side slopes and remove hazardous obstacles. The safety cost-effectiveness of particular roadside improvements is highly dependent on site-specific conditions and interactions between different roadside features. As a result, the width of border area or clear zone for 3R projects may vary and need to be determined .on the basis of a safety analysis and engineering judgment. Use the AASHTO "Roadside Design Guide" (3) for background information and guidance to supplement the following design criteria.

### 10.1 - Safety Analysis

Analyze crash and travel data to identify specific roadside safety problems that might be corrected and to determine if the site has been unduly hazardous compared with the system-wide performance of similar highways. Note: Safety enhancement to correct high hazard locations is required for Federal-aid projects.

Conduct a thorough site inspection to identify roadside fixed object features that pose safety hazards under normal operating conditions. Analyze these potential hazards to determine appropriate corrective action, if any. Note: Correction of substandard geometric features such as horizontal curvature or superelevation may reduce the hazard of roadside obstacles at the affected sites.

Perform cost-effectiveness evaluations, when appropriate, to determine whether roadside improvements are warranted.

### 10.2 - Clear Zone Width and Lateral Clearance Width

See FDM 11-15-1 for additional guidance on Clear Zone and Lateral Clearance.

Clear zone is defined as that roadside border area, including the shoulder, starting at the edge of the traveled way, available for safe use by errant vehicles. Establishment of a minimum width clear zone implies that rigid objects and certain other hazards with clearances less than the minimum width are either removed, relocated to an inaccessible position or outside the minimum clear zone, remodeled to make safely traversable or breakaway, or shielded.

The provision of clear zone during previous projects represents a significant investment in roadway safety. Therefore, perpetuate As Built original clear zone widths, unless they are less than the minimums shown below.

Following in this procedure are qualified exceptions to this general requirement that apply to trees, utility poles, cattle passes, and culverts.

Lateral Clearance (also known as "operational offset") is defined in FDM 11-15-1 as an obstruction free area beginning at the edge of driving lane, and extending a minimum distance so as not to interfere with the operation of the roadway. Lateral clearance is required for all urban and rural roadways.

**Rural Highways**

1. Where the design AADT is less than 1,500, the minimum clear zone width shall be the greater of either 10 feet or As Previously Built, but not farther than the right-of-way limits.
2. Where the design AADT is greater than or equal to 1,500, the minimum clear zone width shall be the greater of either 18 feet or As Previously Built, but not farther than the right-of-way limits.
3. Lateral Clearance shall be as shown in FDM 11-15-1, Table 1.

**Urban and Suburban Roadways - With Shoulders**

1. Where the posted speed is 45 mph or less the minimum clear zone width shall be the greater of either 10 feet or As Previously Built, but not farther than the right-of-way limits.
2. Where the design AADT is less than 1,500 and the posted speed is greater than 45 mph, the minimum clear zone width shall be the greater of either 10 feet or As Previously Built, but not farther than the right-of-way limits.
3. Where the design AADT is greater than or equal to 1,500 and the posted speed is greater than 45 mph the minimum clear zone width shall be the greater of either 18 feet or As Previously Built, but not farther than the right-of-way limits.
4. Lateral Clearance shall be as shown in FDM 11-15-1, Table 1.

**Roadways With Curbs and Posted Speeds of 40 mph or Less**

1. Clear zone is not required; however, it is desirable to locate/relocate as many fixed objects as possible to an area adjacent to the R/W line or as far from the traveled way as practical.
2. The desirable lateral clearance width shall be 2.0 feet measured from face of curb, but not less than existing lateral clearance. The minimum lateral clearance width shall be 1.5 feet measured from face of curb, but not less than existing.

**Roadways With Curbs and Posted Speeds of 45 mph or Greater**

1. The clear zone width shall be as required for rural highways measured from the edge of the through traffic lane—see above.
2. The desirable lateral clearance width shall be 2.0 feet measured from face of curb, but not less than existing. The minimum lateral clearance width shall be 1.5 feet measured from face of curb, but not less than existing.

**10.3 - Sideslopes and Ditches**

Steep foreslopes can be a safety hazard and are also difficult and costly to maintain. Don't steepen foreslopes, beyond what is described below, when widening or raising lanes and shoulders, because the usable width of finished shoulder is reduced when the adjacent foreslope is steeper than 4:1.

***Table 3. Standards for 3R Construction of Unshielded Foreslopes Within Clear Zone***

| Existing Foreslope | Constructed Foreslope |
|---|---|
| 4:1 or flatter | Desirable – not steeper than existing<br>Steepest – 4:1 |
| Steeper than 4:1* | Desirable – not steeper than existing<br>Steepest 3:1 |

* In particular, consider flattening foreslopes steeper than 4:1 on the outside of horizontal curves when warranted by crash

history, or when design AADT exceeds 3,500.

Proposed unshielded foreslopes to be constructed outside the clear zone under 3R work shall not be steeper than 3:1.

If there is a traversable, but non-recoverable foreslope (i.e. between 3:1 and 4:1) within the clear zone, a recovery area, per FDM 11-15-1, Attachment 10, may be required.

Existing critical foreslopes (i.e. steeper than 3:1) that are outside of the proposed construction limits must be evaluated for possible flattening or shielding.

Evaluate ditch cross sections to determine whether they are traversable. Preferred ditch cross sections are shown in FDM 11-15-1, Attachment 12. Perpetuate existing traversable ditches. Consider safety improvement of ditches with 3R work, when practical.

### 10.4 - Roadside Obstacles

#### 10.4.1 - Utilities

Above ground utility features such as poles, guy wires, pedestals, etc. shall be relocated outside the minimum clear zone. In addition, do not allow above ground utility features near ditch bottoms or on the ditch foreslope. Although departmental policy [4] states that both above- and below-ground utility facilities are to be “located at or as near as practical to the right-of-way line,” they should not be located directly on it because these facilities could interfere with the placement of right-of-way monuments.

Note: Utility companies have a legal right to occupy highway right of way through a permit process.

#### 10.4.2 - Trees

Trees and hazardous shrubs in rural areas shall be removed from the clear zone. In urban areas, only remove trees for identified safety concerns.

#### 10.4.3 - Mailbox Supports

Hazardous mailbox supports within the clear zone shall be identified and either modified or replaced in cooperation with the owners. - see “Hazardous Mailboxes” in FDM 11-15-1.

#### 10.4.4 - Sign and Light Supports

Breakaway supports shall be used for signs located within the clear zone except sign bridge supports that shall be either located outside of the clear zone or shielded by traffic barrier.

Light supports shall be located and made breakaway in accordance with FDM 11-10-1 of the "Traffic Guidelines Manual" [8] and as directed by the Regional Chief Traffic Engineer.

#### 10.4.5 - Cross-Drainage and Cattle Pass Structures

Cross-drainage and cattle pass structures with headwalls and wing walls near the traveled way shall be extended where necessary to at least the full roadway width. Cross-drainage structures and end treatments wider than 36 inches within the clear zone can be made traversable for passenger cars by using bar grates or pipes to reduce the clear opening width. Cattle pass structures that are not being used are either to be removed or filled in. Structure openings of 48 inches or more within the clear zone shall be evaluated for possible shielding with guardrail. On certain 3R projects marking culvert ends is required. Mark all cross drain culvert ends and cattle passes on major reconditioning projects (or other 3R projects that include the location survey information for cross drainage structures and cattle passes) with Marker Post, Flexible, for Culvert Ends. Marking is optional on resurfacing and pavement replacement projects where the location of cross drains and cattle passes is not identified in the survey. Marking includes single and multiple culvert ends and cattle passes in shielded and unshielded locations either inside or outside the clear zone on the public right-of-way. Do not mark driveway culvert ends or field entrances or underdrain outfalls.

### 10.5 - Embankment Slopes and Culvert Ends at Side Roads and Driveways

Embankment slopes at side roads and driveways that are replaced shall be 6:1 or flatter where design AADT exceeds 3,500. If possible, construct embankment slopes of 6:1 or flatter when culvert headwalls are removed, made traversable or ditches re-graded. Headwalls at culvert ends under side roads, driveways or field entrances, that are located in a vulnerable position relative to the main road traffic, are to be either removed, relocated beyond the clear zone, or shielded by a traffic barrier.

### 10.6 - Bridges

Guardrail shall be provided at all bridge approaches in accordance with warranting criteria contained in FDM 11-45-1.

### 10.7 - Guardrail

Guardrail needs shall be evaluated and provided or upgraded in accordance with the guidance contained in FDM 11-45-1. Unwarranted guardrail and non-standard traffic barrier shall be removed.

### 11 - References

[1] Technical Advisory T 5040.28, "Developing Geometric Design Criteria and Processes for Non-freeway RRR Projects", U.S. Department of Transportation, Federal Highway Administration October 17, 1988.

[2] "Special Report 214, Designing Safer Roads, Practices for Resurfacing, Restoration and Rehabilitation", TRB, 1987. Out of print. E-mail TRBSales@nas.edu to obtain a photo copy.

[3] "Roadside Design Guide, AASHTO", 1989.

[4] "A Policy for the Accommodation of Utilities on Highway Rights of Way", Wisconsin Department of Transportation, Central Office Maintenance, 1988.

[5] TRANS 209, Highway and Bridge Project Selection Process.

[6] TRANS 213, Local Bridge Program.

[7] Report No. FHWA-ED-89-044, "Recording and Coding Guide For The Structure Inventory and Appraisal of the Nations Bridges, Federal Highway Administration, 1995.

[8] "Traffic Guidelines Manual," Wisconsin Department of Transportation, Central Office Traffic

**LIST OF ATTACHMENTS**

| | |
|---|---|
| Attachment 1 | Alternatives to Reconstruction to Enhance Safety |
| Attachment 2 | 3R Design Criteria for Rural State Trunk Highways Functionally Classified as Arterials |
| Attachment 3 | 3R Design Criteria for Rural State Trunk Highways Functionally Classified as Collectors and Locals |
| Attachment 4 | Design Criteria for Resurfacing/Reconditioning Town Roads |
| Attachment 5 | Design Criteria for 3R Projects on Rural County Trunk Highways Functionally Classified as Arterials |
| Attachment 6 | Design Criteria for 3R Projects on Rural County Trunk Highways Functionally Classified as Collectors and Locals |
| Attachment 7 | Evaluation of an Existing Horizontal Curve |