

# **GEOMETRIC DESIGN CRITERIA**

**for  
Non-freeway Resurfacing,  
Restoration, and  
Rehabilitation Projects**

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**Arkansas State Highway and  
Transportation Department**

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**Approved by FHWA**

*R. G. Fairbrother*

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## **1. GENERAL**

Federal Highway Administration regulations provide that each State may adopt geometric design criteria to be used in the development of non-freeway resurfacing, restoration, and rehabilitation projects (RRR), rather than using new construction standards. The criteria must address 10 factors set forth in FHWA Technical Advisory T5040.28, dated October 17, 1988. In accordance therewith, the Arkansas State Highway and Transportation Department has adopted the following criteria

## **2. APPLICABILITY**

Criteria contained in this document apply to non-freeway RRR projects on the Federal-Aid Primary, Secondary and Urban Systems.

These criteria address geometric design features identified in Part 25, Title 23 CFR as controlling criteria for geometric design. The 10 features addressed are lane and shoulder width, speed, horizontal and vertical alignment, bridge width, cross slope, superelevation, stopping sight distance and horizontal clearance.

When structural capacity, grades or vertical clearance are modified, new construction criteria will normally apply, unless a design exception has been approved by the FHWA.

Criteria in this document do not apply to other features such as pavement design, traffic control devices, pavement markings, roadway lighting, construction materials and methods, etc.

These criteria also do not apply to RRR projects on access-controlled facilities which are considered on a case-by-case basis and to reconstruction projects (the fourth R) which generally are designed to meet new construction standards.

## **3. RRR PURPOSE**

The purpose of RRR projects is to preserve and extend the service life of existing highways and to enhance safety. Since safety enhancement is an essential consideration, RRR projects will be developed and accomplished in a manner which identifies and incorporates appropriate safety improvements.

By their purpose and definition, RRR projects reflect and emphasize the economic management of the existing highway system in order to protect the investment in and to derive the maximum economic benefit therefrom. Economic considerations are a major factor in determining the priority and scope of RRR projects. Special emphasis is placed on implementing cost-effective projects recognizing, however, that certain upgradings for safety and operational purposes are desirable and necessary.

## **4. SCOPE**

### **4.1 General**

As noted, RRR projects are to preserve and extend the service life of existing highways and to enhance safety. Therefore, RRR projects may include such items as placement of additional surface material and/or other work necessary to return an existing roadway, including shoulders, roadside, and appurtenances to a condition of structural and functional adequacy. RRR projects may also include reworking or strengthening of base materials and upgrading of geometric features and appurtenances for safety purposes.

RRR projects generally do not increase the level of service. However, the fact that there is an active project underway extends an opportunity to do more safety upgrading than would normally be done under the safety program alone, particularly where a desirable improvement can be made at a reasonable cost. When upgrading of geometric features becomes a major factor in project costs or impacts, the project will be converted to "reconstruction" (fourth R) and is not covered by these criteria.

Generally speaking, RRR projects are designed to achieve at least a ten-year service life when possible.

### **4.2 Determination**

The scope of RRR projects is determined by many factors. The following shall be considered and included as appropriate in the AHTD RRR Form and discussed during initial reviews or at the plan-in-hand review.

#### **a. Pavement Condition**

The existing pavement condition and the scope of needed pavement improvements dictate, to a large extent, what improvements are feasible, prudent, or practical. More significant geometric upgrading might be appropriate if the pavement improvements are substantial, but may not be appropriate or economical if the needed pavement improvements are relatively minor.

The geometric deficiencies may be so severe that the overall highway improvements must be more substantial in order to facilitate the necessary geometric improvements. A point may be reached; however, where even with substantial geometric deficiencies, the economic and environmental constraints preclude making the improvements indicated by these criteria [See 4.2 (f)].

A judgmental decision must then be made as to whether the service demand requires proceeding with less than desirable rehabilitation efforts. For these cases, justification will be submitted and approval obtained from the FHWA.

**b. Physical Characteristics**

The physical characteristics of a highway and its general location often determine what improvements are necessary, desirable, possible, practical, or cost-effective. Topography, climate, adjacent development, existing alignment (horizontal and vertical), cross section (pavement width, shoulder width, cross slope, side slopes, etc.), and similar characteristics must be considered in determining the scope of geometric or safety improvements to be made in conjunction with pavement-type RRR work.

**c. Traffic Volumes**

Traffic data is needed in the design of all highway improvements, including RRR. It is an important consideration, both in the determination of the appropriate level of improvement (i.e., reconstruction vs. RRR) and in the selection of actual values for the various geometric elements. For RRR, the need for a formal forecast of future traffic is greatest when the current traffic is approaching the capacity of the highway, and decisions must be made regarding the timing of a major improvement such as additional lanes. Studies to determine future traffic are not normally necessary on very low volume road when even high percentage increases in traffic do not significantly impact design decisions.

**d. Speed**

Geometric design criteria are generally established based on speed. For RRR work, the average running speed over the project length will be determined and used as the basis for establishing the various geometric elements.

**e. Accident Records**

Evaluation of accident records often reveals problems requiring special attention. In addition, relative accident rates can be an important factor in establishing the scope of RRR projects. A review of accident records is an integral part of the RRR project development process. On County Secondary projects this information is not normally available; however, when it is available,

it will be reviewed. (See 5.6 for additional discussion on conducting a safety analysis.)

#### **f. Potential Impacts of Various Types of Improvements**

Quite often, the scope of geometric improvements contemplated for RRR projects is influenced by potential impacts on the surrounding land and development. Typically, social, environmental, and economic impacts severely limit the scope of RRR projects, particularly where the existing right-of-way is narrow and there is considerable adjacent development. The need for additional right-of-way frequently determines the upper limit of practical geometric improvements.

### **5. GEOMETRIC DESIGN CRITERIA**

#### **5.1 Pavement Cross Section**

- a.** Pavement cross slope shall meet current standards.
- b.** A skid resistant surface is an essential part of all pavement improvements and will be provided on all projects.
- c.** Pavement edge drop-offs are undesirable. The RRR design will eliminate existing pavement edge drop-offs.
- d.** Superelevation of existing curves will be retained if the curve speed is within 15 mph of the average running speed established for the project. If curve speed is more than 15 mph below the project speed, superelevation will be corrected to current standard or the curve reconstructed in accordance with Section 5.4(a).

#### **5.2 Roadways**

Roadway is defined as the travel way plus usable shoulders. Lane and shoulder widths shall be as shown in Table 1. Roadways at or above the minimum values shown may be rehabilitated at their existing widths. Normally, additional grading and additional right-of-way acquisition will be very limited. In the event the Safety Analysis indicates a section where grading is recommended as a cost effective treatment (normally horizontal or vertical curve correction), the new section shall be constructed to the same roadway width as the rest of the RRR improvement.

### 5.3 Bridges

The minimum width for bridges to remain in place shall be as shown in Table 2. The travel way shall be established by the minimum lane width shown in Table 1. Usable bridge width is defined as the clear width between curbs or rails, whichever is less. Bridges which are at or exceed the RRR minimum width may be left in place if structurally adequate with no additional structure work necessary. The exception would be where severely deficient bridge railing, or deteriorated deck exists, where the structure has a load carrying capability that is below legal limits or where the approach alignment warrants improvement.

Bridges that are within the limits of a RRR project and are less than the RRR minimum width will be widened or replaced. When such widening or replacement is funded with Bridge Replacement funds, the new width shall meet new construction standards. When RRR funds are used, the width may be reduced, if necessary, but shall not be less than the roadway width established for the RRR project.

Where structural elements such as bridge railing are constructed, the work shall be in accordance with current standards.

Where bridge railing is to be structurally upgraded and safety curbs are present with no sidewalk, the upgraded design should effectively eliminate the safety curb.

Guard rail at bridge approaches should be evaluated and upgraded if necessary to meet current standards.

**TABLE 1**

**LANE AND SHOULDER WIDTHS**

ADT		Average Running Speed (mph)	Less than 10% Trks		10% or more Trks	
Current	Projected		Minimum Lane Width (ft)	Minimum Shoulder Width* (ft)	Minimum Lane Width (ft)	Minimum Shoulder Width* (ft)
<b>0-750</b>		<b>All</b>	<b>10</b>	<b>2</b>	<b>10</b>	<b>2</b>
	<b>751-2000</b>	<b>Below 50</b>	<b>11</b>	<b>2</b>	<b>11</b>	<b>3</b>
		<b>50 &amp; over</b>	<b>11</b>	<b>3</b>	<b>11</b>	<b>4</b>
	<b>2001-4000</b>	<b>Below 50</b>	<b>11</b>	<b>3</b>	<b>12</b>	<b>3</b>
		<b>50 &amp; over</b>	<b>12</b>	<b>3</b>	<b>12</b>	<b>4</b>
	<b>Over 4000</b>	<b>All</b>	<b>12</b>	<b>6</b>	<b>12</b>	<b>6</b>

\*May be 1 foot less in mountainous terrain

**TABLE 2**  
**BRIDGE WIDTHS**

ADT		Usable Bridge Width (feet)
Current	Projected	
<b>0-750</b>		<b>Approach travel way width</b>
	<b>751-2000</b>	<b>Approach travel way width + 2 ft</b>
	<b>Over 2000</b>	<b>Approach travel way width + 4 ft</b>

#### **5.4 Alignment**

##### **a. Horizontal curves**

Reconstruction of horizontal curves should be considered when the curve design, assuming correct superelevation is provided, corresponds to a speed that is more than 15 mph below the average running speed established for the project, and the traffic volume is more than 750 vehicles per day.

Reconstruction to RRR standards is to be considered when the above criteria are exceeded. Where reconstruction is justified, superelevation shall be in accordance with 5.1(d). If curve reconstruction is not justified, appropriate safety and other mitigation measures should be applied.

##### **b. Vertical curves**

Reconstruction of vertical curves should be considered when the existing curve design, based on the stopping sight distance provided, corresponds to a speed that is more than 20 mph below the average running speed established for the project, the traffic volume is more than 1500 vehicles per day, and the curve hides major hazards from view. If curve reconstruction is not justified, appropriate safety and other mitigation measure should be applied.

#### **5.5 Side slopes and Clear Zones**

Roadside characteristics are important in determining the overall level of safety provided by a highway. Accident rates are lower and accidents are

less severe on highways with gentle slopes and few obstacles near the roadway. Roadside features should be evaluated considering the following:

- Clear zone will be established on a project-by-project basis with a minimum 10-ft clear zone provided. On higher speed facilities (above 40 mph), clear zones shall be as wide as practicable considering such features as functional class of the facility, existing right-of-way limits, tree lines, etc.;
- Remove, relocate, or shield isolated roadside obstacles;
- Mailbox supports considered hazardous should be replaced;
- Flatten side slopes of 3:1 or steeper where the accident analysis reveals significant run-off-road accidents; otherwise, retain existing slope ratios, and:
- Where driveway culverts with headwalls are located within the established clear zone on higher speed rural facilities (above 40 mph) the headwalls should be removed and replaced with acceptable end treatments, and slopes flattened if necessary.

## **5.6 Safety Elements**

During the development of a RRR project and prior to development of the AHTD RRR Form, a Safety Analysis will be performed to identify safety problems. The Analysis shall be documented in writing and any identified problem areas will be noted on the AHTD RRR Form.

The RRR Form will address such items as:

- Traffic volume [4.2 (c)]
- High Accident locations [4.2 (e)]
- Accident rate
- Average running speed and design speed where appropriate
- Structurally deficient or functionally obsolete bridges
- Proposed geometrics
- Existing bridge widths
- Intersection problems
- Etc.

Where accident rates are high or there are concentrations, a determination will be made as to improvements that can be accomplished within the parameters of a RRR project. Recommendations and decisions

on safety improvements should be consistent with the degree of the safety problem and the opportunity for correction.

The following are examples of safety-oriented improvements that should be considered on RRR projects.

- Ditch relocation and regrading
- Minor realignment
- Flattening of slopes
- Upgrading of public and private road connections
- Widening of pavement and/or grading
- Sight distance corrections
- Elimination of roadside obstructions (trees, poles, etc.)
- Widening of bridges
- Upgrading of bridge and/or approach guardrailing
- Upgrading guardrail to current standards
- Improvement of spot safety problems
- Providing channelization
- Upgrading of signing and marking

Where roadway geometry or other roadway features do not meet the drivers' expectancy, and reconstruction is not appropriate, signs, markings, and other devices beyond the normal requirements should be considered. While traffic control devices cannot fully mitigate all problems associated with certain geometric features, they can compensate for certain operational deficiencies.

Upgrading should not be so extensive as to create another expectation on an unimproved adjacent section of roadway. These safety-oriented improvements will be considered by the plan-in-hand party.

## **5.7 Basic Safety Improvements**

Basic safety improvements will be included in all RRR projects. Basic safety improvements are defined as upgrading guardrail and bridge rail to present standards, removing obstacles within clear zones, providing signing and pavement markings in accordance with the Manual on Uniform Traffic Control Devices, providing a skid resistant surface and providing special signing, marking, and delineation for restricted width bridges. Approach guardrail or other appropriate end treatment shall be installed in accordance with current State policy.

## **5.8 Exceptions**

Exceptions to the above criteria will normally not be requested unless there are extenuating circumstances such as extraordinary costs,

significant environmental impacts, or other items such as adjacent sections of roadway that are less than the minimum value shown in Table 1 but are of such condition as to preclude upgrading of the route segment in the foreseeable future. The fact that right-of-way is required is not in itself a reason for exception; however, excessive right-of-way costs may be a basis for an exception. Exceptions to these criteria will be submitted to and approval gained from FHWA in writing.

## **6. Stage Construction**

Because of funding limitations, size of contract, necessity of competitive bidding, etc., there will be occasions where stage construction will be necessary on RRR projects. Where stage construction is necessary, the ultimate improvement will be addressed in the development of the AHTD RRR Form. Construction will then be staged as necessary. When projects designated for stage construction include bridges, the bridges shall be included in the first stage of work.