

Office of State Aid Road Construction (OSARC) ROADWAY DESIGN MANUAL



OFFICE OF STATE AID ROAD CONSTRUCTION
P.O. Box 1850
Jackson, MS 39216

Harry Lee James, PE
State Aid Engineer

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GEOMETRIC DESIGN OF STATE AID PROJECTS

1.1 GENERAL

1.1.1 Project Oversight

The Office of State Aid Road Construction (State Aid) is responsible for oversight of the State Aid Program (SAP), Local System Bridge Replacement and Rehabilitation Program (LSBP), and the Local System Road Program (LSRP) for the benefit of the several county Boards of Supervisors. State Aid also administers programs or projects by agreement with the Boards that include Federal Highway (FHWA), Mississippi Development Authority (MDA), or other sources. County governments enter formal agreements with State Aid and have certain responsibilities to be eligible to have state funds expended for county road and bridge construction. Additional information is available in the State Aid Standard Operating Procedures.

This document provides the geometric design criteria for projects administered by State Aid. The design criteria and procedures for State Aid projects are similar to state highways but focus on collector routes with lower traffic or local access of economic or cultural features. This document was removed from the Mississippi Department of Transportation (MDOT) Roadway Design Manual (RDM) and maintains references to the RDM throughout.

1.1.2 Legislative Background

The Mississippi Legislature established State Aid in 1949 to administer the State Aid Road Program assisting Mississippi's counties in the construction and maintenance of secondary non-state-owned roads and bridges. State Aid is an office within the MDOT directed by the State Aid Engineer who is appointed by the Governor.

The original selection criteria for the State Aid System placed a special emphasis on those roads that are essential to the conservation and development of natural resources and for economic and social value. The criteria were also intended to encourage desirable land use. The State Aid Road Program serves the agricultural, business, educational, and industrial interests of the counties and helps form a complete collector network.

State Aid funds are eligible for constructing, improving, widening, straightening, surfacing, or reconstructing county roads on the State Aid System to State Aid criteria. These funds are not eligible for routine maintenance activities (e.g., mowing, pot-hole patching, replacing missing or damaged signs). Preventative maintenance projects (e.g., seal course, striping, bridge repair, painting) are eligible for State Aid funds.

The success of the original State Aid Road Program and the needs of counties to improve local roads enabled the passage of legislation allowing additional expenditure of state funds on the local road system. The 1994 Regular Session of the Legislature passed House Bill 1302 establishing the Local System Bridge Replacement and Rehabilitation Program (LSBP). The State Aid Engineer is responsible for administering the program, which assists counties and municipalities in the replacement and rehabilitation of certain bridges located on local road systems. All subsequent and applicable references to County Engineer are also construed to mean LSBP Engineer. The Board of Supervisors is required

to appoint a LSBP Engineer to administer the LSBP program at the county level. The duties of the LSBP Engineer parallel those of the County Engineer and the Board may elect to appoint the County Engineer as the LSBP Engineer.

The 2001 Regular Session of the Legislature passed Senate Bill 2318, which established the Local System Road Program (LSRP). The LSRP allows counties to use LSBP and State Aid funds (subject to certain criteria) for the construction, reconstruction, and paving of county roads not on the State Aid Road System. The LSRP is limited to routes classified as local roads that provide access to the State Aid System, Federal-Aid System, or State Highway System, and where the ADT is 400 vehicles or less.

The *Mississippi Code*, Chapters 9, 18, and 37 of Section 65, and the Office of State Aid Road Construction website provides additional information on the programs administered by State Aid.

1.1.3 Office of State Aid Road Construction Responsibilities

It is the responsibility of the State Aid Engineer to:

- prepare and adopt uniform design criteria and specifications for construction and maintenance of State Aid projects,
- approve revisions to the State Aid System,
- approve all construction programs,
- approve plans and specifications for construction projects,
- authorize advertisement for bids,
- concur in the awards of contracts,
- approve and disburse all payments made from the project fund,
- approve final acceptance of completed projects, and
- have annual and other inspections of completed projects to ensure that they are properly maintained by the respective County Board of Supervisors.

In addition, the State Aid Engineer is responsible for distributing Federal-aid funds eligible for projects on county roads, and for monitoring the design of those projects. These activities are coordinated with FHWA through MDOT and are documented in the State Aid Standard Operating Procedures.

1.1.4 County Responsibilities

County Boards of Supervisors for Mississippi's 82 counties have jurisdiction over roads and bridges on the State Aid System in their respective counties. Each Board of Supervisors is required to appoint a County Engineer to act on behalf of the Board to administer engineering functions at the county level, subject to the rules and regulations promulgated by the State Aid Engineer. It is the responsibility of the Board of Supervisors to:

- designate the county roads to be included in the State Aid System,
- prepare and adopt annual construction programs,
- initiate (program) construction projects on the State Aid System,
- acquire necessary rights-of-way for State Aid administered projects,
- advertise for bids,
- award contracts,

- ensure adequate maintenance of completed projects, and
- provide for adjustment of utilities, as may be required.

In addition to preparing the annual construction program, County Engineers are responsible for making surveys; preparing plans, specifications, and contract proposal documents; attending lettings; supervising and inspecting construction; and submitting progress and final estimates. Counties may obtain the services of engineering firms for any of these responsibilities; however, only as county engineers and not as consulting engineers.

1.1.5 Sources of Information

1.1.5.1 Design Guides

Design criteria for State Aid projects adhere closely to the policies established by AASHTO. AASHTO's A Policy on Geometric Design of Highways and Streets, Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT \leq 400), Manual for Assessing Safety Hardware, and Roadside Design Guide provide the basis for geometric design and roadside safety criteria. These are supplemented with policies and criteria established by State Aid. The design of traffic control devices should be according to the current edition of the Manual on Uniform Traffic Control Devices (MUTCD).

1.1.5.2 Standard Specifications and Drawings

State Aid publishes the Standard Specifications for State Aid Road and Bridge Construction along with appropriate supplemental specifications and special provisions as necessary.

Standard drawings have been developed that address specific details of bridges, guardrail, superelevation, and traffic control devices (e.g., striping, signing). These drawings and documents are available to the County Engineers and should be incorporated in the contract plans when applicable. Most of these documents and additional information about State Aid are available online.

1.1.5.3 Technical Assistance

County Engineers may obtain technical guidance and assistance from State Aid and from the various divisions of the MDOT as needed in specialized cases. State Aid will review all designs and plans submitted by the counties for adequacy and compliance with the applicable design criteria.

2.1 BASIC DESIGN CONTROLS

This section describes the basic factors that determine highway and street minimum design controls.

2.1.1 Highway Systems and Funding

RDM Section 2-1.0 describes the concept and presents a brief description of the functional classification system and Federal-aid routes. MDOT maintains about one-third of the designated rural major collector routes and the counties maintain the remaining two-thirds. Most county major collector routes have been designated as State Aid roads and are eligible State Aid project funding. Rural minor collector routes and roads that are not functionally classified comprise the local system. MDOT Planning Division maintains functional classification and traffic count maps online.

Federal project numbers on the State Aid System (on-system) are designated with a “-B” suffix. Federal projects on local roads not on the State Aid System (off-system) may require that matching funds be paid by the county. Federal Off-system projects are designated with a “-BO” suffix.

The LSBP and LSRP programs were created to allow state funds to be used on the local system. The LSBP program main intent is to replace failing and deficient hydraulic structures with a new bridge or culvert. LSBP funding can be used for minimum approaches and the law requires the local entity to provide for the base and pavement. The LSRP program involves the lowest level of design, which is adequate for low speeds and low traffic volumes. The highest design requirements, where practical, associated with the type of the funds should be used on a project. Projects in urban areas should be designed using the criteria in the MDOT RDM Chapter 14 “Geometric Design of Urban Streets” and considered at the project initiation/project stage.

2.1.2 Project Scope of Work

The State Aid District Engineer and the County Engineer are responsible for determining the recommended scope of work for proposed State Aid projects. The State Aid Engineer will approve or disapprove the recommendation. The scope of work definitions presented in Section RDM 2-7.0 also apply to State Aid projects.

3.1 GEOMETRIC DESIGN CRITERIA (NEW CONSTRUCTION/RECONSTRUCTION)

The guidelines presented in the following sections, combined with referenced material from the RDM, should be used in the design of new construction or reconstruction State Aid projects. These criteria apply to both collector and local roads unless otherwise noted.

3.1.1 Design Traffic Volumes

For new construction and reconstruction, State Aid projects should be designed to accommodate traffic volumes that will occur within the projected life of the facility. However, if the daily hourly volume (DHV) is less than 100, the current ADT may be used for design. Planning Division maintains a Traffic Volume Map online at mdot.ms.gov (search “trafficcounters”). State Aid projects are usually on rural roads with lower traffic volumes and do not typically require a highway capacity analysis. However, traffic engineering studies may be required using procedures in the *Highway Capacity Manual* or considering innovative alternatives (e.g., roundabouts).

3.1.2 Design Speed

The design speed should be based on the topography and roadway functional classification. Design consistency is known to provide a safer highway. A long straightaway followed by a sharp horizontal curve is a poor design because a driver not familiar with the road, tired, or distracted, may fail to realize in time to slow down for the curve. In general, lower design speeds are applicable to highways with winding alignment in rolling terrain, or where environmental conditions, such as adjacent cultural or historic land use, may dictate. Conversely, higher design speeds are applicable to highways in level terrain and where other factors are not an issue.

Design speed is discussed in RDM Section 2-2.01. Minimum design speeds for State Aid projects, based on terrain conditions, are provided in the geometric design criteria tables in this section.

3.1.3 Stopping and Passing Sight Distance

RDM Section 4-5.02.01 presents stopping sight distance values and passing sight distance values for various design speeds. Stopping sight distance is measured from the driver's eye, which is 3.5 feet above the pavement to a 2-foot object height. Passing sight distance is measured from a 3.5-foot eye height to a 2.0-foot object height. Sight distance is also discussed in RDM Section 2-8.02.

3.1.4 Horizontal Alignment

In general, the criteria and procedures presented in RDM Chapter 3 "Horizontal Alignment" will apply to State Aid projects. However, the following sections offer additional guidance that applies specifically to State Aid projects.

3.1.4.1 Curve Types

Deflection changes in alignment on State Aid projects should usually be a simple curve. Compound curves are rarely used. Simple curves are discussed in RDM Section 3-3.01.01.

3.1.4.2 Traveled Way Widening

Traveled way widening should be provided on State Aid projects according to the *State Aid Standard Drawings*.

3.1.4.3 Superelevation Rate and Minimum Radii

State Aid has adopted an $e_{\max} = 10\%$ for rural State Aid projects. The minimum radii for $e_{\max} = 10\%$ is provided in Table 3.1-A below. Where practical, flatter horizontal curves should be provided. The minimum length of a horizontal curve for new construction is 200 feet of full superelevated roadway.

3.1.4.4 Superelevation Transition Length

At a minimum, the total superelevation transition length should be accomplished according to the *State Aid Standard Drawings*.

**Table 3.1-A
MINIMUM RADII**

Design Speed (mph)	Minimum Radii (ft)
30	200
40	410
50	694
55	877
60	1090

Note for Table 3.1-A: $e_{\max} = 10\%$

3.1.4.5 Superelevation Axis of Rotation

The superelevation axis of rotation should normally follow the centerline of the roadway. The superelevation axis of rotation is illustrated in the *State Aid Standard drawings*.

3.1.5 Vertical Alignment

The criteria and procedures presented in RDM Chapter 4 “Vertical Alignment” also apply to State Aid projects. The following presents a few observations on the application to State Aid projects:

3.1.5.1 Maximum Grades

The geometric design criteria tables in [Section 3.1.1](#) present the maximum grades for State Aid projects.

3.1.5.2 Minimum Grades

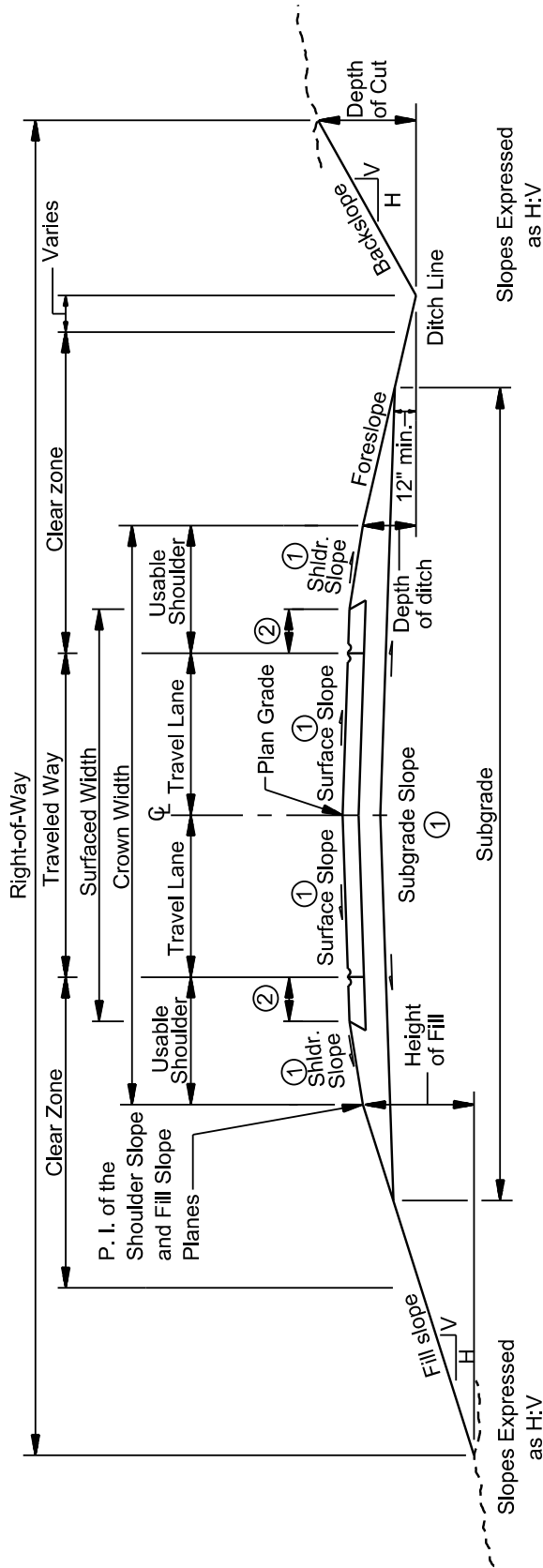
RDM Section 4-3.02 states that the minimum longitudinal gradient on uncurbed pavements may be 0% (level) where the pavements are adequately crowned to drain laterally; however, it is desirable to provide a 0.4% minimum longitudinal grade because the original lateral crown slope may degrade because of swell, consolidation, maintenance operations, or resurfacing. On State Aid projects, every reasonable effort should be made to meet the 0.4% minimum gradient.

3.1.5.3 Minimum Length of Vertical Curve

On State Aid projects, the minimum length of vertical curve should be 200 feet unless the curve is located at a stop condition, temporary grade tie, new construction to an existing road tie, bridge replacement project, or where other special conditions exist. For these situations, a minimum 100-foot vertical curve length may be allowed. Where it is not practical to provide a 100-foot vertical curve, it may be acceptable to provide an algebraic grade differential of 0.5% without a vertical curve.

3.1.6 Cross-Section Elements

Figure 3.1-A below illustrates a typical highway cross-section on a State Aid project. The design values for the cross-section elements are provided in the geometric design tables in [Section 3.1.1](#). RDM Section 2-8.03 presents a discussion on each cross-section element that generally applies to State Aid projects. The following sections provide additional guidance specifically for State Aid projects.



① Typical cross slopes:
 Pavement surfaces:
 High: 2%
 Intermediate: 2% - 3%
 Low: 2% - 4%
 Double Bituminous Surface Treatment: 2%
 Unpaved Shoulders: 4%
 Subgrade: 3%

② Paved shoulder with pavement safety edge and ground-in rumble stripe

TYPICAL SECTION NOMENCLATURE (State Aid Roads)

Figure 3.1-A

3.1.6.1 Lane Widths

Surfaced lane widths vary according to functional classification and traffic volumes. These are presented in the geometric design tables in [Section 3.1.11](#).

3.1.6.2 Shoulder Width and Type

Shoulders should be well graded. Fully surfaced shoulders are rarely provided on State Aid projects. The widths in the geometric design tables in [Section 3.1.11](#) refer to the usable shoulder width. For Federal-aid asphalt paving projects, a 2-foot paved shoulders with rumble stripes and pavement safety edge should be provided on each side of the traveled way except for bridge replacement projects. See Section 8-2.0 of MDOT's RDM for more information.

3.1.6.3 Right-of-Way Width

According to Mississippi State law, the right-of-way for State Aid projects is to be provided by the County Board of Supervisors at no cost to the project fund. Desirably, the right-of-way width should accommodate construction, adequate drainage, and proper maintenance of the highway facility without easements. The minimum right-of-way width should not be less than the required cross-section elements for design, including the side slopes and/or roadside clear zones. In unusual circumstances, where backslopes extend beyond the normal right-of-way width, temporary construction easements may be obtained.

3.1.6.4 Bridges

The geometric design tables in [Section 3.1.11](#) provide criteria for the minimum width of new and reconstructed bridges on all State Aid projects. The structural design on these bridges should be according to the latest edition of AASHTO's *LRFD Bridge Design Specifications*. The minimum design loading structural capacity for new and reconstructed bridges is HL-93. The minimum design loading structural capacity for existing bridges to remain in place is HS-15. Assistance from the State Aid Bridge Engineer may be requested for additional information concerning hydraulic design and the information required for review.

For a reconstruction project, there may be one or several existing bridges within the project limits. The geometric design tables in [Section 3.1.11](#) also provide the roadway width and design loading structural capacity to evaluate the adequacy of the existing bridge(s). If the bridge meets the design loading structural capacity, it is unlikely to be cost-effective to improve the geometrics of the bridge. At some locations, the geometric deficiencies may be severe and/or there may be an adverse crash history at the bridge. In such cases, consideration should be given to widening the bridge to meet new construction/reconstruction criteria as part of the reconstruction project.

If the existing bridge width is less than the width shown in the geometric design tables in [Section 3.1.11](#), and if the bridge will remain in place, a design exception should be requested. In all cases, the signing and pavement markings for the bridge should meet the criteria in the MUTCD.

All existing bridge rails and the approach transitions should be evaluated to determine if any improvements are necessary. Approach guardrail is required to meet at least the TL-2 criteria as defined in the latest edition of AASHTO's *Manual for Assessing Safety Hardware*. Approach guardrail is not required on LSBP projects; however, approach guardrail may be included if the County provides funds

for the approach base and pavement. [Section 3.1.10](#) provides guidance on designing approach guardrail layouts.

An existing bridge on a State Aid road may be reconstructed as a spot improvement project. The criteria in RDM Section 12-5.0 will apply to the geometric design of the bridge.

3.1.6.5 Roadside Clear Zone

Adequate clearance between the edge of traveled way and roadside obstructions is an important safety factor. Table 3.1-B below presents the minimum required clear zone for State Aid projects. Where practical, additional roadside clearance should be provided. The roadside clear zone should be free of all unyielding objects (e.g., trees, non-breakaway sign supports or poles) and any other fixed object (e.g., brick or ornamental mailboxes) that may severely damage an out-of-control vehicle. Utilities may be placed near the outer limits of the right-of-way according to S.O.P. No. SA II-2-8. Clear zones are discussed in RDM Section 9-2.0.

**Table 3.1-B
RECOMMENDED CLEAR ZONES**

Design Speed	Clear Zone
$V \leq 45$ mph	10 ft
$V > 45$ mph	See RDM Section 9-2.0

3.1.6.6 Vertical Clearances

The minimum vertical clearance at underpasses for new and reconstructed bridges on State Aid projects should be 14 feet – 6 inches over the entire roadway. This clearance height provides an additional 6 inches for future resurfacing. Where existing bridges will remain in place, the minimum vertical clearance is 14 feet. These clearances apply to the rural collector or local road passing underneath. For structures over railroads, the minimum vertical clearance between the top of rail and bottom of the highway structure is 25 feet.

3.1.6.7 Surface and Shoulder Cross Slopes

The pavement surface should be sufficiently sloped to ensure proper drainage and to not affect vehicular operation. Recommended pavement cross slopes for State Aid projects are presented in Table 3.1-C. Cross slopes for the double bituminous surface treatment (DBST), which is considered an intermediate type pavement, should be 2%. Paved shoulders should match the adjacent traveled way slopes if ≤ 4 feet. Unpaved shoulder cross slopes should be 4.0%.

3.1.6.8 Pavement Skid Resistance

All hot plant mixed bituminous pavements for surface courses on Federal-aid projects are required to generate a friction value of at least 0.35 to secure Federal participation in the project. This requirement is only applicable for those roads that have a posted speed limit of 45 miles per hour or greater.

3.1.6.9 Side Slopes

The maximum rate of side slope depends on the stability of the soil as determined by investigations presented in the soil profiles. Slopes should be as flat as practical to help provide adequate vehicular recovery areas. Side slopes on State Aid projects should be no steeper than 3:1. Slopes steeper than 3:1 with fill heights greater than 10 feet may require guardrail. The geometric design tables in [Section 3.1.11](#), provide the side slope criteria for State Aid projects.

Rounding of the cross-section should be provided at ditch bottoms and tops of backslopes. All side slopes should be vegetated. RDM Section 8-1.0 discusses erosion control and ditch treatments.

**Table 3.1-C
RECOMMENDED PAVEMENT CROSS SLOPES
(for State Aid Projects)**

Surface Type	Range of Cross Slope
High ⁱ	2%
Intermediate ⁱⁱ	2% to 3%
Low ⁱⁱⁱ	2% to 4%

Notes for Table 3.1-C:

- i. High-type pavements are those that retain smooth riding qualities and good nonskid properties in all-weather under heavy traffic volumes and loadings with little maintenance.
- ii. Intermediate type pavements are those designed to retain smooth riding qualities and good nonskid properties in all weather, but under lighter loads and lesser traffic volumes.
- iii. Low-type surfaces are those with surface-treated earth surfaces and those with loose surfaces (e.g., shell and gravel).

3.1.7 At-Grade Intersections

MDOT RDM Chapter 6 on “At-Grade Intersections” presents criteria for the design of at-grade intersections. In general, these criteria also apply to State Aid projects; however, the following should be considered:

3.1.7.1 General Design Controls

Applies to State Aid projects. However, considering the lower traffic volumes on State Aid projects, it may not be cost-effective to meet some of the design criteria (e.g., a 1% gradient on the storage platform).

3.1.7.2 Turning Radii Design

The criteria for rural intersections applies directly to State Aid projects.

3.1.7.3 Turning Roadways

Turning roadways are seldom warranted on State Aid projects. Where used, the criteria should be considered.

3.1.7.4 Auxiliary Lanes

Auxiliary lanes are seldom required on State Aid projects. Where used, the criteria should be considered.

3.1.7.5 Roundabouts

The criteria for roundabouts is applicable to State Aid projects.

3.1.7.6 Intersection Sight Distance

The criteria for intersection sight distance applicable to State Aid projects.

3.1.7.7 Channelization

Channelization is rarely required on State Aid projects. Where used, the criteria should be considered.

3.1.7.8 Driveway Design

The criteria is applicable to State Aid projects.

3.1.7.9 Intersection Near Railroad Crossings

The criteria is applicable to State Aid projects.

3.1.8 Traffic Control Devices

Signs, pavement markings, and traffic signal controls (where appropriate) are essential elements for highways. Traffic control devices for State Aid projects should comply with the *State Aid Standard Drawings* and the current edition of the *MUTCD*.

The use of a 6-inch traffic stripe is permissible, but not required on any State Aid project regardless of lane widths.

3.1.9 Environmental Quality

Environmental quality and protection is required in the development and design of each project. Current requirements are detailed in the State Aid SOPs and *Standard Specifications*. The county or local jurisdiction is responsible for complying with the following requirements:

- Clean Water Act – A written permit from the US Army Corps of Engineers is required for any filling, clearing, or draining of wetlands or when filling 0.1 acres or more of waters of the US.
- National Environmental Policy Act – Appropriate environmental documentation for the impacts associated with the project is required.
- Mississippi Department of Environmental Quality (MDEQ) National Pollutant Discharge Elimination System (NPDES) permits – Permit coverage under the appropriate MDEQ Construction General Permit is required for projects that disturb 1 to 5 acres (MSR15) or 5 acres or more (MSR10).
- Additional Permits – Additional permits or permit coverage may be required depending on the project locale.

Erosion and sediment control (ESC) best management practices (BMP) should be included to enable the construction to proceed with a minimum negative impact on the environment. Necessary pay items

should be set up and shown on the plans to minimize erosion and return disturbed areas to a stable and natural appearance. Any specific concerns or sensitive areas should be addressed in the project Storm Water Pollution Prevention Plan (SWPPP) and included in the project contract assembly. Additional information concerning ESC, BMP, and SWPPP is available from MDEQ.

3.1.10 Roadside Safety

RDM Chapter 9 “Roadside Safety” presents the MDOT’s roadside safety criteria. These criteria apply, as practical, to the roadside safety design of new construction/reconstruction of State Aid projects. Tables 3.1-D and 3.1-E provide alternative length of need calculations for flared guardrail guardrail on non-Federal-aid projects with design speeds of 50 miles per hour or less, and where the traffic volumes are less than 1,000 vehicles per day.

**Table 3.1-D
LENGTH OF NEED (LON)
(Bridge Rail Approaches – Approach Side)**

Design Speed (mph)	Traffic Volume (ADT)	Flare Rate	Tangent Section (ft)	End Terminal LON Contribution (ft)	“A” (ft)	“B” (ft)	No. of 12.5 ft Sections for B
40	< 1,000	30:1	18.15	25.0	80.65	37.5	3
50	< 1,000	30:1	18.15	25.0	118.15	75.0	6

Note for Table 3.1-D:

“A” and “B” in this table apply to both sides of a bridge approach on a divided highway and to the right side of a bridge approach on a two-way facility. The MDOT Roadway Design Standard Drawings should be referenced for the application of “A” and “B.”

**Table 3.1-E
LENGTH OF NEED (LON)
(Bridge Rail Approaches – Off Side)**

Design Speed (mph)	Traffic Volume (ADT)	Flare Rate	Tangent Section (ft)	End Terminal LON Contribution (ft)	“C” (ft)	“D” (ft)	No. of 12.5 ft Sections for B
40	< 1,000	30:1	18.15	25.0	43.15	0.0	0
50	< 1,000	30:1	18.15	25.0	68.15	0.0	2

Note for Table 3.1-E:

“C” and “D” in this table apply to the left side of a bridge approach on a two-lane, two-way facility. The MDOT Roadway Design Standard Drawings should be referenced for the application of “C” and “D.”

Non-flared guardrail Length of Need (LON) will be determined by current AASHTO standards and specifications based on the design criteria. OSARC has developed guidance documents and procedures to assist with the calculation of length of need.

3.1.11 Geometric Design Criteria

This Section presents design criteria for new construction or reconstruction of State Aid projects. State Aid design criteria for cross-section and alignment elements are presented in the following tables:

- Table 3.1-F “Geometric Design Criteria for Rural Collectors (State Aid and Federal-aid Routes)”
- Table 3.1-G “Geometric Design Criteria for State Aid Rural Local Roads (Non-Federal aid Routes)”
- Table 3.1-H “Geometric Design Criteria for Rural LSBP Projects”
- Table 3.1-I “Geometric Design Criteria for Rural LSRP Projects”

3.1.12 Exceptions to Geometric Design Criteria

All projects are required to meet the *controlling design criteria* shown on the appropriate Geometric Design Criteria tables. Every reasonable effort should be made to provide a design that exceeds these minimum values. If an exception is necessary, the County Engineer is responsible for preparing the Design Exception Report with concurrence of the District Engineer and submitting the request to the State Aid Engineer for approval. Depending on the current policy a design exception may require FHWA approval if Federal funds are used.

**Table 3.1-F
GEOMETRIC DESIGN CRITERIA FOR RURAL COLLECTORS
(State Aid and Federal-Aid Routes) (New Construction/Reconstruction)**

		DESIGN ELEMENT	Manual Section	ADT < 400	ADT 400 – 1,500	ADT 1,500 – 2,000	ADT > 2,000			
Design Controls	Design Speed ⁽¹⁾	Level	3.1.2	40 mph	50 mph		60 mph			
		Rolling		30 mph	40 mph		50 mph			
	Control of Access		2-4.0 ⁱ 11-1.05 ⁱ	Control by Regulation (Type 3)						
Level of Service			2-3.04 ⁱ	C						
Cross-Section Elements	Travel Lane Width ⁽²⁾		3.1.6	10 ft	11 ft		12 ft			
	Shoulder Width ⁱⁱ	Usable	3.1.6	4 ft	5 ft	6 ft	8 ft			
		Surfaced		2 ft						
	Cross Slope	Travel Lane	3.1.6	See Figure 3.1-A and Table 3.1-C						
		Shoulder		Paved Shoulder: Same as Travel Lane Unpaved Shoulder: 4%						
	Auxiliary Lanes	Lane Width	2-8.03 ⁱ	10 ft	11 ft					
		Usable Shoulder Width		4 ft	5 ft	6 ft	8 ft			
	New and Reconstructed Bridges	Structural Capacity	3.1.6	HL-93						
		Minimum Width ⁽³⁾	12-5.0 ⁱ	26 ft	28 ft	30 ft	40 ft			
	Existing Bridges to Remain in Place	Structural Capacity	3.1.6	HS-15						
		Minimum Width ⁽⁴⁾	12-5.0 ⁱ	22 ft	22 ft	24 ft	28 ft			
	Roadside Clear Zone	Guardrail	3.1.10	Usable Shoulder Width						
		Obstruction ⁽⁵⁾	9-4.0 ⁱ 9-2.0 ⁱ	See footnote note (5) below						
Slope Schedule ⁽⁶⁾	Cut	Foreslope (within clear zone)	3.1.6	V ≤ 45 mph: 3:1 V > 45 mph: 4:1						
		Depth of Ditch ⁽⁷⁾		3 ft						
		Backslope ⁽⁸⁾		3:1						
	Fill	Desirable: 6:1 Maximum: 3:1								
DESIGN SPEED (mph)				30	35	40	45	50	55	60
Stopping Sight Distance (ft)		2-8.02 ⁱ	200	250	305	360	425	495	570	
Passing Sight Distance (ft)		2-8.02 ⁱ	500	550	600	700	800	900	1,000	
Intersection Sight Distance (ft) ⁽⁹⁾		6-6.0 ⁱ	335	390	445	500	550	610	665	
Superelevation Rate		3.1.4	10%							
Minimum Horizontal Curve Radius (e _{max} = 10%) (ft)		3.1.4	200	292	410	540	694	877	1,090	
Maximum Grades	Level	3.1.5	7%	7%	7%	7%	6%	6%	5%	
	Rolling		9%	9%	8%	8%	7%	7%	6%	
Minimum Grades ⁽¹⁰⁾		3.1.5	Desirable: 0.4% Minimum: 0.0%							
Vertical Curve (K-values)	Crest	3.1.5	19	29	44	61	84	114	151	
	Sag		37	49	64	79	96	115	136	
Vertical Clearance (Collector Under)	New/Reconstructed Bridges ⁽¹¹⁾	3.1.6	14.5 ft							
	Existing Bridges		14 ft							
	Sign Truss/Ped. Bridge		19 ft							
Vertical Clearance (Collector Over Railroad)		3.1.6	25 ft minimum							

Note for Table 3.1-F:

- i. References the MDOT RDM. To determine the application of controlling design criteria, see MDOT's RDM Section 2-9.02.
- ii. See section 3.1.6.2 for additional requirements for federally funded projects.
- iii. See footnotes [i.e. Design Speed ⁽¹⁾] annotated in the table above and presented below.

**GEOMETRIC DESIGN CRITERIA FOR RURAL COLLECTORS
(State Aid and Federal-Aid Routes) (New Construction/Reconstruction)**

Footnotes to Table 3.1-F

1. Design Speed – A rural collector may pass through a relatively built-up area. In these sections, a design speed as low as the posted speed limit may be used. For ADT < 400, a 40 miles per hour design speed, 5-foot shoulder, and 28-foot bridge width may be used without justification.
2. Travel Lane Width – For industrial routes, 12-foot lane widths are desirable.
3. New/Reconstructed Bridges (Minimum Width) – For bridges more than 100 feet in length, a minimum bridge width of the traveled way plus 3 feet on each side will be acceptable. Note that the bridge widths in the table assume minimum lane and shoulder widths; the bridge should be widened accordingly for a wider approach roadway. Where the approach roadway is surfaced, the surfaced width should be carried across all structures. RDM Section 12-5.0 should be referenced for bridge projects performed as a spot improvement. Approaching guardrail transitions to the bridge rail should be provided on new bridges.
4. Existing Bridges to Remain in Place (Minimum Width) – Clear width between curbs or rails, whichever is less, should be at least the same as the approach traveled way width. The table widths do not apply when bridge length is greater than 100 feet. These structures should be evaluated individually considering clear width, traffic volumes, remaining life of structure, design speed, and any other relevant factors. In addition, the criteria in the table for the width of existing bridges to remain in place will apply when work is only performed on the bridge substructure (e.g., reinforcement), but not the bridge deck. Approach guardrail transitions should be evaluated and replaced, if necessary.
5. Roadside Clear Zone – RDM Section 9-2.0 discusses the design criteria for clear zone distances. All values should be measured from the edge of traveled way.
6. Slopes – RDM Section 13-2.02.03 provides guidance if high-volume change soil is present.
7. Depth of Ditch – For DHV \leq 200 and design speeds of 45 miles per hour and below, the depth of ditch may be reduced to 2 feet – 6 inches. A minimum 1-foot depth of ditch should be maintained from the subgrade shoulder. The foreslope distance should be adjusted as required in cuts in superelevated sections.
8. Backslope – Backslopes may be modified when located in special geological formation and/or land uses as follows:
 - a. in loess formation, 1:4 (H:V) (not vegetated)
 - b. in rock formations, 1:4 (H:V) (not vegetated)
 - c. in delta-cultivated lands, 1:1 to 2:1 (H:V) (not vegetated)
9. Intersection Sight Distance (ISD) – Table values assume ISD for passenger cars turning onto a level two-lane roadway. RDM Section 6-6.0 provides guidance on grade corrections and truck ISD.
10. Minimum Grades – On bridges, a minimum 0.5% longitudinal grade should be provided where practical.
11. Minimum Vertical Clearances – Table value includes an additional 6-inch allowance for future resurfacing.

**Table 3.1-G
GEOMETRIC DESIGN CRITERIA FOR STATE AID RURAL LOCAL ROADS
(Non-Federal Aid Routes) (New Construction/Reconstruction)**

		DESIGN ELEMENT	Manual Section	ADT < 100	ADT 100 – 250	ADT > 250		
Design Controls	Design Speed ⁽¹⁾	Level	3.1.2	30 mph	40 mph	See Table 3.1-F		
		Rolling		30 mph	30 mph			
	Control of Access		2-4.0 ⁱ 11-1.05 ⁱ	Control by Regulation (Type 3)				
Level of Service		2-3.04 ⁱ	C					
Cross-Section Elements	Travel Lane Width		3.1.6	10 ft				
	Shoulder Width ⁱⁱ	Usable	3.1.6	3 ft	4 ft			
		Surfaced		2 ft				
	Cross Slope	Travel Lane	3.1.6	See Figure 3.1-A and Table 3.1-C				
		Shoulder		Paved Shoulder: Same as Travel Lane Unpaved Shoulder: 4%				
	Auxiliary Lanes	Lane Width	2-8.03 ⁱ	9 ft				
		Usable Shoulder Width		4 ft				
	New and Reconstructed Bridges	Structural Capacity	3.1.6	HL-93				
		Minimum Width ⁽²⁾	12-5.0 ⁱ	26 ft				
	Existing Bridges to Remain in Place	Structural Capacity	3.1.6	HS-15				
		Minimum Width ⁽³⁾	12-5.0 ⁱ	22 ft				
	Roadside Clear Zone ⁽⁴⁾	Guardrail	3.1.6	Usable Shoulder Width				
		Obstruction	9-4.0 ⁱ 9-2.0 ⁱ	10 ft				
Slope Schedule ⁽⁵⁾	Cut	Foreslope (within clear zone)	3.1.6	Maximum: 1:1				
		Depth of Ditch ⁽⁶⁾		2.5 ft				
		Backslope ⁽⁷⁾		3:1				
	Fill	1 ft to 4 ft		3:1				
		> 4 ft		2:1				
Alignment Elements	DESIGN SPEED			30 mph	35 mph	40 mph	45 mph	50 mph
	Stopping Sight Distance		2-8.02 ⁱ	200 ft	250 ft	305 ft	360 ft	425 ft
	Passing Sight Distance		2-8.02 ⁱ	500 ft	550 ft	600 ft	700 ft	800 ft
	Intersection Sight Distance ⁽⁸⁾		6-6.0 ⁱ	335 ft	390 ft	445 ft	500 ft	550 ft
	Superelevation Rate		3.1.4	10%				
	Minimum Horizontal Curve Radius (e _{max} = 10%)		3.1.4	200 ft	292 ft	410 ft	540 ft	694 ft
	Maximum Grades	Level	3.1.5	7%	7%	7%	7%	6%
		Rolling		10%	10%	10%	9%	8%
	Minimum Grades ⁽⁹⁾		3.1.5	Desirable: 0.4% Minimum: 0.0%				
	Vertical Curve (K-values)	Crest	3.1.5	19	29	44	61	84
		Sag		37	49	64	79	96
	Vertical Clearance (Local Road Under)	New/Reconstructed Bridges ⁽¹⁰⁾	3.1.6	14.5 ft				
		Existing Bridges		14 ft				
Sign Truss/Ped. Bridge		19 ft						
Vertical Clearance (Local Road Over Railroad)		3.1.6	25 ft					

Note for Table 3.1-G:

- i. References the MDOT RDM. To determine the application of controlling design criteria, see MDOT's RDM Section 2-9.02.
- ii. See Section 3.1.6.2 for additional requirements for federally funded projects.
- iii. See footnotes [i.e. Design Speed ⁽¹⁾] annotated in the table above and presented below.

**GEOMETRIC DESIGN CRITERIA FOR STATE AID RURAL LOCAL ROADS
(Non-Federal Aid Routes) (New Construction/Reconstruction)**

Footnotes to Table 3.1-G

1. Design Speed – A local rural road may pass through a relatively built-up area. In these sections, a design speed as low as the posted speed limit may be used.
2. New/Reconstructed Bridges (Minimum Width) – For bridges more than 100 feet in length, a minimum bridge width of the traveled way plus 1 foot on each side will be acceptable. Note that the bridge widths assume minimum lane and shoulder widths; the bridge should be widened accordingly for a wider approach roadway. RDM Section 12-5.0 should be referenced for bridge projects performed as a spot improvement. Approaching guardrail transitions to the bridge rails should be provided on new bridges.
3. Existing Bridges to Remain in Place (Minimum Width) – Clear width between curbs or rails, whichever is less, should be at least the same as the approach traveled way width. The table widths do not apply when bridge length is greater than 100 feet. These structures should be evaluated individually considering clear width, traffic volumes, remaining life of structure, design speed, and any other relevant factors. In addition, the criteria in the table for the width of existing bridges to remain in place will apply when work is only performed on the bridge substructure (e.g., reinforcement), but not the bridge deck. Approaching guardrail transitions should be considered in special situations.
4. Roadside Clear Zone – RDM Section 9-2.0 discusses the design criteria for clear zone distances. All values should be measured from the edge of traveled way.
5. Slopes – RDM Section 13-2.02.03 provides guidance if high-volume change soil is present.
6. Depth of Ditch – A minimum 1-foot depth of ditch from the subgrade shoulder should be provided. The foreslope distance should be adjusted as required in cuts in superelevated sections.
7. Backslope – Backslopes may be modified when located in special geological formation and/or land uses as follows:
 - a. in loess formation, 1:4 (H:V) (not vegetated)
 - b. in rock formations, 1:4 (H:V) (not vegetated)
 - c. in delta-cultivated lands, 1:1 to 2:1 (not vegetated)
8. Intersection Sight Distance (ISD) – Table values assume ISD for passenger cars turning onto a level two-lane roadway. RDM Section 6-6.0 provides guidance on grade corrections and truck ISD.
9. Minimum Grades – On bridges, a minimum 0.5% longitudinal grade should be provided where practical.
10. Minimum Vertical Clearances – Table value includes an additional 6-inch allowance for future resurfacing.

**Table 3.1-H
GEOMETRIC DESIGN CRITERIA FOR RURAL LSBP PROJECTS
(New Construction/Reconstruction)**

	DESIGN ELEMENT		Manual Section	ADT						
				< 50	50 – 250	251 – 400	401 – 1,500	1,501 – 2,000	> 2,000	
Design Controls	Design Speed (mph) ⁽¹⁾	Level	3.1.2	30	35	40	50	60	60	
		Rolling		30	30	35	40	50	50	
	Control of Access		2-4.0 ^R 11-1.05 ^R	Control by Regulation (Type 3)						
Level of Service		2-3.04 ^R	C							
Cross-Section Elements	Travel Lane Width		3.1.6	10 ft		11 ft		12 ft		
	Shoulder Width	Usable ⁽²⁾	3.1.6	3 ft	4 ft	4 ft	6 ft	8 ft		
		Surfaced		2 ft						
	Cross Slope	Travel Lane	3.1.6	See Figure 3.1-A and Table 3.1-C						
		Shoulder		Paved Shoulder: Same as Travel Lane Unpaved Shoulder: 4%						
	Auxiliary Lanes	Lane Width	2-8.03 ^R	10 ft			11 ft			
		Usable Shoulder Width ⁽²⁾		3 ft	4 ft	4 ft	6 ft	8 ft		
	New and Reconstructed Bridges	Structural Capacity	3.1.6	HL-93						
		Minimum Width ⁽³⁾⁽⁴⁾	12-5.0 ^R	24 ft	26 ft	26 ft	28 ft	32 ft	40 ft	
	Rehabilitated Bridges	Structural Capacity	3.1.6	HL-93						
		Minimum Width ⁽⁵⁾	12-5.0 ^R	22 ft	22 ft	22 ft	22 ft	24 ft	28 ft	
	Roadside Clear Zone	Guardrail	3.1.6	Usable Shoulder Width						
		Obstruction ⁽⁶⁾	9-4.0 ^R 9-2.0 ^R	See footnote note (6) below						
Slope Schedule	Cut	Foreslope (within clear zone) ⁽⁷⁾	3.1.6	2:1	3:1 Max	3:1 Max				
		Depth of Ditch ⁽⁸⁾		2 ft	2.5 ft	3 ft				
		Backslope ⁽⁹⁾		3:1 to 1:4		3:1				
	Fill	0-4 ft		Max: 2:1	3:1	Maximum: 3:1				
> 4 ft		2:1	2:1							
Alignment Elements	DESIGN SPEED (mph)			30	35	40	45	50	55	60
	Stopping Sight Distance (ft)		2-8.02 ^R	200	250	305	360	425	495	570
	Intersection Sight Distance (ft) ⁽¹⁰⁾		6-6.0 ^R	335	390	445	500	550	610	665
	Superelevation Rate		3.1.4	10%						
	Minimum Horizontal Curve Radius (e _{max} = 10%) (ft)		3.1.4	200	292	410	540	694	877	1,090
	Maximum Grades	Level ⁽¹¹⁾	3.1.5	7%	7%	7%	7%	6%	6%	5%
		Rolling ⁽¹¹⁾		9%	8.5%	8%	8%	7%	7%	6%
	Minimum Grades ⁽¹²⁾		3.1.5	Desirable: 0.4% Minimum: 0.0%						
	Vertical Curve (K-values)	Crest	3.1.5	19	29	44	61	84	114	151
		Sag		37	49	64	79	96	115	136
Vertical Clearance (Road Under)	New/Reconstructed Bridges ⁽¹³⁾	3.1.6	14.5 ft							
	Existing Bridges		14 ft							
	Sign Truss/Ped. Bridge		19 ft							
Vertical Clearance (Road Over Railroad)		3.1.6	25 ft							

Note for Table 3.1-H:

- i. References the MDOT RDM. To determine the application of controlling design criteria, see MDOT's RDM Section 2-9.02.
- ii. See section 3.1.6.2 for additional requirements for federally funded projects.
- iii. See footnotes [i.e. Design Speed ⁽¹⁾] annotated in the table above and presented below.

**GEOMETRIC DESIGN CRITERIA FOR RURAL LSBP PROJECTS
(New Construction/Reconstruction)**

Footnotes to Table 3.1-H

1. Design Speed – Minimum values for design speed are current posted speeds.
2. Shoulder Width – A 3-foot minimum width may be provided for ADT under 100.
3. New and Reconstructed Bridges (Minimum Width) – The bridge widths assume minimum lane and shoulder widths; the bridge should be widened accordingly for a wider approach roadway. RDM Section 12-5.0 should be referenced for bridges performed as a spot improvement.
4. New and Reconstructed Bridges (Minimum Width) (ADT > 1500) – For bridges more than 100 feet in length, a minimum bridge width of the traveled way plus 3 feet on each side will be acceptable.
5. Rehabilitated Bridges (Minimum Width) – In no case should the minimum clear width be less than the approach traveled way width. RDM Section 12-5.0 should be referenced for bridges performed as a spot improvement.
6. Roadside Clear Zone – RDM Section 9-2.0 discusses the design criteria for clear zone distances. All values should be measured from the edge of traveled way.
7. Foreslope – A 2:1 maximum foreslope may be used for ADT under 100.
8. Depth of Ditch – For $DHV \leq 200$ and design speeds of 40 miles per hour and below, the depth of ditch may be reduced to 2 feet – 6 inches. A minimum 1 foot depth of ditch from the subgrade shoulder should be maintained. The foreslope distance should be adjusted as required in cuts and superelevated sections.
9. Backslope – Backslopes may be modified when located in special geological formation and/or land uses as follows:
 - a. in loess formation, 1:4 (H:V) (not vegetated)
 - b. in rock formations, 1:4 (H:V) (not vegetated)
 - c. in delta-cultivated lands, 1:1 to 2:1 (H:V) (not vegetated)
10. Intersection Sight Distance (ISD) – Table values assume ISD for passenger cars turning onto a level two-lane roadway. RDM Section 6-6.0 provide guidance on grade corrections and truck ISD.
11. Maximum Grades – For design speeds of 30 miles per hour or less and ADT under 100, the maximum algebraic grade difference to a bridge without vertical curves should be 3%; the maximum length of approach for bridges should be that required to tie in the existing roadway to the bridge; and the roadway width should be the same width from the bridge end to a point a minimum of 21 feet from the bridge end.
12. Minimum Grades – On bridges, a minimum 0.5% longitudinal grade should be provided where practical.
13. Minimum Vertical Clearances – Table value includes an additional 6-inch allowance for future resurfacing.

**Table 3.1-I
GEOMETRIC DESIGN CRITERIA FOR RURAL LSRP PROJECTS
(New Construction/Reconstruction)
(ADT < 400)**

	DESIGN ELEMENT		Manual Section	Design Speed (mph)			
				30	35	40	
Design Controls	Design Speed (mph)		3.1.2	Posted or Operating Speed			
	Control of Access		2-4.0 ^R 11-1.05 ^R	Control by Regulation (Type 3)			
	Level of Service		2-3.04 ^R	C			
Cross Section Elements	Total Roadway Width ⁽¹⁾ (Includes both Traveled Way and Shoulders)		3.1.6	18 ft			
	Cross Slope	Travel Lane	3.1.6	See Figure 3.1-A and Table 3.1-C			
		Shoulder		4%			
	Auxiliary Lanes		2-8.03 ^R	N/A			
	New and Reconstructed Bridges	Structural Capacity	3.1.6	HL-93			
		Minimum Width ⁽²⁾	12-5.0 ^R	See Table 3-H			
	Existing Bridges to Remain in Place	Structural Capacity	3.1.6	HS-15			
		Minimum Width ⁽³⁾	12-5.0 ^R	Current Width			
	Roadside Clear Zone	Guardrail	3.1.6	Usable Shoulder Width			
		Obstruction ⁽⁴⁾	9-4.0 ^R 9-2.0 ^R	6 ft			
	Slope Schedule	Cut	Foreslope (within clear zone) ⁽⁵⁾	3.1.6	3:1 Max		
			Depth of Ditch ⁽⁶⁾		2.5 ft		
			Backslope ⁽⁷⁾		3:1		
	Fill		Maximum: 2:1	0 - 4 ft: 3:1 > 4 ft: 2:1	Maximum: 3:1		
Alignment Elements	DESIGN SPEED (mph)			30	35	40	
	Stopping Sight Distance (ft)		2-8.02 ^R	200	250	305	
	Intersection Sight Distance (ft) ⁽⁸⁾		6-6.0 ^R	335	390	445	
	Superelevation Rate		3.1.4	10%			
	Minimum Horizontal Curve Radius (e _{max} = 10%) (ft)		3.1.4	200	292	410	
	Maximum Grades	Level	3.1.5	7%	7%	7%	
		Rolling		10%	10%	10%	
	Minimum Grades ⁽⁹⁾		3.1.5	Desirable: 0.4% Minimum: 0.0%			
	Vertical Curve (K-values)	Crest	3.1.5	19	29	44	
		Sag		37	49	64	
	Vertical Clearance (Local Road Under)	New/Reconstructed Bridges ⁽¹⁰⁾	3.1.6	14.5 ft			
		Existing Bridges		14 ft			
		Sign Truss/Ped. Bridge		19 ft			
Vertical Clearance (Local Road Over Railroad)		3.1.6	25 ft				

Note for Table 3.1-I:

- i. References the MDOT RDM. To determine the application of controlling design criteria, see MDOT's RDM Section 2-9.02.
- ii. See section 3.1.6.2 for additional requirements for federally funded projects.
- iii. See footnotes [i.e. Design Speed ⁽¹⁾] annotated in the table above and presented below.

**GEOMETRIC DESIGN CRITERIA FOR RURAL LSRP PROJECTS
(New Construction/Reconstruction)**

Footnotes to Table 3.1-I

1. Total Roadway Width – For industrial, commercial, and agricultural access roads with frequent trucks and/or large farm machinery, roadway widths of 22 feet to 24 feet should be considered.
2. New and Reconstructed Bridges (Minimum Width) – In no case should the minimum clear width be less than the approach paved roadway way width. RDM Section 12-5.0 should be referenced for bridges performed as a spot improvement.
3. Existing Bridges to Remain-in-Place (Minimum Width) – Current width may remain provided there is not a site-specific safety problem related to the bridge width.
4. Roadside Clear Zone – All values should be measured from the edge of traveled way. A clear zone as wide as practical should be provided within the constraints of costs, terrain, right-of-way, or potential social/environmental impacts. Where it is impractical to provide a 6-foot clear zone, lesser clear zones may be used.
5. Foreslope – A 2:1 maximum foreslope may be used for ADT under 100.
6. Depth of Ditch – For design speeds of 40 miles per hour and below, the depth of ditch may be reduced to 2 feet. A minimum 1 foot depth of ditch from the subgrade shoulder should be maintained. The foreslope distance should be adjusted as required in cuts and superelevated sections.
7. Backslope – Backslopes may be modified when located in special geological formation and/or land uses as follows:
 - a. in loess formation, 1:4 (H:V) (not vegetated)
 - b. in rock formations, 1:4 (H:V) (not vegetated)
 - c. in delta-cultivated lands, 1:1 to 2:1 (not vegetated)
8. Intersection Sight Distance (ISD) – Table values assume ISD for passenger cars turning onto a level two-lane roadway. RDM Section 6-6.0 provides guidance on grade corrections and truck ISD.
9. Minimum Grades – On bridges, a minimum 0.5% longitudinal grade should be provided where practical.
10. Minimum Vertical Clearances – Table value includes an additional 6-inch allowance for future resurfacing.

3.2 GEOMETRIC DESIGN: RESURFACING, RESTORATION AND REHABILITATION-3R

The criteria in this section apply to the design of 3R projects on State Aid roads and only apply to rural major collector facilities (State Aid and Federal-aid). In addition, much of the design criteria presented in [Section 3.1](#) and in other chapters of this manual apply to 3R projects on State Aid projects. Unless stated otherwise in this section, the criteria for new construction/reconstruction of State Aid roads apply to 3R projects.

3.2.1 3R Project Evaluation

Roadside safety, crash history, and traffic control items are several factors that should be evaluated in the design of a 3R project.

3.2.2 Design Controls

The following should be considered:

- Design Speed – Table 3.2-A presents the criteria for design speed. In addition, the selected design speed should equal or exceed the anticipated posted or regulatory speed limit of the completed facility.
- Design Year Volume – Desirably, all elements of the facility will meet the level-of-service (LOS) criteria for an ADT or DHV determined for 10 years beyond the expected construction completion date. At a minimum, the highway facility should accommodate the LOS based on current traffic volumes as determined at the construction completion date.
- Traffic Data – The necessary level of improvement should be determined by an analysis of the traffic data. In addition to the mainline ADT and DHV, this should include:
 - a. percent of trucks and buses
 - b. high-crash locations
 - c. turning movements and traffic volumes at intersections
 - d. any known future traffic impact

**Table 3.2-A
GEOMETRIC DESIGN CRITERIA FOR RURAL COLLECTORS
(State Aid and Federal-Aid Routes) (3R Projects)**

	DESIGN ELEMENT		Manual Section	Design Year ADT ⁽¹⁾					
				ADT < 750		751 – 1,500		1,501 – 2,000	
				Percent Trucks					
				≥ 10%	< 10%	≥ 10%	< 10%	≥ 10%	< 10%
Design Controls	Design Speed ⁽²⁾	Level	3.2	40 mph		50 mph			
		Rolling		30 mph		40 mph			
	Control of Access		2-4.0 ^R 11-1.05 ^R	Control by Regulation (Type 3)					
Level of Service		2-3.04 ^R	Desirable: C Minimum: D						
Cross Section Elements	Travel Lane Width ⁽³⁾		3.2.3	10 ft	11 ft	V ≤ 45: 11 ft V ≥ 50: 12 ft	11 ft		
	Shoulder Width	Usable	3.2.3	2 ft	V ≤ 45: 2 ft V ≥ 50: 3 ft	V ≤ 45: 2 ft V ≥ 50: 3 ft			
		Surfaced		2 ft					
	Cross Slope	Travel Lane	3.1.6	See Figure 3.1-A and Table 3.1-C					
		Shoulder		Paved Shoulder: Same as Travel Lane Unpaved Shoulder: 4%					
	Auxiliary Lanes	Lane Width	3.2.3	10 ft	11 ft				
		Usable Shoulder Width		4 ft					
	New and Reconstructed Bridges ⁽⁴⁾	Structural Capacity	3.2.3	HL-93					
		Minimum Width ⁽⁵⁾		22 ft	24 ft				
	Existing Bridges to Remain in Place	Structural Capacity	3.2.3	HS-15					
		Minimum Width ⁽⁵⁾		Approach Traveled Way Width	Approach Traveled Way Width + 2 ft OR 22 ft, whichever is less	Approach Traveled Way Width + 2 ft OR 24 ft, whichever is less			
	Roadside Clear Zone	Guardrail	12-2.08 ^R	Usable Shoulder Width					
Obstruction ⁽⁶⁾		4.07	See footnote (6) below						
Slope Schedule	Cut	Foreslope (within clear zone)	3.1.6	3:1					
		Depth of Ditch		2 ft					
		Backslope		Ditch Line < 10 ft from ETW: 2:1 Ditch Line ≥ 10 ft from ETW: 1:1					
	Fill	Height ≤ 10 ft		2:1					
Height > 10 ft		3:1							
Alignment Elements	DESIGN SPEED			30 mph	35 mph	40 mph	45 mph	50 mph	
	Stopping Sight Distance		2-8.02 ^R	200 ft	250 ft	305 ft	360 ft	425 ft	
	Passing Sight Distance		2-8.02 ^R	500 ft	550 ft	600 ft	700 ft	800 ft	
	Intersection Sight Distance ⁽⁷⁾		6-6.0 ^R	335 ft	390 ft	445 ft	500 ft	550 ft	
	Superelevation Rate		4.04	See RDM Section 12-2.04					
	Minimum Horizontal Curve Radius		4.04	See RDM Section 12-2.04					
	Maximum Grades	Level	12-2.05 ^R	9%	9%	9%	9%	8%	
		Rolling		11%	11%	10%	10%	9%	
	Minimum Grades ⁽⁸⁾		3.1.5	Desirable: 0.4% Minimum: 0.0%					
	Vertical Curve (K-values)	Crest	12-2.05 ^R	See RDM Section 12-2.05					
		Sag							
	Vertical Clearance (Collector Under)	New/Reconstructed Bridges ⁽⁹⁾	3.1.6	14.5 ft					
Existing Bridges		14 ft							
Sign Truss/Ped. Bridge		19 ft							
Vertical Clearance (Collector Over Railroad)		3.1.6	23 ft						

**Table 3.2-A
GEOMETRIC DESIGN CRITERIA FOR RURAL COLLECTORS
(State Aid and Federal-Aid Routes) (3R Projects - Continued)**

	DESIGN ELEMENT		Manual Section	Design Year ADT ⁽¹⁾				
				2,001 – 4,000		> 4,000		
				Percent Trucks				
				≥ 10%	< 10%	≥ 10%	< 10%	
Design Controls	Design Speed ⁽²⁾	Level	3.2	50 mph				
		Rolling		40 mph				
	Control of Access		2-4.0 ^R 11-1.05 ^R	Control by Regulation (Type 3)				
	Level of Service		2-3.04 ^R	Desirable: C Minimum: D				
Cross Section Elements	Travel Lane Width ⁽³⁾		3.2.3	12 ft				
	Shoulder Width	Usable	3.2.3	6 ft	5 ft	6 ft	5 ft	
		Surfaced		2 ft				
	Cross Slope	Travel Lane	3.1.6	See Figure 3.1-A and Table 3.1-C				
		Shoulder		Paved Shoulder: Same as Travel Lane Unpaved Shoulder: 4%				
	Auxiliary Lanes	Lane Width	3.2.3	11 ft				
		Usable Shoulder Width		4 ft				
	Reconstructed/ Rehabilitated Bridges ⁽⁴⁾	Structural Capacity	3.2.3	HL-93				
		Minimum Width ⁽⁵⁾		28 ft				
	Existing Bridges to Remain in Place	Structural Capacity	3.2.3	HS-15				
		Minimum Width ⁽⁵⁾		Approach Traveled Way Width + 4 ft	Approach Traveled Way Width + 4 ft OR 28 ft, whichever is less			
	Roadside Clear Zone	Guardrail	12-2.08 ^R	Usable Shoulder Width				
		Obstruction ⁽⁶⁾	3.2.7	See footnote (6) below				
Slope Schedule	Cut	Foreslope (within clear zone)	3.1.6	3:1				
		Depth of Ditch		2 ft				
		Backslope		Ditch Line < 10 ft from ETW: 2:1 Ditch Line ≥ 10 ft from ETW: 1:1				
	Fill	Height ≤ 10 ft		2:1				
Height > 10 ft		3:1						
Alignment Elements	DESIGN SPEED			30 mph	35 mph	40 mph	45 mph	50 mph
	Stopping Sight Distance		2-8.02 ^R	200 ft	250 ft	305 ft	360 ft	425 ft
	Passing Sight Distance		2-8.02 ^R	500 ft	550 ft	600 ft	700 ft	800 ft
	Intersection Sight Distance ⁽⁷⁾		6-6.0 ^R	335 ft	390 ft	445 ft	500 ft	550 ft
	Superelevation Rate		3.2.4	See RDM Section 12-2.04				
	Minimum Horizontal Curve Radius		3.2.4	See RDM Section 12-2.04				
	Maximum Grades	Level	12-2.05 ^R	9%	9%	9%	9%	8%
		Rolling		11%	11%	10%	10%	9%
	Minimum Grades ⁽⁸⁾		3.1.5	Desirable: 0.4% Minimum: 0.0%				
	Vertical Curve (K-values)	Crest	12-2.05 ^R	See Section 12-2.05				
		Sag						
Vertical Clearance (Collector Under)	New/Reconstructed Bridges ⁽⁹⁾	3.1.6	14.5 ft					
	Existing Bridges		14 ft					
	Sign Truss/Ped. Bridge		19 ft					
Vertical Clearance (Collector Over Railroad)		3.1.6	23 ft					

Note for Table 3.2-A:

- i. References the MDOT RDM. To determine the application of controlling design criteria, see MDOT's RDM Section 2-9.02.
- ii. See section 3.1.6.2 for additional requirements for federally funded projects.
- iii. See footnotes [i.e. Design Speed ⁽¹⁾] annotated in the table above and presented below.

**GEOMETRIC DESIGN CRITERIA FOR RURAL COLLECTORS
(State Aid and Federal-Aid Routes) (3R Projects)**

Footnotes to Table 3.2-A

1. Design Year ADT – Desirably, the design year ADT should be 10 years beyond the construction completion date. At a minimum, it should be the current traffic volumes as of the construction completion date.
2. Design Speed – The design speed should equal or exceed the anticipated posted or regulatory speed limit after construction.
3. Lane Widths – For industrial routes, 12-foot lane widths are desirable.
4. New Bridges (Minimum Width) – For new bridges within the limits of a 3R project, the minimum width should be the full approach roadway width according to the criteria for new construction. RDM Section 12-5.0 should be referenced for bridge projects performed as a spot improvement.
5. Reconstructed Bridges/Rehabilitated Bridges/Existing Bridges to Remain in Place (Minimum Width) – RDM Section 12-5.0 should be referenced for bridge projects performed as a spot improvement.
 - a. For reconstructed and rehabilitated bridges within the limits of a 3R project, a 20-foot width is acceptable on non-Federal-aid projects where the ADT \leq 250 and the approaching travel lanes are 10 feet wide each.
 - b. For existing bridges to remain in place, a 20-foot width is acceptable on non-Federal-aid projects for all traffic volumes where the approaching travel lanes are 10 feet wide each.
6. Roadside Clear Zone – [Section 3.2.7](#) discusses the design criteria for clear zones. All values should be measured from the edge of traveled way.
7. Intersection Sight Distance (ISD) – Table values assume ISD for passenger cars turning onto a level two-lane roadway. RDM Section 6-6.0 provides guidance on grade corrections and truck ISD.
8. Minimum Grades – On bridges, a minimum 0.5% longitudinal grade should be provided where practical.
9. Minimum Vertical Clearances – Table values include an additional 6-inch allowance for future resurfacing.

3.2.3 Cross-Section Elements

3.2.3.1 General

Table 3.2-A presents the criteria for cross-section elements on 3R projects for State Aid roads. The cross-section widths of the existing road should be evaluated using these criteria. The policy on the application of the cross-section widths in the table is as follows:

- Existing Width Does Not Meet the 3R Width – Consideration should be given to widening the element. If the decision is made to widen the cross-section element, a width should be provided that at least meets the 3R criteria, which should be sufficient for most 3R projects. However, it may be appropriate to widen the element to meet new construction/reconstruction criteria.
- Existing Width Does Meet the 3R Width – In most cases, it will not be cost-effective to widen the cross-section element to meet new construction/reconstruction criteria if the existing width meets 3R criteria. Where practical, consideration should be given to widening the element to meet new construction/reconstruction criteria.

[Section 3.1.6](#) provides an elaboration on the cross-section elements on State Aid projects (e.g., surface and shoulder cross slopes) for new construction/reconstruction. Much of this discussion also applies to 3R projects. In addition, the cross-section criteria in the following sections should be considered.

3.2.3.2 Bridge Scope of Work

For bridges within the limits of a 3R project, the bridge may be replaced, reconstructed, rehabilitated, or remain in place. The existing structural capacity, geometrics, crash history, costs, and historical significance of the bridge will determine the appropriate action. However, if an existing bridge is structurally sound and if it meets the design loading structural capacity, but does not meet the geometric criteria, it is unlikely to be cost-effective to improve the geometrics of the bridge. Nonetheless, the geometric deficiencies may be severe and/or there may be an adverse crash history at the bridge that would dictate that the bridge should be replaced.

3.2.3.3 Bridge Width

In summary, the following should be considered when determining bridge widths within the limits of a 3R project:

- Bridge Replacement – For this scope of work, the full approach roadway width should be provided across the bridge according to new construction criteria, based on a 20-year traffic projection. [Section 3.1.6](#) should be referenced for further guidance.
- Bridge Reconstruction/Bridge Deck Rehabilitation – For these scopes of work, the full approach 3R roadway width from Table 3.2-A should be provided across the bridge. Traffic volume projections should be based on the same design year as for the overall 3R project.

- Existing Bridges to Remain in Place – The existing width of bridges proposed to remain in place should be evaluated using the criteria in Table 3.2-A. If the existing width does not meet these criteria, the bridge should be widened as part of the 3R project or a design exception is required.

On low-volume roads, it may be appropriate to leave in place a bridge with a clear width of 18 feet or less. In such cases, the approaches should be transitioned to the narrow width, and the bridge should be signed and/or signalized to operate as a one-way bridge.

All bridges that are narrower than the approach roadway width (including shoulders) should be evaluated for special narrow bridge treatments. At a minimum, the signing and pavement markings should meet the criteria of the *MUTCD*. In addition, FHWA's *Mitigation Strategies for Design Exceptions** provides guidance specifically for narrow bridges (e.g., special pavement markings). The value of these additional treatments should be evaluated for the bridge.

See <https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/> for mitigation strategies.

3.2.3.4 Bridge Rails/Transitions

For new, reconstructed, or rehabilitated bridges, the existing bridge rails and approaching guardrail-to-bridge-rail transitions should be upgraded to meet at least the TL-2 criteria as defined in the latest edition of AASHTO's *Manual for Assessing Safety Hardware (MASH)*. For existing bridges to remain in place within the limits of a 3R project, the Office of State Aid Bridge Section is responsible for evaluating the adequacy of the existing bridge rail to determine if it should be upgraded. The adequacy of any existing approaching bridge rail transition should be evaluated for possible upgrading.

If an existing rail that will remain is structurally inadequate and does not meet AASHTO's loading and performance requirements (e.g., timber railing or the metal flex rail on a precast bridge), an approved design exception is required. Reasons for an exception request might include excessive cost to upgrade the rail, no crash history, or the possibility of increasing the number of posts to strengthen the rail.

All existing guardrail transitions approaching a bridge rail should be evaluated for practical improvements. The following specific criteria should be considered:

- Precast bridges with concrete post, metal rail systems, and concrete rail and curb bridges of any length and width should be blocked out to the gutter line across the entire structure and connected to the approach guardrail.
- Bridges that have existing approach guardrail that does not meet the current guardrail design should have the old guardrail removed and new guardrail installed according to currently approved criteria.

3.2.4 Horizontal Alignment

The horizontal alignment criteria in [Section 3.1.4](#) will apply to 3R projects on State Aid roads, except as noted below:

- The safe speed chart should be used to determine the design speed of an existing horizontal curve. Field measurements may be required to obtain the as-built information. The design speed of the existing curve should be compared to the design speed of the 3R project.
- A safe speed chart should only be used to decide if corrective action should be considered. Once the decision has been made to improve the curve, the criteria in [Section 3.1.4](#) should be used to determine the proper combination radii and superelevation to meet the 3R design speed, which may be achieved by either flattening the curve or by increasing the superelevation rate on the curve.
- The safe speed chart can also be used to determine the appropriate advisory speed plate for signing curves that are below the 3R design speed, but will remain in place.
- If the existing curve satisfies the 3R design speed, other details of the horizontal curve (e.g., superelevation runoff length, distribution of superelevation between tangent and curve) will not normally need to be checked.

3.2.5 Vertical Alignment

A 3R vertical curve K-value chart presents the vertical alignment criteria for 3R projects for grades, crest vertical curves, and sag vertical curves. These criteria apply to 3R projects on State Aid roads.

3.2.6 At-Grade Intersections

The design criteria for at-grade intersections also apply to 3R projects on State Aid roads except for intersection sight distance (ISD). These criteria also apply to ISD on 3R projects with the following revisions:

- Location of Eye – At stop-controlled intersections, the location of the eye is assumed to be 15 feet from the edge of traveled way for new construction/reconstruction projects. For 3R projects on State Aid roads ($V < 45$ miles per hour), the location of the eye may be assumed to be 10 feet from the edge of traveled way.
- Sight Flares – It is often not practical to meet the sight flare criteria on 3R projects.

3.2.7 Roadside Safety

The discussion and criteria in RDM Section 12-2.08 on roadside safety applies to 3R projects on State Aid roads, except as noted in the following for roadside clear zones:

- Design Speed Greater than 45 miles per hour – The basic clear zone should be 14 feet from the edge of the traveled way. Side drains, utility poles, trees, and other obstacles should be removed or relocated, if practical. If a side drain is relocated, it should desirably be installed at a distance equal to the clear zone for new construction/reconstruction. The side slope on an intersecting drive or public road should be flattened, if practical. In addition, any headwalls or parapets that are within 4 feet of the usable shoulder should be relocated.
- Design Speed 45 miles per hour or Less (ADT > 750) – The basic clear zone should be 10 feet from the edge of the traveled way. The discussion in Comment #1 on side drains and intersecting

slopes also applies. In addition, any headwalls and parapets that are within 2 feet of the usable shoulder should be relocated. If the headwall or parapet is not relocated but is within 6 feet of the edge of the traveled way, an object marker should be installed according to the *MUTCD*.

- Design Speed 45 miles per hour or Less (ADT < 750) – The basic clear zone should be 6 feet. The discussion in Comment #1 on side drains and intersecting slopes also applies. In addition, any headwalls and parapets that are within 1 foot of the usable shoulder should be relocated. If the headwall or parapet is not relocated but is within 6 feet of the edge of the traveled way, an object marker should be installed according to the *MUTCD*.

3.2.8 Exceptions to Geometric Design Criteria

The discussion in RDM Section 2-10.0 on design exceptions applies equally to the geometric design of 3R projects on State Aid roads, except that the proposed design should be evaluated against the criteria presented in Section [3.2](#).

3.3 PAVEMENT DESIGN

This section establishes the methods, procedures, and design values used for the base and pavement structure design on State Aid projects.

3.3.1 General Criteria

Base and pavement structure design of State Aid projects should consider the following:

- A computer program available from State Aid incorporates many of the details of this section and facilitates determining structural numbers (SN) for the N-year design life and the 20-year design life for comparison. The program output is required on the typical section sheet of the plans for a record of parameters used in the design on base and paving construction projects.

The SN should not be less than 1.26 to ensure that low ADTs and high CBRs do not reduce the base thickness below a reasonable depth.

The construction (i.e., preparation, placement, manipulation, compaction) of the embankment, subbase, and base courses should be in accordance with the governing State Aid specification requirements.

The ground water table should be at least 3 feet below the riding surface of the roadway. If a high-water table or other irregularity is found, then additional site investigation should be considered. Anticipated work should be shown on the plans with the necessary pay items and quantities.

3.3.2 Design Requirements

- Pavement structures for State Aid projects should be designed using a maximum gross load of 80,000 pounds. For LSRP projects, the pavement may be designed for a maximum gross load of 57,650 pounds.
- The coefficients of relative strength should be used for each layer thickness listed in Table 3.3-A.
- The minimum thicknesses for all base course layers are presented in Table 3.3-B.

- The minimum thickness of all subbase layer courses should be 3 inches, except under full-depth asphalt construction, which requires a minimum thickness of 4-inch granular subbase.
- Full-depth asphalt construction requires a total of 6 inches of asphalt paving as shown on the plans in accordance with the Specifications.
- On projects where a traffic analysis indicates a significant imbalance between automobile and truck traffic, all pertinent information (e.g., proposed industrial complex, recreational site, and/or any other features that could influence the design traffic data) should be provided to the State Aid District Engineer, who will request the design traffic data from the Planning Division.

3.3.3 Design Procedure

3.3.3.1 Traffic Counts

Traffic counts for each State Aid project should be obtained by using online MDOT traffic counts, as available. If traffic is estimated to exceed 250 ADT, the State Aid District Engineer may request the Planning Division to provide the design traffic data.

3.3.3.2 Analysis of Traffic

The following information may be assumed when using traffic counts, unless this information is provided:

- 10% trucks in the total ADT
- 675 trucks per 1,000 for the design of flexible pavements
- one-half of all trucks in each travel lane

3.3.3.3 Analysis of Subgrade Material

A complete analysis of the subgrade material and underlying design soil should be conducted as follows:

- A soil profile should be taken by boring and sampling the full depth of design soil (usually 3 feet) at intervals of between 200 feet and 500 feet.
- The AASHTO Soil Classification should be determined. Combination soils should be considered as the worst condition.
- The Unified Soil Classification should be determined.
- The Atterberg Limits and Volume Change should be determined.
- The Group Index should be determined.
- The Gradation should be determined.
- The Standard Density for A-3 Soils should be determined.

- The CBR using Tables 3.3-C or 3.3-D should be estimated for the appropriate soil classification.

A complete soils profile received from the preparing laboratory should contain all the information in the above list.

3.3.4 Design of Pavement Structures

Using the traffic counts obtained above and the CBR determined by information from the soils profile, the pavement structure should be determined as follows:

- Using the computer program that is available from the Office of State Aid Road Construction, the required Structural Number (SN) should be calculated for the N-year design life and the 20-year design life:
 - a. Based on the DHV, the following applies:
 - five-year design life for $DHV \leq 200$
 - eight-year design life for $DHV 201 - 400$
 - ten-year design life for DHV over 400
 - ten-year design life (minimum) for all curb and gutter construction
 - b. To ensure that low ADTs and high CBRs do not reduce the base thickness below a reasonable depth, the required SN for the N-year design should not be less than 1.26.
 - c. The value for PT should be equal to 2.5.
 - d. LSRP designs should use $18k (flex) = 375$ for a 57,650 pound design. A minimum SN of 1.26 is still required.
- After determining the required SN, the pavement structure should be designed using the appropriate layer coefficients for the various pavement components. These are provided in Table 3.3-A.
- Thin asphalt surfaces, 2 inches or less on new construction, should be placed on a single surface treatment. This should generally apply to new untreated granular bases where asphalt is used as a riding surface for high traffic volumes or unusual truck traffic. This requirement may be waived on short sections (e.g., bridge approaches or short sections over box culvert projects). Asphalt surface courses of less than 2 inches should not be used as part of the design structure thickness on granular bases.

**Table 3.3-A
PAVEMENT STRUCTURE LAYER COEFFICIENTS**

Pavement Component	Coefficients (per inch)
Surface Course	
Asphalt Pavement	0.44
Double Bituminous Surface Treatment	0.00
Base Course	
Plant Mix Bituminous Base Course	0.34
Cement Treated Granular Material (Class 1 or 2, Group D)	0.23
Cement Treated Granular Material (Class 3-6, Group D)	0.20
Cement Treated Granular Material (Class 9, Group D)	0.17
Granular Base Course (Class 1-4, Group A or B)	0.10
Crushed Stone	0.14
Subbase Course	
Granular Subbase Course (Class 1 or 2, Group C)	0.12
Granular Subbase Course (Class 3 or 4, Group C)	0.11
Granular Subbase Course (Class 5 or 6, Group C)	0.10
Granular Subbase Course (Class 9, Group C)	0.09
Cement Treated Granular Material (Class 9, Group D)	0.20
Design Soil Treatment	
Lime Treated Course	0.06
Lime-Cement Treated Course	0.15
Cement or Flyash Treated Course	0.15 - 0.20

**Table 3.3-B
MINIMUM BASE COURSE THICKNESSES**

Type of Base	Minimum Thickness
Granular Material, Class 1 - Class 4	6"
Cement Stabilized Granular Material	6"
Fly-ash Stabilized Granular Material	6"
Asphalt Paving	Maximum Mixture Thickness
Asphalt Stabilized Base	6"

**Table 3.3-C
METHOD OF ESTIMATING CBR
(A-4, A-6, and A-7 soils)**

AASHTO Soil Class	Unified Soil Class(es)	Liquid Limit	Plasticity Index	Volume Change	Group	Estimated CBR	
A-7	CH	41 Min.	11 Min.	125		1	
	CH, MH			100-125		2	
	CH			75-99		3	
	MH			63-74		4	
	CL			62		5	
A-6	CL or ML-CL	40 Max.	11 Min.	35-55		5	
				26-34		6	
				17-25		7	
	SC, SMu, or SM-SC	40 Max.	11 Min.		10	8	
					9	9	
					8	10	
					7	11	
					6	12	
					5	14	
					5	15	
A-4	CL	40 Max.	10 Max.	17		7	
				17		8	
	ML or ML-CL	40 Max.	10 Max.		16	8	
					9-16	9	
					0-8	10	
	ML	25	NP			12	
		25				13	
	SC, SM or M-SC	40 Max.				15	
						7-10	16
						4-6	17
						3	18
						2	19
	SMd	40 Max.		NP		1	
						20	

Notes for Table 3.3-C:

- i. Controlling Data
- ii. A-7 Soils: Volume Change
- iii. A-6 Soils: Volume Change and Group Index
- iv. A-4 Soils: Liquid Limit, Plasticity Index, and Volume Change

**Table 3.3-D
METHOD OF ESTIMATING CBR
(A-2 and A-3 soils)**

AASHTO Soil Class	Unified Soil Class(es)	Plasticity Index	Percent Passing No. 40 Sieve	Standard Density (lbs/ft ³)	Estimated CBR	
A-3	"S" Soils and "G" Soils	NP		116	11-15	
				117 - 119	16-20	
				119	20+	
A-2	"S" Soils	7-12	95-100		24	
		1-6			26	
		NP			26	
		NP			28	
		NP			30	
			15			45
			14			46
			13			47
			12			48
			11			49
			10			50
			9			51
			8			52
			7			53
			6			54
			5			55
			4			56
			3			57
			2			58
			1			59
NP	60					

Notes for Table 3.3-D:

- i. Controlling Data
- ii. A-3 Soils: Standard Density
- iii. A-2 Soils: Plasticity Index and/or Percent Passing No. 40 Sieve