7.0 RURAL NON-FREEWAY HIGHWAY DESIGN

- **General**

THIS CHAPTER PROVIDES INFORMATION ON ODOT 4R/NEW RURAL NON-FREEWAY DESIGN STANDARDS AND ODOT 3-R RURAL NON-FREEWAY DESIGN STANDARDS. THE ODOT 4R/NEW RURAL DESIGN STANDARDS ARE COVERED FIRST, FOLLOWED BY THE ODOT 3-R RURAL DESIGN STANDARDS. THE DESIGNER MUST BE AWARE OF WHICH STANDARDS APPLY AND CHOOSE THE APPROPRIATE STANDARDS WHEN DEALING WITH RURAL HIGHWAYS. REFER TO CHAPTER 2 FOR A DISCUSSION ON THE DIFFERENT DESIGN STANDARDS.

Rural highways make up a large percentage of the state highway mileage. Rural highways cover the widest range of geographical and topographical conditions. Rural highways connect all parts of the state to each other. Rural highway designs should provide the safest cost effective solutions. This chapter will discuss the various cross sectional design elements and how topography and traffic volumes affect them. Alignment information is also described. This chapter also discusses how to design highways that are Scenic Byways and highways that travel through the many rural communities located throughout the state.

The arterial road systems provide a high speed and high volume travel network between major points in urban and rural areas. Rural arterials consist of a wide range of roads, from multi-lane rural expressways to low volume, two lane roads. Most rural state highways in Oregon are functionally classified as arterials as they serve the greatest traffic volumes and provide critical connections to the larger urban areas, ports, multi-modal facilities, and recreational areas. However, some state highways serve very low volumes of traffic and are classified as collectors or local roads. The majority of this chapter will describe the design standards and guidelines for rural expressway design and rural arterial highway design, although there will also be discussion on rural collectors and local roads. The design standards and guidelines contained in this chapter are only to be used for non-freeway rural highway design. Rural freeway design is covered under Chapter 6.

7.1 ODOT 4-R/NEW RURAL EXPRESSWAY DESIGN STANDARDS

- **General**

Expressways are designated by the OTC. They are allowed on statewide, regional and district classified highways. Expressways are generally high speed, limited access facilities whose main function is to provide for safe and efficient high speed and high volume traffic movements. The primary function of rural expressways is to provide connections to larger urban areas, ports, and major recreational areas with minimal interruptions. Rural expressways may also serve as major freight corridors or may be located on Freight Routes. Private access is discouraged and public intersections are highly controlled. Rural expressways may utilize at-grade intersections or grade separated interchanges.

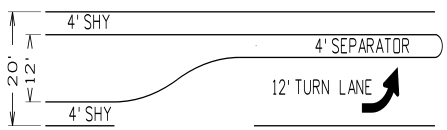
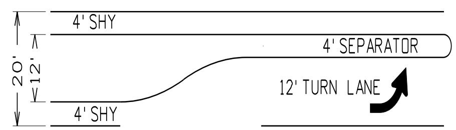
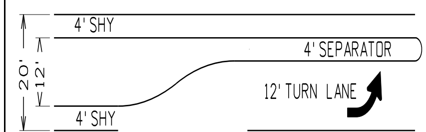
High level roadways, although classified as expressways, may operate more as a freeway. These expressways have grade separations in place of at-grade intersections and are fully access controlled. When high level expressways meet the operational definition of freeways, the expressway should be designed with freeway standards (See Chapter 6). This means many of the design elements in Table 7-1, such as left turn lanes, striped medians, and right turn lanes would not apply.

As part of the designation process, ODOT will designate two types of expressways. The first type is any section that is part of an expressway corridor, but by its location and nature will only be managed as an expressway through access management tools and objectives. An example of this type of expressway is Oregon Route 58 through the Willamette National Forest over Willamette Pass. This section is generally within mountainous terrain. The second type of expressway is any segment of highway that is designed, or planned to be designed to look and function to expressway standards. Using the Oregon Route 58 example, this second type might include the section from I-5 to Dexter. The second type of expressway will generally have a Facility Plan completed. The Facility Plan will identify those sections that should be designed to look and function as expressways. The Facility Plan should also provide some parameters regarding grade separations, interchanges, and at-grade intersections.

For Expressway segments that are not part of the Facility Plan, the design standards for Rural Arterial Highway Design should be used except for the access management standards, where the rural expressway spacing standards should be followed.

Table 7-1 provides standards for the design of reconstruction and new construction projects on rural expressways. Following Table 7-1 is discussion on the different design elements to provide additional background information.

Table 7-1
Rural Expressway Standards

Design Elements	Design Speed		
	55 mph	60 mph	70 mph
Terrain	Mountainous	Rolling	Flat
Travel Lane	12’	12’	12’
Right Turn Lane	12’ plus shoulder[1]	12’ plus shoulder[1]	12’ plus shoulder[1]
Left Turn Lane			
Right Side Shoulder	8’ (4 lane) 10’ (6 lane)	10’ (4 lane) 10’ (6 lane)	10’ (4 lane) 10’ (6 lane)
Left Side Shoulder	4’ (4 lane) 8’ (6 lane)	4’ (4 lane) 10’ (6 lane)	4’ (4 lane) 10’ (6 lane)
Median Striped Median Raised Curb Median[2] Concrete Barrier Median	 14’ Minimum 20’ Travel lane to travel lane 14’ (4 lane) 22’ (6 lane)	 16’ Minimum 20’ Travel lane to travel lane 14’ (4 lane) 26’ (6 lane)	 16’ Minimum 20’ Travel lane to travel lane 14’ (4 lane) 26’ (6 lane)
Continuous Left Turn Lane	N/A[3]	N/A[3]	N/A[3]
Maximum Superelevation[4]	See Table 5-3	See Table 5-3	See Table 5-3
Maximum Degree of Curvature	6° 30’	5° 00’	3° 15’
Maximum Grade	6%	4%	3%
On-street Parking	N/A[5]	N/A[5]	N/A[5]
Vertical Clearance	17’	17’	17’

[1] Shoulder on curbed and uncurbed sections shall be a minimum 3 feet and 4 feet respectively
[2] Minimum raised curb median. Consideration of 6’ raised traffic separator for pedestrian crossing may increase median width.
[3] Continuous turn lanes are not allowed on expressways
[4] Superelevation at intersections may need modification, see Chapter 9. Superelevation rate used from Standard Superelevation, Figure 5-6, which is based on open road conditions.
[5] On-street parking is not allowed on expressways.

7.1.1 DESIGN CONSIDERATIONS

- **Design Speed**

Rural expressways carry high speed and high volume traffic and should be designed accordingly with the function of the facility. Rural expressway design speeds should be designed for a minimum 55 mph design speed in mountainous areas, 60 mph in rolling terrain, and 70 mph in flat terrain. Expressways may in time evolve into freeways and the chosen design speed should allow for that facility type transition.

- **Grades**

The length and percentage of grade has an affect on the operation of the expressway. Long, steep grades reduce the efficiency of the facility, especially when expressways have a tendency to carry high truck volumes. The maximum grades for mountainous, rolling, and flat rural expressways are 6%, 4%, and 3% respectively.

- **Lanes**

Rural expressways are very similar to freeways as they offer a high level of mobility and safety. In addition, expressways may become freeways in the future as the roadway is upgraded to meet the needs of traffic demand. All rural expressway travel lane widths shall be 12 feet. Where right turn channelization is required, lane widths shall comply with Table 7-1.

- **Shoulders**

Rural expressways must have an adequate shoulder for emergency parking, disabled vehicles, and emergency response vehicles. The shoulder also provides significant safety benefits to motorists and bicyclists, as well as improving traffic flow and capacity. Rural expressways will typically have a 10 foot right hand shoulder for most design speeds. (8 feet for 55 mph design speed). In addition to the standard shoulder width, where roadside barriers are used (guardrail, concrete barrier, or bridge rail), the right side shoulder shall include an additional 2 foot "E" or shy distance from the face of barrier.

The left side shoulder for rural four lane expressways shall be 4 feet. Separated rural expressways with more than two lanes in each direction shall have an 8 foot left side shoulder for a design speed of 55mph and 10 feet for all other design speeds (See Table 7-1).

In most situations the shoulder can also accommodate bicycle traffic. In some situations, a multi-use path may better accommodate bicycle traffic. Refer to ODOT's Bicycle and Pedestrian Plan for additional information on multi-use paths.

- **Medians**

Rural multi-lane expressways shall include some type of median treatment. This median could be a variety of types, such as depressed median, raised curb, or concrete barrier. For more information regarding types of median treatments refer to Section 5.5. The median should be a non-traversable type; however, in some situations a painted median is acceptable as in the case of at-grade intersections. The 1999 Oregon Highway Plan requires the construction of a non-traversable median for:

- All new multi-lane highways constructed on completely new alignment; and
- Modernization of all rural, multi-lane expressways, including Statewide (NHS), Regional, and District.

In rural developed areas such as rural communities and centers where left turn movements are necessary and would be allowed, the preferred median type is a raised curb median consisting of a 12 foot raised median (curb to curb). This would also require two 4 foot inside shoulders for an overall median width of 20 feet (travel lane to travel lane). Consideration of double left turn lanes on at-grade intersections on expressways should be given, resulting in a 24 foot raised island. The required two 4 foot inside shoulders would result in an overall median width of 32 feet (travel lane to travel lane).

For multi-lane expressways in most rural environments, a depressed median similar to freeways is the preferred median treatment. The depressed median allows flexibility on running independent grades, while providing a larger separation between travel directions. This type of median treatment should generally be used on rural multi-lane expressways, particularly where right of way is available. A minimum 76 foot (travel lane to travel lane) median is desirable for depressed medians on rural expressways. However, narrower medians could still be considered if adequate separation, proper side slopes, and drainage can be accommodated. Typically a median width of at least 46 feet is necessary to provide the necessary design features. Where the median width is to be less than 46 feet, consider using concrete barrier. As mentioned above, raised curb is generally only appropriate near rural development centers.

The median width necessary for a concrete barrier is controlled by the design speed of the expressway, required shoulder width, and the required shy distance. The minimum median width for a four lane facility is 14 feet (2 foot barrier, 4 foot shoulders, and 2 foot shy distance). Wherever concrete median barrier is used, the designer needs to carefully consider appropriate end treatments. These could include attenuators, mounds, or transitions to other median types such as depressed or raised curb.

Not all expressways, particularly rural sections, will be multi-lane facilities. On two lane rural expressways, a controlled median is not required. A non-traversable median on a two lane expressway should generally be discouraged except at critical locations such as interchanges, access points, or at-grade intersections.

Where a painted traversable median is acceptable in rural areas, the median width shall be a minimum of 14 feet for design speed of 55 mph and 16 feet for design speed of 60 mph or greater. Use of a 14 foot and 16 foot median should be in conjunction with access control measures to ensure that the median is not used as a continuous turn lane. The use of continuous two way left turn lanes (CTWLTL) on rural expressways is discouraged and should only be considered if other alternatives are not feasible. Left turn channelization may be provided at intersections only.

- **Access Control**

Maintaining access control on rural expressways is critical to retaining the safety and efficiency of the facility. No private approaches should be allowed on rural expressways. If there are existing private approaches, a long term plan should be established to eliminate them or provide alternative access as opportunities occur. Public road connections are controlled and spaced according to the access management spacing standards contained in the Oregon Highway Plan, Appendix C. Traffic signals are discouraged on rural expressways, and modernization of expressways that have traversable medians shall result in non-traversable medians.

- **Intersections / Interchanges**

Connections to rural expressways can be either at-grade intersections or grade separated, grade separation being preferred in most cases. Locating intersections along curves presents some design difficulties such as dealing with superelevation rates and sight distance. Rural interchange spacing (crossroad to crossroad) shall follow Table 9-2. For more information relating to intersections and interchange design, refer to Chapter 9.

- **Deceleration & Acceleration Lanes**

Deceleration lanes are encouraged at all intersections and interchanges. Deceleration at an interchange can look similar to a standard right turn lane or a freeway exit ramp. Each situation must be evaluated and analyzed to determine the appropriate treatment. Figure 9-6 should be used for all right turn deceleration lanes. The information contained in Chapter 9 can be used to determine acceptable exit ramp designs.

The use of acceleration lanes on rural expressways should be considered carefully. Acceleration lanes should generally be used at interchanges on rural expressways. Acceleration lanes at at-grade accesses or intersections may not be appropriate. Acceleration lanes should only be used where they will not be influenced by downstream intersections or accesses. At-grade intersections and access locations may consider using acceleration lanes only where access management spacing standards are met, the type of turning movements are considered, and where an engineering analysis shows they will operate safely. Engineering Services Unit and Transportation Planning and Analysis Unit can assist with locating acceleration lanes.

Acceleration lanes can either be freeway style or parallel. All acceleration lanes should be designed long enough to allow merging traffic to be traveling the same speed as mainline traffic. Figure 9-22 and AASHTO's *"A Policy on Geometric Design of Highways and*

Streets-2001" provides guidance for determining the appropriate acceleration lane length. The length may need to be lengthened when a significant volume of truck traffic is using the merge lane or where high volumes are merging into a single lane.

7.2 ODOT 4-R / NEW RURAL ARTERIAL DESIGN STANDARDS

- **General**

Most rural state highways are classified as arterial roadways. Appendix A contains a listing of the functional classification of all state highways. These tables can help a designer determine the appropriate classification of a given highway. However, the designer should research any existing Corridor Plans, or county Transportation System Plans (TSPs), to ensure that the highway classification is correct. Where discrepancies exist between the tables in Appendix A and the classifications assigned by a Corridor Plan or TSP, the higher classification shall be used.

Table 7-2 provides ODOT 4R/New Rural design standards for the design of reconstruction and new construction projects on rural highways. This table provides design standards not only for rural arterials but also for rural collectors and rural local routes. Rural local routes refer to the functional classification of the roadway and not jurisdictional ownership. Following Table 7-2 is discussion on the different design elements in order to provide additional background information. Although the manual will be discussing rural arterials and design elements, the design principles for collectors and local roads are similar. Sections 7.3 and 7.4 cover rural collectors and local roads respectively.

Table 7-2
ODOT 4R/New Rural Arterial Design Standards
ODOT Standards For New / Reconstruction Projects
For Non-Freeway **RURAL** Functional Classifications Including Arterials, Collectors and Local Classifications.

Design Feature	Functional Class														
	Two Lane												Four Lane		
	ADT under 400			ADT 400 - 1500			ADT 1500 - 2000			ADT over 2000			DHV over 700		
Terrain (Flat, Rolling, Mountainous)	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
Design Speed (mph)	60	50	45	70	55	45	70	60	50	70	60	50	70	60	50
Width of Traveled Way (ft.)															
Rural Arterials	24	22	22	24	24	22	24	24	22	24	24	24		2 X 24	
Rural Collectors	22	20	20	22	22	22	24	24	22	24	24	24		2 X 24	
Rural Local Routes	22	20	18	22	22	22	24	24	22	24	24	24		2 X 24	
Shoulder Width (ft.)															
Rural Arterials	4	4	4	6	6	6	6	6	6	8	8	8	8	8	8
Rural Collector	2	2	2	5	5	5	6	6	6	8	8	8	8	8	8
Rural Local Routes	2	2	2	5	5	5	6	6	6	8	8	8	8	8	8
	(See 2001 AASHTO pages 388, 429 and 452 for allowable roadway width exceptions).														
Recommended Max Grades (%)															
Rural Arterials	3	5 (6)[a]	6 (8)[a]	3	4	6	3	4	6	3	4	6	3	4	6
Rural Collector / Local	5	6 (8)[a]	6 (9)[a]	4	6	6	4	5	6	4	5	6	4	5	6
	[a] Recommended Maximum Grades for ADT under 250														
Maximum Degree of Curvature	5°	8°15’	10°30’	3°15’	6°30’	10°30’	3°15’	5°	8°15’	3°15’	5°	8°15’	3°15’	5°	8°15’
Stopping Sight Distance (ft.)	570	425	360	730	495	360	730	570	425	730	570	425	730	570	425
	(See 2001 AASHTO pg. 112 for assumed speed ranges)														
Passing Sight Distance	--------- As Available ---------			--- 2480 ft for 70 mph or less --------------------------											
Surface Type	---------- As determined by Pavements Engineer ----------														
Type of Shoulder Surface	---------- Same as Traveled Way ----------														
Width of Structures	---------- Width of future approach roadway and shoulders, as determined above plus offset to barrier, where applicable ----------														
Width of Major Long Span Bridges	---------- Special study may be required ----------														
Vertical Clearance	---------- 17 feet ----------														
Loading	----------Design Loading – HS 25 Design Truck or HL-93 Vehicular Loading ----------														

- **Design Procedure:** 1) Determine ADT / DHV. 2) Determine terrain. 3) Values beneath terrain will be the project design speed and related features based on functional classification.
- **Climbing or Passing Lanes** shall be considered where combinations of horizontal and vertical alignment prevent passing opportunities. Passing lanes, use 2’ median when 3 or 4 lane sections result. Climbing lanes, use 2’ median in 4 lane section only. Desirable shoulder width is 6’ (minimum 4’). If the roadway has substantial bike use, consult the ODOT Bicycle-Pedestrian Program Manager for input.
- **Four lane construction standards** should be utilized wherever the traffic is likely to approach or exceed capacity. Refer to median table in Figure 7-1 for four lane median width.
- **Where roadside barriers are used**, the shoulder width shall be increased by 2’ to provide barrier clearance and lateral support. (See Section 5.4 “roadside barriers” and Std. Drg. RD420 or RD425).
- **To convert ADT’s** and DHV’s, contact Transportation Planning Analysis Unit.

EXCEPTIONS TO ABOVE STANDARDS SHALL BE APPROVED AS DESCRIBED IN CHAPTER 13

7.2.1 DESIGN CONSIDERATIONS

- **Design Speed**

Rural arterials have a wide range of design speed depending on the terrain, location of facility, and driver expectancy. Design speeds range from 45 mph in mountainous terrain to 70 mph on level terrain. Table 7-2 outlines design speeds based upon volume and terrain. In general design speeds on level terrain range from 60-70 mph, rolling terrain design speeds in rural areas range from 50-60 mph, and mountainous terrain design speeds range from 45-50 mph.

For projects located within a rural community, design speed must be commensurate with the desired running speed through the community. Most rural communities are posted between 35 mph to 45 mph. The design speed for both 3-R and 4-R type projects in rural communities will vary due to community characteristics. In addition, some rural communities may receive special designation as a Special Transportation Area (STA) which will affect the design speed. The designer will need to work with the project team and ODOT planning and corridor groups to determine the type of project in rural communities.

- **Grades**

Rural arterials cover a wide range of topographic areas. The maximum grade for any given segment of rural highway is determined by the type of terrain, whether flat, rolling, or mountainous. Highway grades can have a significant effect on traffic flow and operations and therefore should be as flat as possible. Highways that carry substantial amounts of truck or recreational vehicle traffic will be greatly affected by steep grades. Wherever possible, steep grades should be avoided. Where this is not practical, the length of grade should be minimized. The maximum grade allowed on rural arterial highways can be found in Table 7-2. Where terrain restricts traffic, frequent passing opportunities should be provided where possible.

In some mountainous terrain, long steep grades are unavoidable. In these instances the designer should consider the use of truck climbing lanes. On continuous steep down hill grades, the use of truck escape ramps may be necessary. Where truck escape ramps are deemed necessary, they should be designed as an ascending grade type as per AASHTO's *"A Policy on Geometric Design of Highways and Streets-2001"* pp. 262 – 269. Climbing lanes are covered in more detail in Section 5.10.3

- **Travel Lanes and Lane Width**

Rural highways carry many different types and volumes of traffic. Some highways may be major freight routes, others may be major recreational routes or commuter routes, while some may only serve an isolated farm to market industry or local traffic. Travel lanes need to be designed in accordance with this wide range of highway uses and functions. The number of lanes required is normally arrived at by consideration of projected volume, level of service, and capacity conditions.

When determining the appropriate lane widths for a particular section of highway, the designer needs to consider the highway classification, presence of trucks, highway function, and traffic volumes. Travel lane widths can significantly impact the capacity or mobility of a particular highway section as well as the safety of the section.

Highways that are identified as freight routes by the Oregon Highway Plan (OHP) or by Route Map 7 (Route Map 7 can be found at http://www.odot.state.or.us/forms/motcarr/od/8104.pdf) should utilize a 12 foot lane, regardless of volume. The 12 foot lane should also be used on all rural highways designated as expressways. In addition, a 12 foot lane should generally be used for all statewide classified highways on the National Highway System (NHS). Lower volume collectors and local routes normally have a narrower roadway width. Lane width for regional and district highways is typically based upon functional class and volume. Table 7-2 provides information on standard lane width.

- **Shoulders**

Shoulders are a very important and often overlooked element of a rural highway. Right side shoulders provide lateral clearance from roadside objects, provide lateral support of the highway section, increase capacity, provide an area for emergency parking, provide an area to pass a stalled vehicle, can aid emergency vehicles reaching a crash site, and provide an area for motorists to recover if they drift outside of the travel lanes. Left side shoulders in separated roadways also provide many of the same benefits, but generally are narrower than the right side.

Paved right side shoulders are required on every rural state highway. The width of the shoulder is dependent upon traffic volumes, terrain, and to some degree by design speed. For most rural highways, shoulders of 4 feet to 8 feet are sufficient to provide the adequate level of safety. Lower classification facilities generally have narrower shoulders. Table 7-2 should be used to determine the appropriate shoulder width.

Another benefit of shoulders on rural highways is a safe area for bicycle use. These shoulders are not bicycle lanes, but are a shared facility. Many rural highways provide great recreational opportunities for bicyclists. In addition, Oregon is well known for bicycle routes and scenic areas that attract bicycle users from across the country.

- **Medians**

All multi-lane rural highways shall include a median. The preferred design for these types of highways is a non-traversable type of median. A non-traversable median may consist of a wide depressed median (similar to expressways), a raised mountable curb, or a concrete barrier. Of these, the concrete barrier should be avoided due to the difficulty of providing at-grade intersections that are common to rural highways. Both the depressed and raised curb medians can be easily and safely transitioned to provide turning and crossing opportunities. In some situations, a painted median may be acceptable.

Non-traversable medians must be constructed for:

(a) All new multi-lane highways constructed on completely new alignment; and
(b) Modernization of all rural multi-lane expressways.

Non-traversable medians should be considered for:

(a) All multi-lane highways undergoing 3-R or 4-R improvements; and
(b) Highways not undergoing modernization where a median could improve safety.

Median openings must conform to the Access Spacing Standards contained in the OHP, Appendix C. Where median openings in a non-traversable median are allowed, intersection sight distance should be provided from the intersection. This may require modification of the median design, or providing a median opening wide enough to ensure proper sight distance. The minimum median width is dependent upon the design speed of the highway. Figure 7-1 contains the standard median widths.

Where painted medians are acceptable, they should be a minimum of 8 feet on rural arterials. Rural collectors and rural local roads may have narrower medians. Painted medians must be clearly striped so as not to be confused with continuous two way left turn lanes (CTWLTL). CTWLTLs should be avoided in most rural environments. Short sections may be needed in some rural communities or where closely spaced accesses require it. Figure 7-1 provides standard details for median width, shoulder widths, slopes, and ditch widths.

Refer to Section 5.5 for more information about median design.

STANDARD SECTIONS
FOR HIGHWAYS OTHER THAN FREEWAYS

TABLE "A"
SHOULDERS (Also See TABLE 7-2)

MINIMUM SHOULDER WIDTHS (ft.)			
Current Traffic	Local	Collector	Arterials
ADT under 400	2	2	4
ADT 400 - 1500	5	5	6
ADT 1500 - 2000	6	6	6
ADT over 2000	8	8	8
DHV over over 200 (4 LANES)	8	8	8

*** Min. 6' Shoulder For Urban Arterial When Barrier Curb Is Used.**

* Where roadside barriers are used, the shoulder width shall be increased by 2 feet to provide barrier clearance and lateral support. (See Standard Drg. RD420 or RD425)

TABLE "B"
SURFACING ROCK SLOPES AND DITCH WIDTHS

Shoulder Width (ft.)	Max. Surf. Rock Slope and Ditch Slope (when used)	Ditch Width (when used) (ft.)
10	1:6	3
8	1:6	3
6	1:4	2
4	1:4	2
2	1:3	1½

TABLE "C"
SIDE SLOPES (CUT & FILL)(ft.)

ADT below 1500	0 - 6 6 - 8 8 - 12 over 12	Max 1:4 1:3 1:2 1:½(See ①)
ADT 1500 AND OVER	0 - 5 5 - 10 10 - 15 over 15	Max 1:6 1:4 1:3 1:2

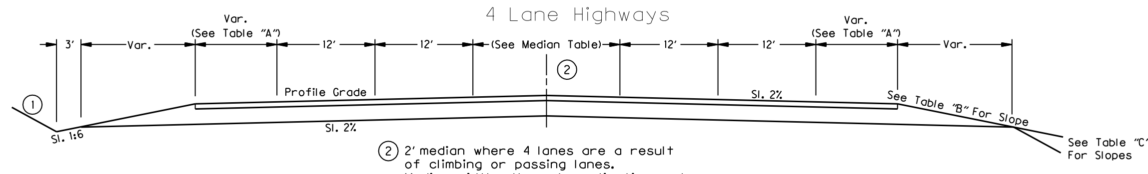
The above slopes are a guide. Flatter slopes to be used where additional cost is minor. In solid rock, slopes are to be determined by type of material and approved by the Roadway Engineer. Also check clear zone standards.

TABLE "D"
MEDIAN WIDTH TABLE

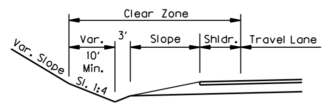
ROADWAY CLASSIFICATION	MINIMUM (ft.)	DESIRABLE (ft.) (Highway Design Speed) Under 55mph	Over 55mph
Urban Collector Roads & Streets	2	12	14
Arterials - Rural	8	14	16
- Urban	4	14	16

TABLE "E"
PARKING WIDTH TABLE

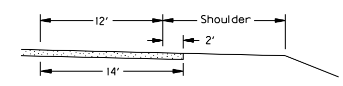
ROADWAY CLASSIFICATION	RESIDENTIAL (ft.)	COMMERCIAL/ INDUSTRIAL (ft.)
Urban Arterials	8 - 10	8 - 10
Urban Collector	7 - 10	8 - 10
Urban Local	7	7



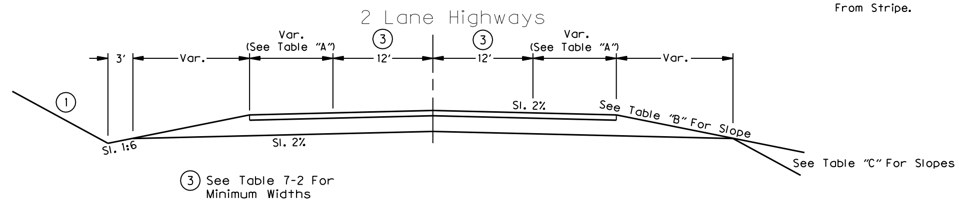
② 2' median where 4 lanes are a result of climbing or passing lanes. Median widths thru channelization and intersections see Std. Drg. RD215 & RD220.



① Use 1:4 Safety Slope At Bottom Of 1:2 Or Steeper Slope.



Where Concrete Pavement Is Used For Travel Lanes, Outside Lane Shall Be Constructed 14' In Width. The Shoulder Stripe Is Located 2' In From Edge Of Concrete And Total Shoulder Width Is Measured From Stripe.

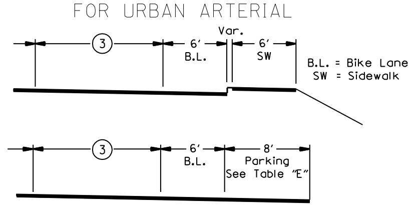


③ See Table 7-2 For Minimum Widths

For minimum bike lane widths See Chapter 11

Sidewalk width is exclusive of curb, utilities, signs, etc., to provide adequate operating clearance. Greater widths should be used in high use areas and against buildings.

BIKE LANE AND SIDEWALK DETAILS
FOR URBAN ARTERIAL



NOTE:
To Convert ADT's and DHV's Contact Planning Section

State of Oregon
Department of Transportation

HIGHWAY DESIGN MANUAL

STANDARD SECTIONS

2003

Figure 7-1
Standard Sections For Rural Highways

- **Roadside Design**

The design of the roadside environment is a critical part of any rural highway segment. A well designed roadside can significantly improve the safety and operation of a particular segment. Steep slopes or obstacles should be avoided or mitigated where possible and practical. Fixed object and run off the road type accidents often account for a significant number of crashes on a segment of highway. Therefore, providing a safe roadside environment should be a goal of every project. The 2002 AASHTO "*Roadside Design Guide*" should be used to determine the clear zone distance and mitigation measures to use for different highway conditions. Section 5.7.3 has additional information and examples on proper clear zone requirements and roadside design.

As AASHTO's "*Roadside Design Guide*" directs, the preferred treatment of roadside obstacles is to relocate them outside of the clear zone. Only where this is not possible or cost effective, should shielding be considered. Where a barrier along a roadway is used to shield a roadside obstacle, a 2 foot shy distance from the normal edge of shoulder and face of barrier should be used. This shy distance maintains the useable shoulder width and provides some additional distance from the travel way and the barrier.

- **Left Turn Lanes**

On some higher volume and speed highways, left turning traffic can become a major safety concern, especially on two-lane highways. On rural highways, left turn lanes should generally only be considered at public road intersections. Chapter 9 discusses siting criteria for installing left turn lanes. When these criteria are met, a left turn lane should be considered in the design. Generally, left turn lanes are not to be constructed for private accesses in rural areas unless the siting criteria are met and installation of a left turn lane will not create additional safety concerns on the highway. A major concern regarding left turn lanes for private access is that successive accesses may require installation of a section of a continuous two way left turn lane (CTWLTL). Using CTWLTLs in rural environments should be discouraged as they may increase development pressure in rural areas. CTWLTLs may be considered where needed specifically for safety in short sections or within the boundaries of a rural community.

As stated above, providing left turn lanes at multiple locations that are spaced closely, may create a need for a CTWLTL. It is undesirable to provide a typical section that creates an hour glass shape. This is where a highway is widened to provide left turn lane, then narrowed back to the original typical, only to be immediately widened again. This situation should be avoided. Left turn lanes in rural areas should be selected where adequate spacing exists to avoid this hour glass problem.

- **Right Turn Lanes**

Similar to left turns, right turning traffic may sometimes create a safety issue at some intersections. However, right turn traffic does not normally need to come to a complete stop and wait for an opposing gap to complete the maneuver, except in the case of a pedestrian crossing. Therefore, the safety implications are not as significant as with left turning vehicles. However, at some intersections, the volumes on the highway and the right turning traffic may be significant enough to create a safety problem. Chapter 9 and Appendix F discuss siting criteria for installing a right turn lane. A right turn lane should be considered only at public road intersections that meet these criteria. Where these criteria are not met, consider widening the right side shoulder to provide an additional space that can better accommodate right turning traffic without as much interference to through traffic. Generally a right shoulder of 8 feet to 10 feet upstream of the intersection is sufficient for vehicles to use. Right turn lanes should not be used for private drives unless the access has significant turning volume, or a specific accident problem could be corrected by utilizing a right turn lane, or the access is within a rural community area (as defined above) and meets the criteria from Appendix F.

- **Emergency/Truck Escape Ramps**

Rural highways are sometimes located in steep terrain. In some sections, long continuous grades may be the only reasonable design option. Where long continuous down grades are present or being considered, the designer should investigate the need for emergency/truck escape ramps. Generally, truck escape ramps are only needed where long descending grades exist. Chapter 3 of AASHTO's *"A Policy on Geometric Design of Highways and Streets-2001"*, pages 259-269 has a lengthy discussion on escape ramps.

- **Truck Weigh Stations**

On freight routes and other major highways, truck weigh stations may be necessary. The Motor Carrier Transportation Branch should be consulted when a weigh station is being impacted or considered. The preferred design for weigh scale locations is to provide acceptable deceleration and acceleration lanes. The station should also be set back from the highway to provide separation from high speed traffic and stopped trucks.

- **Access Management**

Access management is an important tool for maintaining the safety and functionality of a highway segment. In rural environments, access spacing should conform to the standards contained in the Oregon Highway Plan, Appendix C. Generally the purchase of access rights is not necessary in rural environments unless the section is near an interchange or an important intersection that cannot be adequately protected through the normal approach road permit process. For more information about access management, refer to Section 5.11.

7.2.2 SPECIAL DESIGN CONSIDERATIONS

Rural arterial highways cover many miles of varying terrain and roadside development. They also are located in areas of high scenic or historical significance. Designers need to consider the need for special consideration of scenic byways, rural communities, historical markers and viewing sites as they develop design plans.

- **Scenic Byways**

ODOT has established a process for portions or segments of highway routes to be designated as Scenic Byways. Scenic Byways are those routes or segments that are located in significant scenic or historic corridors. ODOT has adopted many State and Federal Scenic Byway routes. These routes are described in the Oregon Highway Plan, pages 67-69. Scenic Byways are eligible for special federal funding. In addition, federal legislation encourages flexibility in design when designing projects within a Scenic Byway corridor.

When designing projects on a Scenic Byway, the designer should try to minimize the impacts to the natural and historic resources along the corridor. This may require the designer to use non-standard designs to avoid and minimize impacts. However, at no time should the safety of the section be compromised. Some special considerations to minimize impacts within Scenic Byway corridors are:

(a) Utilize alternative guardrail types or walls. Consult Roadway and/or Bridge Engineering.
(b) Utilize alternative bridge rails.
(c) Consider visual impacts and obstructions from guardrail. Reconsider the need for it.
(d) Consider reducing design speeds or utilize flexible design speeds to minimize changes to design elements.
(e) Consider blending cut and fill slopes with the natural terrain.

Designers need to coordinate early with Region Planners and the Scenic Byway program to identify key resource issues and concerns. The Scenic Byway program can provide valuable services for determining the scope, issues, and parameters to consider. They are also knowledgeable regarding various flexible design solutions to minimize impacts.

- **Rural Communities**

Rural Communities are unincorporated places comprised of primarily residential uses but also include other uses that help to make the community self sufficient. These other uses may include commercial, industrial, or public places (such as schools, churches, and post offices). Rural communities can take many forms. These different forms are defined in OAR 660 Division 22. Designers should be aware of several issues when designing a highway through a rural community. Issues such as speed, access, and pedestrian safety are very important to the local community.

In many rural communities, the speed of traffic on the highway is a primary concern. Designers should be considerate of this issue when selecting the appropriate design speed through a rural community. However, designers must also consider the highway classification, importance as a freight route, traffic volume, and importance as a recreational route in addition to the roadside characteristics of the community when selecting the design speed. In addition to design speed, the designer may want to consider other techniques to assist in managing traffic speeds. Some traffic calming techniques and designs may be appropriate in some rural communities. The Engineering Services Unit can assist with developing traffic calming designs for these communities.

Rural communities often need a high level of highway access to preserve the economic vitality and functionality of the community. This is generally caused by the lack of a supporting roadway network to reduce the dependence upon direct highway access. Generally, the designer should adhere to the access spacing standards for rural highways other than expressways and per the highway classification. However, in many rural communities, meeting these standards will be difficult. Where access spacing cannot be met, an access deviation will be required as per the 1999 Oregon Highway Plan and OAR 734 Division 51. Where access spacing is less than standard, the designer should investigate alternative access techniques including but not limited to frontage roads, shared access, restricting turn movements, and completing local street systems to reduce highway access dependency.

Pedestrian safety in rural communities is often a major concern. These communities often have small centers of activity on both sides of the highway that require pedestrians to cross. Traffic speed often has a significant physical and psychological impact to pedestrian crossing safety. Techniques to manage traffic speeds should be considered when appropriate. In addition, other tools can assist with pedestrian safety. Providing safe and clear sidewalks should be considered. Generally sidewalks in these areas should be separated from the roadway with a buffer strip. This buffer strip can be landscaped to increase the visual appearance of the area and may also assist with speed management. Clear, delineated pedestrian crossings should be included where appropriate. Use of markings, signing, and construction materials all may be considered to improve the visibility of pedestrian crossing areas. Other features such as bulb-outs and raised medians may also improve pedestrian crossing safety. The designer should be aware of and take into account impacts of historic areas, which may impact the use of certain roadway designs. For more information on pedestrian design, see Chapter 11 of this design manual and the Oregon Bike and Pedestrian Plan.

While these issues are often important considerations for local stakeholders, the designer must still consider the highway classification and other highway designations when developing designs for rural communities. The designer needs to accommodate the through travel as well as local movements when developing project designs in rural communities.

7.3 ODOT 4-R / NEW- RURAL COLLECTOR DESIGN STANDARDS

Collectors serve two very important functions. First collectors provide mobility to and from the arterial streets. Second, collectors provide land access to abutting properties. Due to their dual purpose, collectors have mobility characteristics that are just below those of an arterial and just above those of a local street.

The design elements of collector roads are similar to the design elements of arterials, although typically the range of values are slightly less demanding. Design speeds are normally lower than those for arterials, steeper grades are allowed, and lane and shoulder widths are generally narrower.

The different design standards for rural collectors can be found in Table 7-2. Additional information on collectors can found in Chapter 6 of AASHTO's *"A Policy of Geometric Design of Highways and Streets-2001"*, pages 424-433.

7.4 ODOT 4-R / NEW – RURAL LOCAL ROUTE DESIGN STANDARDS

A rural local route's primary function is to provide access to rural areas. Local routes account for a very large proportion of the roadway mileage in the State. Local routes normally carry very low volumes, therefore, design standards for local routes are generally lower than those standards for collectors and arterials. Design speeds are lower, steeper grades are allowed, and travel lanes and shoulder widths are narrower.

The different design standards for rural local routes can be found in Table 7-2. Additional information on rural local routes can be found in Chapter 5 of AASHTO's *"A Policy on Geometric Design of Highways and Streets-2001"*, pages 384-393.

7.5 ODOT 3-R RURAL DESIGN STANDARDS (NON-FREEWAY HIGHWAYS)

- **General**

This section discusses the appropriate design standards for rural non-freeway highway projects and is applicable to arterials, collectors, and local streets**.** The development of a non-freeway 3-R project should also be responsive to the considerations given in Section 2.2.1 concerning purpose, applicability, scope, determination, and design process. The following are minimums for lane and shoulder width, with consideration and improvement to horizontal and vertical curvature, bridge width and side slopes as appropriate. A feature not meeting the standards as specifically noted for roadway width, bridge width, horizontal curvature (Criteria B-Recommendations on curve corrections, Section 7.5), vertical curvature and stopping sight distance, pavement cross slope, superelevation, vertical clearance, ADA, or pavement design life must be upgraded or a design exception must be documented and approved. For more information on these criteria and other safety-conscious design considerations, the designer should become acquainted with *TRB Special Report #214-"Designing Safer Roads-Practices for Resurfacing, Restoration, and Rehabilitation".*

Once the decision is made to upgrade a roadway feature, the designer should use the *ODOT Highway Design Manual*, *AASHTO's "A Policy on Geometric Design of Highways and Street-2001"*, *AASHTO's "Roadside Design Guide-2002",* or *TRB Special Report #214,* whichever gives guidance in the particular area of need. When evaluating intersections within a 3-R project, turning radius to facilitate truck movements should also be considered as well as intersection sight distance.

- **Roadway Widths**

See Table 7-3 for minimum 3-R roadway widths.

Table 7-3
Minimum 3-R Lane And Shoulder Widths
Rural Non-Freeway (Arterials, Collectors, Local Streets)

Design Yr. Volume (ADT)	**Average Running Speed**	**Less Than 10% Trucks ****		**More Than 10% Trucks ****	
		Lane Width	**Shoulder Width***	**Lane Width**	**Shoulder Width***
Less Than 750 Vehicles	Under 50 mph	9’	2’	10’	2’
	50 mph or Over	10’	2’	10’	2’
750 to 2000 Vehicles	Under 50 mph	10’	2’	11’	2’
	50 mph or Over	11’	3’	12’	3’
2001 to 4000 Vehicles	All Speeds	11’	4’	12’	4’
Over 4000	All Speeds	11’	6’	12’	6’

* The shoulder width may be reduced 3 feet in mountainous terrain, with approval of the Roadway Engineering Manager.
** Trucks are defined as heavy vehicles, single unit configuration or larger (six or more tires).

NOTE: A minimum 11 foot lane is required on all NHS Routes.
A minimum 12 foot lane is required on nationally recognized truck routes.
(See Current Route Map #7, - http://www.odot.state.or.us/forms/motcarr/od/8104.pdf)

• Horizontal Curvature and Superelevation

Alignment improvements to horizontal curvature and superelevation can be as cost effective as lane and shoulder width improvements. Criteria A and B below outline recommendations for superelevation and curvature.

Criteria A: Improve horizontal curves by correction of superelevation to conform to ODOT New Construction Standards if the design speed of the existing curve is less than 15 mph below the ODOT New Construction Standards.

Criteria B: Evaluate reconstruction of curvature when the design speed of the existing curve is more than 15 mph below the running speed of approaching vehicles, and the current year ADT is 2000 or greater. Careful evaluation of the appropriate value to be used for the approach speed of vehicles must be made, taking into account transitioning from tangent alignments to more mountainous curving alignments. The appropriate approach speed for an individual curve is directly dependent on the alignment approaching the curve, potentially generating an approach speed far less than the 85^{th} percentile for the overall project.

When curve reconstruction is not justified, appropriate mitigation measures such as those listed in Table 7-6 should be applied.

• Vertical Curvature and Stopping Sight Distance

Evaluate reconstruction of crest vertical curves if (1) the crest hides from view major hazards such as intersections, sharp horizontal curves, or narrow bridges; (2) the design speed based on the existing Safe Stopping Distance is more than 20 mph below the ODOT New Construction Standards; and (3) the current year ADT is greater than 2000.

If vertical curve reconstruction is not justified/cost effective, or the curve is not reconstructed to new construction standards, appropriate mitigation measures should be applied (see Table 7-6).

• Vertical Clearance

The clear height of structures shall not be degraded to less than 16 feet over the entire roadway width, including the usable width of shoulder. Existing clearances of less than 16 feet but greater than 14 feet shall not be degraded. The clear height shall not be less than 14 feet in any case.

• Bridge Width

A decision must be made to retain, widen or replace any bridge within the limits of a 3-R project. Widening versus replacement should be evaluated to determine the most cost-effective treatment. Consider AASHTO's *"A Policy on Geometric Design of Highways and Streets-2001"* standards for bridges to remain in place, and Table 7-4, whichever is less, for minimum width. Additionally, consideration should be given to the accident history and the cost of widening when determining if widening is cost effective. If the decision is made to replace an existing structure, new construction standards will apply to the bridge replacement portion of the project only, not to the roadway portion. Replacing structures does not change the remainder of a 3-R Project to 4-R.

When a decision is made to retain a bridge, the bridge rail should be evaluated to determine if it can adequately contain and redirect vehicles without snagging, penetrating or vaulting. Consideration should be given to upgrading structurally inadequate or functionally obsolete bridge rail. Consideration should be given to design standard exceptions for railing upgrades, roadway widths, etc., when the structure is listed on or determined eligible for the National Register of Historic Places. The bridge rail design should also be evaluated for pedestrian needs. Appropriate traffic control devices should be installed where the clear roadway width on the structure is less than the approach roadway width.

Table 7-4
Minimum Useable Bridge Widths

Design Year Volume (ADT)	Useable Bridge Width
0 – 750	Width of approach lanes
751 – 2000	Width of approach lanes, plus 2 feet
2001 – 4000	Width of approach lanes, plus 4 feet
Over 4000	Width of approach lanes, plus 6 feet

- **Pavement Design and Cross Slope**

Pavement design for 3-R projects requires a minimum of 8 years of service life.

Appropriate leveling quantities should be included in the project to correct cross slope to 2% and correct curve superelevation as close to new construction standards as reasonably possible.

The designer should be aware of snow zone locations where there is a shoulder break and an “F” mix overlay is being placed. Because of the type of mix there is potential for pavement removal by the snow plows cutting into the pavement in the shoulder break areas. The designer should contact the Project Manager to discuss the need for additional leveling quantities to bring the shoulder slope up to match the existing slope of the travel lanes.

- **Sideslopes and Clear Zone**

A roadside inventory shall be provided on all 3-R projects. This inventory, along with the accident summary and analysis, gives the designer the information necessary to make good design decisions regarding safety improvements. Evaluation and improvement considerations of roadside features should be consistent with the following:

1. Flatten sideslopes of 1:3 or steeper at locations where run-off-road accidents are likely to occur (e.g., on the outside of horizontal curves).

2. Retain current slope ratios. Do not steepen sideslopes when widening lanes and shoulders, unless warranted by special circumstances.

3. Remove, relocate or shield isolated roadside obstacles.

4. Remove vertical drop-offs at the edge of pavement after paving.

- **3-R Projects and STIP Safety Investment Program (SIP)**

Category 1 and 2 SIP projects are those with low accident histories. They receive abbreviated safety features fit the following description.

- "Pave mainly" is the focus.
- Mandatory Design Features are required.
- Low-cost mitigation measures are encouraged.
- Less scoping effort.
- Lower project development cost.
- More dollars go to pavement on the road. The goal is to have no more than 6% of the Pavement Preservation budget in each region focused on safety measures.

Category 3, 4, and 5 SIP projects are those that have a history of fatal or serious crashes and receive targeted safety features fit the following description.

- Safety countermeasures are examined for value in reducing prevalent crash types using the Countermeasure Analysis Tool (CAT).
- Mandatory Design Features are incorporated.
- Benefit/Cost (B/Cs) < 0.8 aren't put in project.
- Safety countermeasures with highest potential payback are incorporated in project.
- Safety countermeasures and features are funded out of each Region's Safety Budget.

Section 2.2 outlines the 3-R design process that should be used in development of all 3-R projects.

- **Mandatory 3-R Design Features**

Following is a list (Table 7-5) of mandatory design elements that must be incorporated with 3-R projects:

Table 7-5
Mandatory Design Features

Geometric Deficiency	Mandatory Corrective Measure
ADA/Sidewalk Ramps	• Ramps shall be added where absent.
Narrow Bridges/Deficient Rails	• Bridge rail retrofit or new bridge rails; upgrade approach guardrail, bridge connections and transitions to current standards unless bridge is scheduled for replacement. • Install Type 3 object markers and post delineators.
Existing Guardrail	• All non-standard terminals within the clear zone shall be upgraded to current standards. • Runs less than 18.5 inches from top of pavement to guardrail post bolt shall be adjusted or replaced to current standards. • Guardrail bridge connections shall be upgraded if appropriate or added if absent.

- **Low-Cost Safety Mitigation Measures**

Table 7-6 is a list of low cost safety measures that should be considered on all 3-R projects as a minimum to mitigate existing safety deficiencies. They can also be used as mitigation in justification for design exceptions.

Table 7-6
Low-Cost Safety Measures

Geometric Deficiency	Low-Cost Safety Measure
Narrow Lanes and/or Shoulders	• Pavement edge lines • Raised pavement markers • Post delineators • Rumble strips
Steep Sideslopes/Roadside Obstacles	• Roadside hazard markings • Round ditches • Install guardrail • Remove or relocate obstacle • Slope flattening • Breakaway hardware
Narrow Bridges/Deficient Rails	• Install supplementary signing • Hazard and pavement markings
Sharp Horizontal Curve	• Install supplementary signing • Shoulder widening • Correct superelevation • Gradual sideslopes • Pavement antiskid treatment • Obstacle removal or shielding • Install post delineators
Poor Sight Distance At Hill Crest	• Install supplementary signing • Fixed-hazard removal • Shoulder widening • Driveway relocation • Illumination
Hazardous Intersection	• Install supplementary signing • Illumination • Pavement antiskid treatment • Speed control