

## **PREFACE**

### ***Purpose***

Many manuals, policies, guides, standards etc. have been published regarding roadway design. Most of these have been written using wide ranges of design recommendations (minimums and maximums) since the contents were intended to apply nationally. The purpose of this manual is to reduce the selection of design alternatives to those most appropriate for the State of Ohio, to document Ohio's interpretation of various policies, and to include design criteria which may be unique to the State of Ohio.

### ***Application***

The criterion included in this manual has been developed to closely conform to the following publications:

- AASHTO - A Policy on Geometric Design of Highways and Streets (2011 Green Book)
- AASHTO - A Policy on Design Standards - Interstate System (2005)
- TRB Report 214 - Designing Safer Roads - Practices for Resurfacing, Restoration and Rehabilitation (1987)
- AASHTO - Roadside Design Guide (2011)
- AASHTO - Guide for the Development of Bicycle Facilities (2012)

This manual is neither a textbook nor a substitute for engineering knowledge, experience or judgment. It is intended to provide uniform procedures for implementing design decisions, assure quality and continuity in design of highways in Ohio, and assure compliance with Federal criteria. Although the manual is considered a primary source of reference by personnel involved in highway design in Ohio, it must be recognized that the practices suggested may be inappropriate for some projects because of fiscal limitations or other reasons.

Consideration must also be given to design standards adopted by city, county or other local governments when designing facilities under their jurisdiction.

In lieu of the geometric design guidelines presented in this manual, the geometric design guidelines presented in the **AASHTO publication "Guidelines for Geometric Design of Low-Volume Roads (2<sup>nd</sup> Edition 2019)** may be used for low-volume collectors and local roads with a design average daily traffic volume of 2000 vehicles per day or less.

### ***Preparation***

The Roadway Design Manual has been developed by the Office of Roadway Engineering. Errors and omissions should be reported to the Office Administrator, Office of Roadway Engineering, Ohio Department of Transportation, 1980 West Broad Street, Columbus, Ohio, 43223.

### ***Format and Revisions***

Updating the manual is intended to be a continuous process and revisions will be issued periodically.

Each page has its publishing date shown. Users are encouraged to keep their copies up to date. Updates are available for viewing or downloading only from ODOT's **Design Resource Reference Center**, found on ODOT's web page. ODOT's Internet address is <http://www.dot.state.oh.us>.

### ***Unit of Measure***

Plans are to be prepared using the English system of units. Any metric units are provided for reference only.

For design purposes, the relationships between the two units are not exact or interchangeable. The user is therefore cautioned to work entirely within one system and not attempt to convert directly between the two.

## OHIO COUNTIES

County	Code	District	County	Code	District
Adams	ADA	9	Licking	LIC	5
Allen	ALL	1	Logan	LOG	7
Ashland	ASD	3	Lorain	LOR	3
Ashtabula	ATB	4	Lucas	LUC	2
Athens	ATH	10			
Auglaize	AUG	7	Madison	MAD	6
			Mahoning	MAH	4
Belmont	BEL	11	Marion	MAR	6
Brown	BRO	9	Medina	MED	3
Butler	BUT	8	Meigs	MEG	10
			Mercer	MER	7
Carroll	CAR	11	Miami	MIA	7
Champaign	CHP	7	Monroe	MOE	10
Clark	CLA	7	Montgomery	MOT	7
Clermont	CLE	8	Morgan	MRG	10
Clinton	CLI	8	Morrow	MRW	6
Columbiana	COL	11	Muskingum	MUS	5
Coshocton	COS	5			
Crawford	CRA	3	Noble	NOB	10
Cuyahoga	CUY	12			
			Ottawa	OTT	2
Darke	DAR	7			
Defiance	DEF	1	Paulding	PAU	1
Delaware	DEL	6	Perry	PER	5
			Pickaway	PIC	6
Erie	ERI	3	Pike	PIK	9
			Portage	POR	4
Fairfield	FAI	5	Preble	PRE	8
Fayette	FAY	6	Putnam	PUT	1
Franklin	FRA	6			
Fulton	FUL	2	Richland	RIC	3
			Ross	ROS	9
Gallia	GAL	10			
Geauga	GEA	12	Sandusky	SAN	2
Greene	GRE	8	Scioto	SCI	9
Guernsey	GUE	5	Seneca	SEN	2
			Shelby	SHE	7
Hamilton	HAM	8	Stark	STA	4
Hancock	HAN	1	Summit	SUM	4
Hardin	HAR	1			
Harrison	HAS	11	Trumbull	TRU	4
Henry	HEN	2	Tuscarawas	TUS	11
Highland	HIG	9			
Hocking	HOC	10	Union	UNI	6
Holmes	HOL	11			
Huron	HUR	3	Van Wert	VAN	1
			Vinton	VIN	10
Jackson	JAC	9			
Jefferson	JEF	11	Warren	WAR	8
			Washington	WAS	10
Knox	KNO	5	Wayne	WAY	3
			Williams	WIL	2
Lake	LAK	12	Wood	WOO	2
Lawrence	LAW	9	Wyandot	WYA	1

# ODOT Districts



★ District Headquarters

<u>DISTRICT</u>	<u>ADDRESS</u>	<u>CITY</u>	<u>ZIP CODE</u>	<u>PHONE NUMBER</u>
District 1	1885 N. McCullough St.	Lima	45801	419-222-9055
District 2	317 E. Poe Rd.	Bowling Green	43402	419-353-8131
District 3	906 N. Clark St.	Ashland	44805	800-276-4188
District 4	2088 South Arlington Rd.	Akron	44306	800-603-1054
District 5	9600 Jacksontown Rd., S.E.	Jacksontown	43030	740-323-4400
District 6	400 E. William St.	Delaware	43015	740-833-8000
District 7	1001 St. Mary's Ave.	Sidney	45365	937-492-1141
District 8	505 S. State Route 741	Lebanon	45036	513-932-3030
District 9	650 Eastern Ave.	Chillicothe	45601	740-773-2691
District 10	338 Muskingum Dr.	Marietta	45750	740-568-3900
District 11	2201 Reiser Ave., S.E.	New Philadelphia	44663	330-339-6633
District 12	5500 Transportation Blvd.	Garfield Heights	44125	216-581-2100

## **GLOSSARY**

**Arterial** - A functional classification for a facility primarily used for through traffic, usually on a continuous route.

**Attenuator (Crash Cushion)** - Protective devices that prevent an errant vehicle from impacting fixed objects by gradually decelerating the vehicle to a safe stop or by redirecting the vehicle away from the obstacle.

**Backslope** - The slope from the back of a ditch to the existing ground surface. (Sometimes referred to as a cut slope.)

**Barrier** - A device which provides a physical limitation through which a vehicle would not normally pass. It is intended to contain or redirect a vehicle.

**Barrier Clearance** - The distance required between the face of a barrier and the face of an obstacle to permit adequate shielding.

**Barrier Grading** - The shaping of the roadside when a barrier is required for slope protection. (See **Figure 307-4**).

**Bicycle Lane or Bike Lane** - A portion of roadway that has been designated by pavement markings and signs for preferential or exclusive use by bicycles.

**Border** - The area between the face of curb and the right of way line. Usually referred to as the border area when no sidewalk is used.

**Buffer** - The space between the face of the curb and the sidewalk for the purpose of providing snow storage, a buffer between cars and pedestrians, a place for signs and to improve aesthetics.

**Clear Zone** - The unobstructed, traversable area provided beyond the edge of the *through traveled way* for the recovery of errant vehicles. The clear zone includes shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes.

**Clear Zone Grading** - The shaping of the roadside using 4:1 or flatter foreslopes and traversable ditches within the clear zone area. (See **Figure 307-3**).

**Cloverleaf Interchange** - An interchange with loop ramps and outer ramps for directional movements. A full cloverleaf has ramps in every quadrant.

**Collector** - A functional classification for a facility in an intermediate functional category connecting smaller local or street systems with larger arterial systems.

**Collector-Distributor (C-D)** - A directional roadway adjacent to a freeway used to reduce the number of conflicts (merging, diverging and weaving) on the mainline facility.

**Common Grading** - The shaping of the roadside using 3:1 or flatter slopes and normal ditches. (See **Figure 307-4**).

**Converging Roadway** - Separate and nearly parallel roadways or ramps which combine into a single continuous roadway or ramp having a greater number of lanes beyond the nose than the number of lanes on either approach roadway.

**Controlled Access** - (Partial control of access) - Highway right of way where preference is given to through traffic. In addition to access connections with selected public roads, there may be some private drive connections.

Crest Vertical Curve - A vertical curve such that the point of intersection of the approach grades is above the roadway profile. Crest vertical curves are concave downward.

Critical Slope - A slope, steeper than 3:1, on which vehicles are likely to overturn.

Cross Slope - The rate of change of elevation along a straight line from one point in cross section to another.

Cut Slope - See Backslope.

Decision Sight Distance - The distance required for a driver to detect an unexpected or otherwise difficult to perceive information source or hazard in a roadway environment that may be visually cluttered, recognize the hazard or its threat potential, select an appropriate speed and path, and initiate and complete the required maneuver safely.

Degree of Curve (Arc Definition) - The angle subtended at the center by an arc of 100 foot length.

Design Exception - A document which explains the engineering and/or other reasons for allowing certain design criteria to be relaxed in extreme, unique, or unusual circumstances.

Design Hour - The 30<sup>th</sup> highest hourly volume of the design year.

Design Hourly Volume - The total volume of traffic in the design hour, usually a forecast of peak hour volume, measured in vehicles per hour.

Design Speed - A selected speed used to determine the various geometric design features of the roadway.

Diamond Interchange - The simplest and most common type of interchange, formed when one-way diagonal ramps are provided in each quadrant and left turns are provided on the minor highway.

Directional Interchange - An interchange, generally having more than one grade separation, with direct connections for all movements.

Diverging Roadway - Where a single roadway branches or forks into two separate roadways without the use of a speed change lane.

Edge of Traveled Way - The intersection of the mainline pavement with the treated or turf shoulder or the curb and gutter.

Expressway - A divided arterial highway with full or partial control of access and generally with grade separations at major intersections.

Fill Slope - See Foreslope.

Foreslope - The slope from the edge of the graded shoulder to the bottom of the ditch. (Also called Fill Slope.)

Freeway - An expressway with full access control and no at-grade intersections.

Functional Classification - The grouping of highways by the character of service they provide.

Glare Screen - A device used to shield a driver's eye from the headlights of an oncoming vehicle.

Graded Shoulder - The area located between the edge of traveled way and the foreslope.

Headlight Sight Distance - The stopping sight distance required on an unlighted sag vertical curve.

Horizontal Sight Distance - The sight distance available in consideration of various horizontal alignment features, such as: degree of curvature and the horizontal distance to roadside obstructions.

Intersection Sight Distance (ISD) - The sight distance required within the corners of intersections to safely allow a variety of vehicular maneuvers based on the type of traffic control at the intersection.

Interstate - Those roadways on the Federal System which have the highest design speeds and the most stringent design standards.

"K" Factor - The length of a vertical curve divided by the algebraic difference in grades expressed as a percent. "K" factors are only applicable where the length of curve is greater than the necessary stopping sight distance.

Lateral Clearance - The distance measured horizontally from the edge of traveled way to the face of an object (parapet, abutment, pier, wall, etc.).

Legal Speed - The legislated or agency authorized maximum speed limit of a section of roadway.

Length of Need (LON) Point - That point on the terminal or longitudinal barrier at which it will contain and redirect an impacting vehicle along the face of the terminal or barrier.

Level of Service - A qualitative measure describing the operational flow of traffic.

Limited Access (Full control of access) - Highway right-of-way where rights of access of properties abutting the highway are acquired, such that all access to and from the highway are prevented except at designated locations.

Local Road - A functional classification used for rural roadways whose primary function is to provide access to residences, businesses or other abutting properties.

Local Street - A functional classification used for urban roadways whose primary function is to provide access to residences, businesses or other abutting properties.

Non-Recoverable Slope - A slope that a vehicle can traverse, but it is generally too steep to allow the vehicle to stop or return to the roadway. Traversable nonrecoverable slopes are between 1V:4H and 1V:3H and are NOT included in the specified clear zone distance.

Normal Design Criteria - The criteria used for the design of new or reconstructed projects (all projects that do not qualify as 3R).

Normal Ditch - A trapezoidal-shaped ditch having a bottom width of 2 feet and rounding of 4 feet (See Figure 307-4).

Passing Sight Distance (PSD) - The visible length of highway required for a vehicle to execute a normal passing maneuver as related to design conditions and design speed.

Peak Hour - The maximum traffic volume hour of the day.

Reconstructed Bridge - Any improvement to an existing bridge involving the replacement of the bridge deck or more.

Recoverable Ditch - A rounded ditch having a radius of either 20 or 40 feet (See Figure 307-2).

Recoverable Slope - A slope on which a motorist may, to a greater or lesser extent, retain or regain control of a vehicle. Slopes flatter than 1V:4H are generally considered recoverable.

Resurfacing, Restoration and Rehabilitation (3R) - Improvements to existing roadways, which have as their main purpose, the restoration of the physical features (pavement, curb, guardrail, etc.) without altering the original design elements.

Resurfacing, Restoration, Rehabilitation and Reconstruction (4R) - Much like 3R, except that 4R allows for the complete reconstruction of the roadway and alteration of certain design elements (i.e., lane widths, shoulder width, SSD, etc.).

Roadside - The area between the outside shoulder edge and the right-of-way limits. The area between roadways of a divided highway may also be considered roadside.

Roadway - The portion of a highway, including shoulders, for vehicular use.

Safety Grading - The shaping of the roadside using 6:1 or flatter slopes within the clear zone area and 3:1 or flatter foreslopes and recoverable ditches extending beyond the clear zone (See **Figure 307-1**).

Sag Vertical Curve - A vertical curve such that the point of intersection of the approach grades is below the profile line. Sag vertical curves are concave upward.

Shared Lane - A lane of a traveled way that is open to both bicycle and motor vehicle travel.

Shared Use Path - Facilities physically separated from motor vehicle traffic by an open space or barrier, either within the highway right-of-way or within an independent right-of-way. Shared use paths may be used by a mix of non-motorized users such as bicyclists, walkers, runners, wheel chair users and skaters.

Sidepath - A shared use path located immediately adjacent and parallel to a roadway.

Shy Distance - The space adjacent to fixed objects, such as walls, fences, shrubs, buildings, parked cars and other features that pedestrians typically avoid.

Shy-line Offset - The distance from the edge of the traveled way beyond which a roadside object will not be perceived as an obstacle by the typical driver to the extent that the driver will change the vehicle's placement or speed.

Sloped Curb (mountable) - Curbs 6 inches or less in height with a sloping face designed to be traversable by vehicles when required.

Spiral - A transition curve from a tangent to a circular curve, or a circular curve to a circular curve, designed to affect a more gradual change of direction. The Euler spiral (clothoid) is used in design.

Stopping Sight Distance (SSD) - The cumulative distance traversed from the time a driver sees a hazard necessitating a stop, actually applies the brakes and comes to a stop.

Superelevation - The cross-slope of the pavement used to compensate for the effect of centrifugal force on horizontal curves.

System Interchange - An interchange that connects two or more freeways via a network of ramps and connectors.

Service Interchange - An interchange that connects a freeway with local surface streets or arterials.

Temporary Road - Any crossover, ramp, roadway, etc. whose sole purpose is to temporarily maintain traffic during construction which is normally removed upon project completion.

Through Traveled Way - The portion of roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Traveled Way - The portion of the roadway for the movement of vehicles, exclusive of shoulders and bicycle lanes.

Traversable Ditch (preferred ditch) - An open ditch with a preferred combination of foreslope, backslope, bottom width and rounding that allows the ditch shape to be used within the clear zone. (See **Figures 307-10 & 307-11**).

Traversable Slope - A slope from which a motorist will be unlikely to steer back to the roadway but may be able to slow and stop safely. Slopes between 1V:3H and 1V:4H generally fall into this category.

Treated Shoulder - That portion of the graded shoulder which has some type of surface treatment.

Tree Lawn - see Buffer.

Trumpet Interchange - A semi-directional "T" interchange.

3R Values - Special values developed for certain design features on 3R improvements.

Vertical Clearance - The distance, measured vertically, from the surface (pavement, shoulder, ground, etc.) to a fixed overhead object (bridge superstructure, sign, signal, etc.).

Vertical Curb (barrier) - A steep faced curb 6 inches or more in height.

## **DESIGN REFERENCE DOCUMENTS**

### ***ODOT Publications***

Contact ODOT Office of Contracts (614) 466-3778 to purchase, or link to them at <http://www.dot.state.oh.us/drrc/>.

The current revision of those listed should be used.

- Bridge Design Manual (ODOT)
- Construction and Material Specifications
- Location and Design Manual
  - Volume Two - Drainage Design
  - Volume Three - Highway Plan
- Ohio Manual of Uniform Traffic Control Devices
- Pavement Design & Rehabilitation Manual
- Railroad Project Procedure Manual
- Real Estate Policies and Procedures Manual
- State Highway Access Management Manual
- Specifications for Subsurface Investigations
- Standard Construction Drawings
  - Roadway Engineering Services
  - Structural Engineering
  - Traffic Engineering



- Traffic Engineering Manual (and appendices)
  - Design Manual for Highway Lighting
  - Design Manual for Directional Guide Signs
  - Standard Sign Design Manual
  - Traffic Control Design Information Manual

### ***AASHTO Publications***

Phone: (202) 624-5800, Web site: <http://www.transportation.org>

- Guide for Erecting Mailboxes on Highways (1994)
- Guide for the Development of Bicycle Facilities (2012)
- **Guidelines for Geometric Design of Low-Volume Roads (2<sup>nd</sup> Edition 2019)**
- Policy on Design Standards - Interstate System (2005)
- Policy on Geometric Design of Highways and Streets (2011)
- Roadside Design Guide (2011)
- Highway Safety Manual (2010)

### ***TRB Publications***

Phone: (202)334-3213, Web site: <http://www.nas.edu/trb/>

- Designing Safer Roads - Practices for Resurfacing, Restoration and Rehabilitation (TRB Special Report 214 - 1987)
- Highway Capacity Manual (TRB - 2010)
- Recommended Procedures for the Safety Performance Evaluation of Highway Features (NCHRP)

## **REFERENCES**

Procedures for Developing Design Designations for Non-Interstate Bridge Replacement/  
Rehabilitation Projects

Guidelines for Identifying Acceptable Locations for the Disposal of Waste Material and  
Construction Debris or The Excavation of Borrow Material Within ODOT Right-of-Way

Landscaping Guidelines