HIGHWAY DESIGN MANUAL

Chapter 2 Design Criteria

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CHAPTER 2
DESIGN CRITERIA

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2.1 INTRODUCTION

NYSDOT uses a Design Criteria Computer Program to automate the development of design criteria for capital projects. The program is web based and available on the Department's Internet site. The purpose of this chapter is to define the design elements and standard values or range for each of the design elements. The chapter also provides designers with a methodology to perform an independent check of the Design Criteria Program.

NYSDOT has established the following seventeen (17) design elements as critical criteria for the design of highways and bridges:

- Design Speed
- Lane Width
- Shoulder Width
- Bridge Roadway Width
- Grade
- Horizontal Curvature
- Superelevation
- Stopping Sight Distance
- Horizontal Clearance
- Vertical Clearance
- Travel Lane Cross Slope
- Rollover
- Structural Capacity
- Level of Service
- Control of Access
- Pedestrian Accommodation
- Median Width

The standards provided in this chapter are applicable to new construction, reconstruction, and bridge projects on highways with over 400 vehicles per day. For each project, the values established for the applicable critical design elements represent the Design Criteria for that project. Critical design elements and design criteria for 2R/3R (resurfacing, restoration, and rehabilitation) projects are included in Chapter 7 of this manual and for low-volume bridges with 400 or fewer vehicles per day are included in Chapter 4 of this manual.

Design criteria are influenced by:

- The highway functional classification
- Traffic volumes
- Operating speed
- Terrain (level, rolling, mountainous)
- Development density and land use
- Project type (e.g., new construction, reconstruction, 3R, 2R - simple 3R projects, and 1R - single course resurfacing projects)

Design criteria are presented to provide guidance to individuals preparing the plans, profiles and cross sections. The design criteria for the project alternatives are normally determined during the project scoping stage. In making these determinations, the scoping participants should be aware that the criteria are generally the least acceptable values and, if routinely used, may not result in the optimum design from a safety, operational, or cost-effectiveness perspective. Design criteria values should be established taking into consideration the Department's Context-Sensitive Solution philosophy that strives for outcomes that meet transportation service and safety needs, as well as environmental, scenic, aesthetic, cultural, natural resource, and community needs.

It is the Department's **policy** to at least meet the design criteria values for the individual project under consideration. However in situations where values less than the design criteria values are desirable for certain design elements, a formal justification must be prepared in accordance with Department policy for use of the nonstandard feature as specified in Section 2.8 of this chapter.

| The Design Criteria Program output table, providing the information similar to Table 2-16 of this
| chapter, is to be used to present design criteria for projects covered by this chapter. Separate criteria are to be provided for adjoining highways when they are being reconstructed to tie into the new mainline. For complex projects involving several highway types, there may be different sets of design criteria for different portions of the project or for different alternatives.

There are other design elements with established values that must be considered in addition to the critical design elements when scoping and designing a project. These elements can affect some of the critical design elements and have a considerable impact on the cost, scope, and quality of a project. Examples include design storm, length of speed change (acceleration and deceleration) lanes, design vehicle, clear zone, and level of service (a critical design element for the mainline on interstate projects only). Since these other elements are <u>not</u> listed as critical design elements, they are not addressed in this chapter but are discussed in others (e.g., Chapter 5 Basic Design, Chapter 18 Facilities for Pedestrians and Bicyclists).

The inclusion of specified design criteria in this chapter does not preclude the use of engineering judgment to consider alternative engineering values and does not necessarily mean that existing roadways, which were designed and constructed using different criteria, are either substandard or unsafe. Many existing facilities are adequate to safely and efficiently accommodate current traffic demands and need not be reconstructed solely to meet current design criteria.

2.2 PROJECT TYPES

In order to provide consistent methods for developing projects and reporting program data, projects are categorized into types which are determined by their predominant purpose. When the project consists of two or more different kinds of work, judgment must be used to identify the predominant reason for the project in order to select the appropriate type.

When projects have more than a single type of work, it is not appropriate to use a single set of design criteria. There may be several sets of design criteria that apply to different portions of the project or to different alternatives.

The design criteria included in this chapter apply to all Department highway projects that are new construction and reconstruction, and to all Department bridge projects on highways with over 400
| vehicles per day. For additional information on project types, refer to Appendix 5 Design Year
| Traffic Forecasts of the *Project Development Manual*, and Bridge Manual, Section 2.

2.3 DESIGN CRITERIA SOURCES

This section provides a brief description of the major sources used to establish geometric design criteria for all Department highway projects which are new construction, reconstruction, or interstate and freeway 2R/3R, and for all Department bridge projects with over 400 vehicles per day.

2.3.1 **A Policy on Geometric Design of Highways and Streets**

This policy was developed by AASHTO's Standing Committee on Highways. Guidance included in the policy is based on established practices and is supplemented by recent research. The policy is intended to form a comprehensive reference manual for assistance in administration, planning, and educational efforts pertaining to design formulation. A recommended range of design values for critical dimensions of various types of highway facilities is provided.

2.3.2 **A Policy on Design Standards, Interstate System**

This policy provides standards for design features specific to interstate highways. The standards outlined in this publication must be followed for projects on the interstate system in addition to the AASHTO geometric requirements in *A Policy on Geometric Design of Highways and Streets*.

2.3.3 **NYSDOT Bridge Manual**

This manual was developed by the NYSDOT Structures Design and Construction Division. Section 2 of this manual serves as a standard for designers in determining minimum requirements for bridge widths, clearances, and live loadings for all bridge replacement and bridge rehabilitation projects. It is also intended to clarify the above geometric design requirements for all types of bridge work except maintenance.

2.3.4 **NYSDOT Guidelines for the Adirondack Park**

Although this document does not establish design criteria, it is being referenced here because it provides important guidelines for consideration when designing projects within the Adirondack Park. Geometric guidelines for projects within the Adirondack Park are contained in Chapter IV of this publication.

These guidelines were developed by the Adirondack Park Task Force which is comprised of representatives of the Adirondack Park Agency, the Department of Environmental Conservation, and Regions 1, 2, and 7 of the Department of Transportation. They serve as an interagency guide for the design, construction, and maintenance of highways, bridges and maintenance facilities within the Adirondack Park. The purpose of this document is to ensure the preservation and enhancement of the unique character of the Adirondack Park, which may require extra effort by the designer to ensure that the project fits harmoniously into the natural surroundings. These guidelines do not apply to projects on Interstate Route 87 within the Adirondack Park.

When the use of these guidelines results in a value less desirable than that listed as design criteria, a justification must still be prepared in accordance with Department policy for the use of the nonstandard feature. Part of this justification should be a reference to these guidelines.

2.3.5 **Americans with Disabilities Act Accessibility Guidelines (ADAAG)**

This document provides the minimum standards for the design of facilities that must be accessible for people with disabilities as required by the Americans with Disabilities Act (ADA). This document is referenced here because the legal requirement to design and construct all pedestrian facilities in accordance with its provisions may have a direct, unavoidable influence on other critical design elements of a project.

The standards in this document must be strictly adhered to unless a formal justification is provided in accordance with the standards. Departures from these standards should be discussed as nonstandard features. Be advised that the justification requirements are more strict than those discussed in Section 2.8.

2.3.6 **National Cooperative Highway Research Program (NCHRP)**

Numerous problems facing highway engineers and administrators are studied through this coordinated program of cooperative research conducted by the Transportation Research Board. Upon completion of the research, the problems and recommended solutions are presented in an NCHRP report. Information contained in these reports is considered to be the most current, nationally recognized data on the topic presented. The information contained in these reports is usually adopted in subsequent issuances of the design manuals that host the subject topic.

2.4 FUNCTIONAL CLASSIFICATION OF HIGHWAYS

Highways are classified by the character of service they provide. Freeways move high traffic volumes at high speeds with limited local access. Local roads and streets are intended to avoid high speed and volume for increased local access. Arterials and collectors provide intermediate service. The functional classification of a roadway is a major factor in determining the appropriate design criteria.

The Department's *Functional Classification Maps* and *Highway Inventory* should be referenced to determine the existing functional classification of the project roadway(s). This information is maintained by the Highway Data Services Bureau and is available from the Regional Planning & Program Management Group.

The functional classification terminology does not precisely match that used for design criteria. Judgement should be used to determine the appropriate design criteria category. For example, the Functional Classification Maps / Highway Inventory have categories that identify some routes as Urban - Principal Arterial - Expressway and Rural - Principal Arterial - Other, yet these roadways should normally be designed utilizing the design criteria for *Other Freeways* in Section 2.7.1.2 of this chapter. If the designer believes any of the project roadway classifications should be changed as a result of current or proposed conditions, they should consult the Regional Planning & Program Management Group to determine if the classification should be revised.

Because they have fundamentally different characteristics, urban and rural areas are classified separately. Project developers and designers have the responsibility to determine this classification. The design criteria classification selected should be made on the basis of the anticipated character of an area during the design life rather than political or urban area boundaries. If an area within an urban boundary, indicated on the Functional Classification Map, is rural in character and is anticipated to remain rural in character for most of the design life of the project, it should be designed utilizing rural criteria. Likewise if an area, within a rural boundary, is urban in character, such as a hamlet or village, or it is anticipated to become urban in character during the design life of the project, it should be designed utilizing urban criteria. Indicators of urban character for nonfreeways include:

- Sidewalks (observations of more than occasional pedestrian travel or the presence of development associated with more than occasional pedestrian travel)
- Bicycle usage
- Curbing
- Closed drainage systems
- Driveway densities greater than 15 driveways/km
- Minor commercial driveway densities of 6 driveways/km or greater
- Major commercial driveways
- Numerous right of way constraints
- High density of cross streets
- 85^{th} percentile speeds of 70 km/h or less

More than one of the above indicators is usually needed to classify an area as urban. The urban area boundaries, as shown on the Functional Classification Maps, should <u>not</u> be used to determine whether urban or rural design criteria applies. Areas that meet one or more of the above indicators but are not clearly urban in character may be considered suburban in character when this category is available (e.g., superelevation chart selection & interstate LOS). Otherwise, suburban areas should be considered as rural in character.

Table 2-1 serves as guide for selecting the appropriate design criteria category for a project based upon the functional classification as recorded on the *Functional Classification Maps* and *Highway Inventory*.

Table 2-1 Functional Classification of Highways - Various Sources[1]

Classification is based upon the service the highway is intended to provide and is dependent upon census data and urban boundaries		Classification determined by the designer based upon conditions anticipated during the design life of the project.[2]		
NYSDOT Highway Inventory & Functional Classification Maps		**Design Classification**	**Character (per HDM §2.4)**	**Criteria Section**
Description	**Code**			
Urban - Principal Arterial - Interstate	11	Interstate	Urban and Rural	2.7.1.1
Rural - Principal Arterial - Interstate	01			
Urban - Principal Arterial - Expressway	12	Other Freeways	Urban and Rural	2.7.1.2
Rural - Principal Arterial - Other	02			
Urban - Principal Arterial - Other	14	Arterial	Urban	2.7.2.2
Urban - Minor Arterial	16			
Rural - Principal Arterial - Other	02		Rural	2.7.2.1
Rural- Minor Arterial	06			
Urban - Collector	17	Collector	Urban	2.7.3.2
Rural Major Collector	07			
Rural Minor Collector [3]	08		Rural	2.7.3.1
Rural Local [3]	09	Local	Rural	2.7.4.1
Urban Local [3]	19		Urban	2.7.4.2

Notes:

1. This table presents the general relationship between the Functional Classifications and the Design Criteria. There may be situations where the association presented will not coincide as shown.
2. Classifications are based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004.
3. Classification that is typically not federal-aid eligible.
4. Highway Data Services Bureau maintains the official, most current, record of Highway Functional Classifications and National Highway System (NHS) designations.

2.4.1 **Interstates and Other Freeways**

2.4.1.1 Interstates

Interstate highways are freeways on the interstate highway system. Generally, they are interregional high-speed, high-volume, divided facilities with complete control of access.

2.4.1.2 Other Freeways

Other freeways are local, intraregional and interregional high-speed, divided, high-volume facilities with complete control of access. Most freeways have been classified as principal arterials.

Expressways are divided highways for through traffic with full or partial control of access and generally with grade separations at major crossroads. Section 2.7.1.2 Other Freeways applies to expressways and to multilane divided parkways, including parkways with occasional at-grade intersections.

2.4.2 **Arterials**

2.4.2.1 Rural Arterials

A major part of the rural highway system consists of rural arterials, which range from two-lane roadways to multilane, divided, controlled-access facilities. Generally, they are high-speed roadways for travel between major points.

2.4.2.2 Urban Arterials

Urban arterials generally carry large traffic volumes within and through urban areas. They vary from multilane, divided, controlled-access facilities to two-lane streets. They serve major areas of activity, carrying a high proportion of an area's traffic on a small proportion of the area's lane mileage.

2.4.3 **Collector Roads and Streets**

Collectors serve a dual function. They collect and distribute traffic while providing access to abutting properties.

2.4.3.1 Rural Collectors

Rural collectors are two-lane roadways connecting roadways of higher classification, larger towns, and smaller communities. They link local traffic generators with rural areas.

2.4.3.2 Urban Collectors

Urban collector streets link neighborhoods or areas of homogeneous land use with arterial streets. They serve the dual function of land access and traffic circulation.

2.4.4 **<u>Local Roads and Streets</u>**

2.4.4.1 Local Rural Roads

Local rural roads are primarily town and county roads. Their primary purpose is access to the abutting property. They constitute a high proportion of the highway mileage but service a low proportion of the traffic volume.

2.4.4.2 Local Urban Streets

Local urban streets are primarily village and city streets. Their primary purpose is access to abutting property.

2.4.5 **<u>Other Roadways</u>**

The roadways defined in this section are not considered a functional classification. They have a different function than the highways discussed in the classifications above, and are defined here so the appropriate design criteria can be determined.

2.4.5.1 Parkways

These are usually divided highways for noncommercial traffic with full control of access, grade separations, interchanges, and occasional at-grade intersections. Parkways are designated by law.

2.4.5.2 Ramps

Ramps are turning roadways that connect two or more legs of an interchange. They may be multilane.

2.4.5.3 Speed-Change Lanes

A speed-change lane is an auxiliary lane, primarily for the acceleration or deceleration of vehicles entering or leaving through traffic.

2.4.5.4 Turning Roadways

Turning roadways are separate connecting roadways at intersections.

2.4.5.5 Collector - Distributor Roads

Collector - distributor roads are auxiliary roadways within or between interchanges. The purpose of these roadways is to remove weaving traffic from the mainline and to minimize entrances and exits.

2.4.5.6 Frontage Roads

Frontage or service roads are auxiliary roadways along controlled access facilities. They provide access to adjacent property.

2.4.5.7 Climbing Lanes

Climbing lanes are auxiliary lanes provided for slow-moving vehicles ascending steep grades. They may be used along all types of roadways.

2.4.5.8 Intersections

Intersections are covered in Chapter 5 of this manual.

2.5 PROJECT DATA

The following items are factors in determining the values of some of the critical design elements.

2.5.1 **<u>Traffic</u>**

2.5.1.1 Traffic Volume

Traffic volume directly affects the geometric features selected for design of highway and bridge projects. The general unit of measure for traffic on a highway is the two-way, average daily traffic (ADT), defined as the total volume during a given time period (in whole days), greater than one day and less than one year, divided by the number of days in that time period. The ADT volume utilizing a time period of one year is referred to as the two-way, annual average daily traffic (AADT). An hourly traffic volume is also used for design purposes. The unit of measure for this traffic is the two-way, design-hour volume (DHV) which is usually represented by the 30th highest hourly volume of the year chosen for design. This volume is adjusted to provide a one-way, directional design-hour volume (DDHV). Refer to Chapter 5, Section 5.2 of this manual for additional information on traffic data.

2.5.1.2 Trucks and Other Heavy Vehicles

For consistency with the definition in AASHTO's *A Policy on Geometric Design of Highways and Streets*, the term "trucks" used in this chapter refers to <u>all</u> heavy vehicles. The *Highway Capacity Manual* defines heavy vehicles as vehicles having more than four tires touching the pavement and include trucks, buses, and recreational vehicles. Trucks impose a greater effect on a highway or bridge than passenger cars do. Truck volumes are generally addressed as follows:

- A very low percentage of trucks is considered to be 2% or less.
- A high percentage of trucks is considered to be 10% or more. For the interstates and other freeways, a DDHV of 250 vph is used to indicate a high percentage of trucks.

2.5.1.3 Traffic Design Year

Highway and bridge design should be based on traffic volumes that are expected to occur within the expected service life of the project. The year chosen for design must also be no further ahead than that for which traffic can be estimated with reasonable accuracy. Refer to Appendix 5 Design Year Traffic Forecasts of the *Project Development Manual* to determine the appropriate design year for the project.

2.5.1.4 Speed Studies

Speed studies provide an essential measure for evaluating highway geometry. The speed study results may also serve as the basis for selecting a design speed within the acceptable range for the highway's functional class (refer to Section 2.6.1 of this chapter for a discussion of design speed). Consult Chapter 5, Section 5.2.4 of this manual for more information on speed studies and terminology.

2.5.2 **Terrain**

The topography of the land traversed has an influence on the horizontal and vertical alignment of a highway. The terrain classifications pertain to the general character of a specific route corridor. For design purposes, variations in topography are categorized by terrain, utilizing the definitions in AASHTO's *A Policy on Geometric Design of Highways and Streets*:

- Level Terrain - That condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expenses.
- Rolling Terrain - That condition where the natural slopes consistently rise above and fall below the road or street grade and where occasional steep slopes offer some restriction to normal horizontal and vertical roadway alignment.
- Mountainous Terrain - That condition where longitudinal and transverse changes in the elevation of the ground with respect to the road or street are abrupt and where benching and side hill excavation are frequently required to obtain acceptable horizontal and vertical alignment.

2.5.3 **Special Routes**

There are special routes designated to serve specific purposes as shown below.

2.5.3.1 Strategic Highway Corridor Network (STRAHNET)

The United States Department of Defense has a program called Highways for National Defense (HND) to ensure the mobility of United States Forces during national defense operations. To support this program, a Strategic Highway Corridor Network (STRAHNET) was established. The STRAHNET includes highways which are important to the United States Strategic Defense Policy and which provide defense access, continuity, and emergency capabilities for the movement of personnel, materials, and equipment in both peacetime and war time. This system consists of all interstate and some noninterstate highways. The minimum vertical clearance on these routes is 4.9 m. Refer to Section 2 of the Bridge Manual for information on the 4.9 m vertical clearance routes *[note: sections of the interstate system have been exempted from the vertical clearance requirements]*. The Highway Data Services Bureau of the Technical Services Division maintains the designation and map information concerning the STRAHNET system.

2.5.3.2 Designated Qualifying and Access Highways

The 1982 Federal Surface Transportation Assistance Act (STAA) and the State 1990 Truck Safety Bill provided regulations concerning a system of reasonable access routes for special dimension vehicles. Minimum travel lane widths of 3.6 m must be provided along Designated Qualifying Highways. Minimum travel lane widths of 3.0 m are required along Designated Access Highways and for routes within 1.6 km of Qualifying Highways. The Traffic Engineering and Highway Safety Groups maintain a listing of all designated highways in the publication *Official Description of Designated Qualifying and Access Highways in New York State*.

2.5.3.3 Bicycle Routes

Bicycle routes are distinguished by their designation and signing as preferred routes through high demand corridors. The surface treatments and lane widths required are especially important to assure the usability of designated bicycle routes. Refer to Chapter 18 of this manual for further guidance.

2.5.3.4 National Highway System (NHS)

This system was established after passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and was approved by Congress in 1995. The NHS is separate and distinct from the functional classification system. The NHS consists of interconnected urban and rural highways (including toll facilities) which serve major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities, and other major travel destinations; meet national defense requirements; or serve interstate and interregional travel. Although limited in number, there are segments of local highways and rural minor collectors that are classified as part of the NHS. All routes on the Interstate System are a part of the National Highway System. The NHS is designated on functional classification maps maintained by the Highway Data Services Bureau. Maps are available in the Regional Planning and Program Management Group. The routes can also be identified on FHWA's website.

2.6 CRITICAL DESIGN ELEMENTS

The seventeen (17) items discussed in this section are defined as the critical design elements. Usually, minimum or maximum values are specified for these elements.

2.6.1 **Design Speed**

Design speed is a selected speed used to determine the various geometric design features of the roadway. The design speed should be a logical one with respect to the functional classification of highway, anticipated off-peak 85th percentile speed, topography, the adjacent land use, and any planned improvements for the facility, including future projects on adjacent segments. Once selected, many of the critical elements of the highway are related to the design speed.

There are important differences between the design criteria applicable to low- and high-speed designs. AASHTO's *A Policy on Geometric Design of Highways and Streets*, defines the upper limit for low-speed at 70 km/h and the lower limit for high-speed at 80 km/h (i.e., low-speed $\leq$ 70 km/h & high speed $\geq$ 80 km/h). Project design speeds are to be rounded to the nearest 10 km/h value and should, therefore, fall within one of these two categories.

2.6.1.1 Selecting a Design Speed

The design speed is either:

- the maximum functional class speed or
- a speed based on the anticipated off-peak 85th percentile speed within the range of functional class speeds.

The selected design speed is to be approved by the Regional Traffic Engineer. For freeways, the design speed shall equal or exceed the regulatory speed limit in every case. Scoping documents, design approval documents, etc., should contain the basis for the design speed. The anticipated off-peak 85th percentile speed is to be based on:

- Existing off-peak 85th Percentile Speed - Refer to Section 2.5.1.4 of this chapter and Chapter 5, Section 5.2.4 of this manual for definitions and acceptable methods. For new facilities, the anticipated off-peak 85th percentile speed may be based on the speeds of facilities with similar classifications, geometry, and traffic characteristics.
- Improvements - Since speeds often increase when there is a new pavement surface and when geometric improvements are made, engineering judgement should be exercised in determining the reasonableness and applicability of using an existing off-peak 85th percentile speed that is below the maximum functional class speed.
- Traffic Calming - Refer to Chapter 25 of this manual for requirements and guidance.

Note: A nonstandard design speed is NOT to be used. Design speed is considered the core critical design element from which other criteria are developed (Ref. 23 CFR 625). A nonstandard design speed cannot be justified since a reduction in the design speed effectively lowers several speed-related critical design elements, which must be justified individually.

2.6.1.2 Design Speed Segments

The use of different design speeds for continuous segments of a facility should be kept to a minimum to better assure consistency of design features such as vertical and horizontal alignment. However, significant changes in highway environment or terrain may necessitate a different design speed for different highway segments within the project (i.e., rural vs. urban, flat vs. mountainous, a large change in side road or driveway density, a large change in building offsets, etc.).

2.6.2 **Lane Width**

The highway lane is the portion of the traveled way used for a single line of vehicles. Wide curb lanes in urban areas are designed to accommodate bicycles and motor vehicles simultaneously. Refer to Chapter 18 of this manual and Section 2.7 of this chapter.

2.6.3 **Shoulder Width**

The shoulder is the portion of the roadway contiguous with the traveled way. Narrow shoulders less than 1 m wide adjacent to curbing are sometimes called curb off-sets. Shoulders may provide for:

- Evasive maneuvers.
- Reduced driver stress.
- Storm water flow in curbed and gutter sections.
- Stopped vehicles.
- Mail delivery.
- Maintenance and protection of traffic.
- Maintenance operations such as snow removal.
- Oversized vehicles.
- Bicycle and pedestrian use.
- Emergency use.
- Structural support of subbase and surface courses.

The width of shoulder is the actual width that can be used for an evasive maneuver. Areas behind curbing (turfed, stabilized, or paved) are not considered part of the shoulder since the edge of the useable shoulder must be flush with the traveled way. Therefore, curbs located closer to the edge of the traveled way than the required shoulder width require the shoulder to be justified as a nonstandard feature. The area behind curbing (turfed, stabilized, or paved) may be useful for disabled vehicles and as part of the clear zone.

Interstate and other freeway shoulders are to be fully paved. As an exception, historic parkways classified as freeways require paving only for the first 1.2 m of shoulder.

Nonfreeway shoulders may be either fully or partially paved or stabilized. Generally, the entire shoulder width is paved. In curbed areas the entire shoulder is to be paved.

2.6.4 **Bridge Roadway Width (Clear Roadway Width of Bridge)**

A bridge is a structure, including supports, erected over a depression or an obstruction such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 6.1 m. The bridge roadway width is the clear distance between inside faces of bridge railing, or the clear distance between faces of curbs, whichever is less. The bridge roadway width includes travel lanes, areas flush with the travel lanes (turn lanes, flush medians, shoulders, curb offsets, parking lanes, and bike lanes), and the Department's standard 125 mm wide brush curb introduced at the bridge. Bike paths, sidewalks, safety walks, and curbing for sidewalks or safety walks are not part of the bridge roadway width.

2.6.5 **Grade**

The maximum grade is the maximum allowable rate of change in vertical alignment of a highway. Since the rate of grade has a direct effect on the operating speed of vehicles on a highway, the maximum grade is chosen to encourage uniform operating speeds throughout the traffic stream while providing a cost-effective design. Refer to Chapter 5, Section 5.7.4.1 of this manual for a discussion of minimum grades to accommodate drainage.

2.6.6 **Horizontal Curvature**

The minimum radius is a limiting value of curvature for a given design speed and is determined from the maximum rate of superelevation and the maximum side-friction factor selected for design. The highway and turning roadway radii used for curve and superelevation design is measured from the inner edge of the traveled way. On two-lane facilities, the radius may be measured to the centerline of the two travel lanes as the difference in radii is small. Note that the radius shown on plan sheets is for construction purposes and is measured to the horizontal control line, which often follows the roadway centerline or the median edge of traveled way.

2.6.7 **Superelevation**

Superelevation is the cross slope of the pavement at a horizontal curve, provided to partially counterbalance the centrifugal force on a vehicle going around that curve. A number of factors influence the maximum allowable rate of superelevation, including climate and area type (i.e., urban, suburban, or rural). For freeways and rural facilities, an 8% maximum rate is used to provide the maximum safety benefit while minimizing the potential low-speed operational problems on ice and snow.

Higher rates of superelevation are undesirable:

- In urban areas due to impact on building fronts, drainage, sidewalks, and driveways.
- For segments with wide variations in travel speeds, common on high-volume, urban and suburban facilities.

In suburban areas, a 6% maximum superelevation rate may be used. In urban areas, a 4% superelevation rate is used (except on interstates, other freeways, expressways, parkways, and ramps). The actual superelevation provided for each curve is determined using the appropriate e_{max} table (Tables 2-11 through 2-14) referenced in Section 2.7 of this chapter. Table 2-11 is for use on urban streets since it minimizes the use of superelevation by maximizing the use of side friction (refer to Method 2 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004). Tables 2-12 through 2-14 use superelevation to gradually increase the side friction demand (refer to Method 5 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004). When curves occur on grades steeper than 5%, refer to Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004 for further guidance.

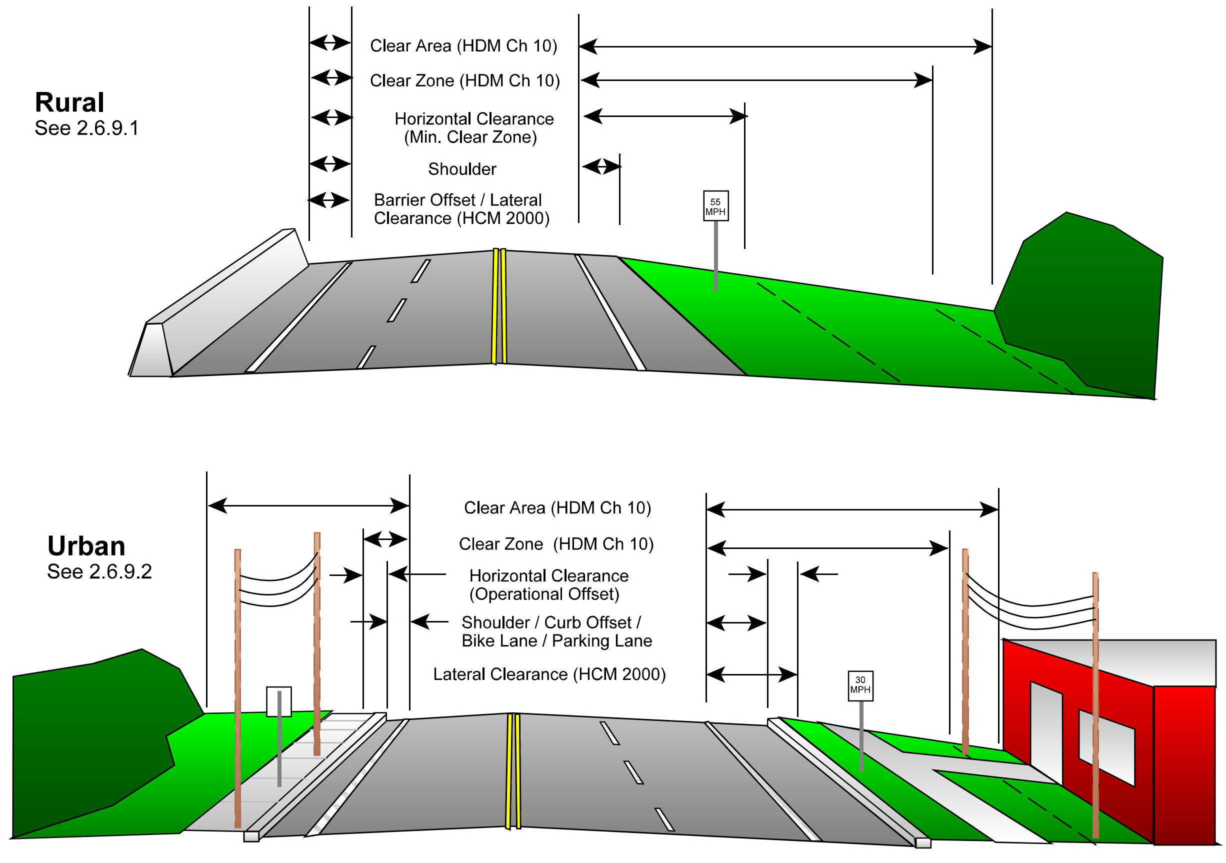
2.6.8 **Stopping Sight Distance (Horizontal and Vertical)**

Sight distance is the length of roadway ahead visible to the driver. The minimum sight distance available on a roadway should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. There are three types of stopping sight distance. These are stopping sight distance for crest vertical curves, stopping sight distance for sag vertical curves (also called "headlight sight distance"), and stopping sight distance for horizontal curves.

The effect of grades on vertical curve stopping sight distance is not considered when determining the minimum values. For two-way facilities the sight distance available on downgrades is generally larger than on upgrades. The unadjusted stopping sight distance, more or less, provides an average of the downgrade and upgrade values. For one-way roadways without wide shoulders or multiple travel lanes to accommodate evasive maneuvers, an adjustment for grade is desirable.

The effect of concrete barriers and other visual obstructions must be considered when determining horizontal sight distance. A concrete barrier placed on the inside of a horizontal curve will restrict sight distance around that curve. This is a common problem on curvilinear freeways. Refer to Chapter 5 of this manual, Section 5.7.2 for additional information on sight distance.

Figure 2-1 Horizontal Clearance



Note: Terms based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, unless otherwise noted.

2.6.9 Horizontal Clearance

Horizontal clearance is a segment of the road section lying adjacent to the traveled way, identified as an operational offset in urban areas and for rural areas identified as a portion of the "clear zone" (defined in Chapter 10 of this manual as an area for recovery of errant vehicles). It does not replace the need to select a clear zone in accordance with Chapter 10 of this manual that will generally be substantially wider than the horizontal clearance criteria in this chapter. A more detailed description of what features are allowed within these two categories follows. See Figure 2-1.

2.6.9.1 Interstates, Other Freeways, Expressways, Rural Arterials, Rural Collectors, and Local Rural Roads

Horizontal clearance serves as an extension of the shoulder and provides allowance for recovery of errant vehicles, disabled vehicles, parking, etc. Curbs, traversable slopes, breakaway supports, etc., are permitted within the horizontal clearance. Fixed objects, nontraversable slopes, etc., are not permitted. The width is measured from the edge of traveled way. It includes shoulders or auxiliary lanes (e.g., speed change lanes, climbing lanes, turning lanes).

2.6.9.2 Urban Arterials, Urban Collectors, and Local Urban Streets

Horizontal clearance functions as an "operational" offset that minimizes restrictions to traffic flow and provides space for opening car doors, the lateral clearance affecting capacity and vehicle position within a lane, and vehicle overhangs at intersections. The area within the horizontal clearance is to be an unobstructed, relatively flat area provided beyond the edge of traveled way. Obstructions include sign posts, lighting posts, poles, hydrants, trees, bollards, etc. The width is measured from the face of curb.

2.6.9.3 Turning Roadways

Along turning roadways, horizontal clearance functions as a portion of the clear zone that minimizes restrictions to traffic flow and provides space for the lateral clearance and vehicle position within a lane, disabled vehicles, and vehicle overhangs during turning movements. The area within the horizontal clearance is to be an unobstructed, relatively flat area provided beyond the edge of traveled way. Obstructions include sign posts, lighting posts, poles, hydrants, trees, bollards, etc. The width is measured from the edge of traveled way.

2.6.10 **Vertical Clearance**

Vertical clearance is the minimum vertical clear distance to an obstruction over any part of the traveled way and shoulders. See the Bridge Manual Section 2 for specific design criteria.

2.6.11 **Travel Lane Cross Slope**

Travel lane cross slope is the minimum value of sustained transverse slope of a travel lane. For tangent sections of the traveled way this cross slope is commonly called "normal crown." The purpose of travel lane cross slope is to provide positive drainage from the pavement.

2.6.12 **Rollover**

Rollover is the measure of the difference in cross slope between two adjacent highway lanes or a highway lane and its adjacent shoulder.

2.6.13 **Structural Capacity**

Structural capacity is the ability of a bridge to carry its dead load and a given live load. The live load (which includes impact effects), is expressed in terms of standard AASHTO truck configurations or equivalent uniform lane loads.

2.6.14 **Level of Service**

Level of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. Level of service is described by a letter grade from A (best) to F (worst). Level of service is a critical design element only for interstate highways. Refer to Chapter 5 of this manual, Section 5.2.2 for additional information on level of service.

2.6.15 **Control of Access**

Control of access is defined as the regulated limitation of access rights to and from properties abutting the highway facilities. Control of access is measured by the degree to which access is controlled, that is, fully controlled, partially controlled, or uncontrolled. Control of access is a critical design element only for interstate highways, other freeways, ramps, and a portion of the cross road or service road at the ramp terminal. The control of access for interstates and other freeways is discussed in Appendix 8 of the *Project Development Manual*. The control of access at ramp terminals is discussed in Chapter 6 of this manual.

2.6.16 **Pedestrian Accommodation**

Pedestrian accommodation is defined as the provision of facilities to ensure safe pedestrian movement within and through the project area and consists of sidewalks, ramps, pedestrian crossings, and other design facilities. Pedestrian accommodation is a critical design element for all highway construction / reconstruction projects except in areas where:

- Pedestrians are prohibited by law from using the roadway.
- The project exists in an area with a low population and a lack of pedestrian generators which indicates the absence of a need for pedestrian facilities, and the project is not considered likely to promote the development of such pedestrian generators (i.e., secondary development) within the life cycle of the project.

The standards for pedestrian accommodations are concerned with the usability of those accommodations by persons with disabilities and established by the United States Access Board in the *Americans with Disability Act Accessibility Guidelines (ADAAG)*. The standards and other requirements found in ADAAG must be strictly adhered to unless a formal justification is provided in accordance with the provisions prescribed in the document. Departures from the ADAAG standards and other requirements should be discussed as nonstandard features. The ADAAG nonstandard justification presentation requires more analysis than required under Section 2.8 of this chapter. Refer to Chapter 18 of this manual for guidance.

If pedestrians will not be accommodated in a Department project other than in circumstances described above, it is a variance from Department policy and requires documentation of justification of nonconforming features as described in Chapter 5.1 of this manual.

2.6.17 **Median Width**

A median is defined as the portion of a divided highway separating the traveled way for traffic traveling in opposing directions. The median width is expressed as the dimension between the through-lane edges and includes the left shoulders, if any. Median width is a critical design element only for interstates, other freeways, and multilane divided rural arterials.

An arterial is not normally considered to be divided unless two travel lanes are provided in each direction of travel and the median has a width of 1.2 m or more and contains a barrier, turf, raised sections, or lowered sections to preclude its use by motorists, except in emergencies or where the median is specifically designed to allow for left turns.

2.7 STANDARDS

This section provides the standard values for the critical design elements.

The values are provided for each functional classification, with further division of arterials, collectors, and local roads for rural and urban conditions, similar to the format of AASHTO's *A Policy on Geometric Design of Highways and Streets*. In addition, values are provided for other roadways such as parkways, ramps, speed change lanes, turning roadways, climbing lanes, collector-distributor roadways and frontage roads. When these values are not met, concurrence with nonstandard features must be obtained from FHWA, the Deputy Chief Engineer, or the Regional Director as described in Section 2.8 of this chapter and in the *Project Development Manual*.

The values shown are the minimum or maximum values or other parameters as applicable. In some cases further refinement of the values, dependent on certain conditions, are provided.

Desirable values are also provided for a few of the critical design elements (wider shoulders on certain interstates and other freeways, curb offsets on urban streets and turning lanes). Whenever practicable, considering factors such as cost limitations and social, economic, and environmental impacts, the designer should strive to achieve the desirable or other levels better than the minimum or maximum values shown.

It is intended that the minimum widths be used for travel lanes and shoulder widths, except for the desirable wider shoulders noted on certain interstates and other freeways.

There are technical discrepancies between the metric and U.S. customary values in AASHTO's *A Policy on Geometric Design of Highways and Streets*. Guidance on this issue is provided in Section 2.8.2 of this chapter.

The values for bridge widths are established by the NYSDOT Bridge Manual Section 2. They are influenced by future plans for the adjacent highway and should be considered both the minimum acceptable and the desirable values.

The values for design of pedestrian accommodations that must be accessible to persons with disabilities are established by the United States Access Board in the Americans with Disability Act Accessibility Guidelines (ADAAG). Refer to Chapter 18 of this manual for further guidance.

2.7.1 **<u>Interstates and Other Freeways</u>**

2.7.1.1 Interstates

The design criteria for interstate highways are detailed in sections A to P below.

A. Design Speed

The design speed shall be either the maximum speed for the area character and terrain or a speed based on the anticipated off-peak 85th percentile speed within the range of speeds for the area character and terrain. Refer to Section 2.6.1 for guidance on design speed and Chapter 5 of this manual, Section 5.2.4 for methods to determine the off-peak 85th percentile speed. The following are the range of design speeds based on the area character and terrain.

Area Character	**Terrain**	**Minimum Design Speed** (km/h)	**Maximum Design Speed** ✴ (km/h)
Rural	Level	110	110
Rural	Rolling	110	110
Rural	Mountainous	80	100
Urban	All	80	110

✴ For consistency with adjacent sections and anticipated off-peak 85th percentile speeds higher than the maximum values tabulated above, a 120 km/h maximum speed may be used for rural (level & rolling) freeways and a 110 km/h maximum speed may be used for rural mountainous freeways.

B. Lane Width

Travel lanes = 3.6 m minimum.

C. Shoulder Width

Determine from Table 2-2.

D. Bridge Roadway Width

Determine from NYSDOT Bridge Manual, Section 2.

E. Grade

Determine maximum from Table 2-2.

F. Horizontal Curvature

Determine minimum radius from Table 2-2. For curves flatter than the minimum radius, the radius and superelevation on each horizontal curve shall be correlated with the design speed in accordance with the appropriate e_{max} table (Table 2-13 for $e_{max.}$ = 6% or Table 2-14 for $e_{max.}$ = 8%).

G. Superelevation

8% maximum. A 6% maximum may be used in urban and suburban areas to minimize the effect of negative side friction during peak periods with low travel speeds.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum distances from Table 2-2.

I. Horizontal Clearance

The minimum horizontal clearance to obstructions (measured from the edge of traveled way) is 4.6 m where no barrier is provided. Where barrier is provided, the minimum is the shoulder width but never less than 1.2 m, except:

- On bridges where the NYSDOT Bridge Manual, Section 2 allows less than 1.2 m.
- In depressed sections where the minimum is the shoulder width plus 0.6 m.

J. Vertical Clearance

Determine minimum from NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

Travel lanes = 1.5% minimum to 2% maximum.

L. Rollover

Between travel lanes = 4% maximum. At edge of traveled way = 8% maximum. When the superelevation rate exceeds 6%, a maximum rollover rate of 10% at the edge of traveled way may be permitted. Refer to Chapter 3, Section 3.2.5.1 Shoulder Cross Slopes and Rollover Limitations of this manual for further guidance.

M. Structural Capacity

Determine from NYSDOT Bridge Manual, Section 2.

N. Level of Service (LOS)

A minimum of four traffic lanes shall be provided on the Interstate System. The number of lanes shall be sufficient to accommodate the selected DDHV (directional design hourly volume) at an acceptable level of service as listed below, and shall be determined on the basis of design year volumes. On ascending grades which exceed the critical design length, a climbing lane analysis shall be made in accordance with TRB's *Highway Capacity Manual*, and AASHTO's *A Policy on Geometric Design of Highways and Streets*, and climbing lanes added where warranted.

The following levels of service are the criteria for interstates:

Rural, level terrain	LOS = B minimum
Rural, rolling terrain	LOS = B minimum
Rural, mountainous terrain	LOS = C minimum
Urban and suburban *	LOS = C minimum

* **Note:** In heavily developed sections of metropolitan areas, conditions may necessitate LOS = D minimum. Scoping and design approval documents should include documentation of the heavily developed metropolitan area conditions.

Some interstate projects, especially in urban areas, will provide levels of service below those shown above due to social, economic, and environmental and/or policy/intergovernmental decisions during project scoping and design. Such decisions for lesser levels of service should be made in accordance with National Environmental Policy Act (NEPA) and/or State Environmental Quality Review Act (SEQR) procedures and, where applicable, with the Major Metropolitan Transportation Investment process. These decisions should be supported and documented in the design approval documents.

O. Control of Access

Access to the interstate system shall be fully controlled. Access is to be achieved by interchanges at selected public highways. Access control shall extend the full length of ramps and terminals on the crossroad. Such control shall either be acquired outright prior to construction or by the construction of frontage roads or by a combination of both.

Control for connections to the crossroad should be provided beyond the ramp terminals by purchasing access rights or providing frontage roads. Such control should extend beyond the ramp terminal at least 30 m in urban areas and 90 m in rural areas (see Chapter 6 of this manual for more specific details).

The interstate highway shall be grade separated at all railroad crossings and selected public crossroads. All at-grade intersections of public highways shall be eliminated. To accomplish this the connecting roads are to be terminated, rerouted, or intercepted by frontage roads.

P. Median Width

Medians in rural areas in level or rolling terrain shall be at least 11.0 m wide and desirably 15 m - 30 m wide. Medians in mountainous terrain or in urban areas shall be at least 3.0 m wide.

2.7.1.2 Other Freeways

The design criteria for freeways other than interstates is the same as Section 2.7.1.1 Interstates with the exception of Section 2.7.1.1N Level of Service, which is not a standard for other freeways.

Table 2-2 Design Criteria for Interstates and Other Freeways

Shoulders [1]		
Description	**Width, m** Minimum	Desirable
Right side:		
General	3.0	3.0
In mountainous terrain involving high cost for additional width	2.4	3.0
For noninterstate parkways that exclude truck and bus traffic	2.4	3.0
Where trucks exceed 250 DDHV (directional design hourly volume)	3.0	3.6
Left side:		
General	1.2	1.2
For interstates of six or more lanes	1.2	3.0
For interstates of six or more lanes where trucks exceed 250 DDHV	1.2	3.6

Design Speed (km/h)	Maximum Percent Grade			Minimum Stopping Sight Distance, m	Minimum Radius Curve, m e_{max} = 6%	Minimum Radius Curve, m e_{max} = 8%
	Level [2]	Rolling [2]	Mountainous			
80	4	5	6	130	252	229
90	4	5	6	160	336	304
100	3	4	6	185	437	394
110	3	4	5	220	560	501
120	3	4	-	250	756	667

Notes:
1. For bridges, determine the shoulder width from the NYSDOT Bridge Manual, Section 2.
2. Grades 1% steeper may be used for one-way downgrades and for extreme cases in urban areas where development precludes the use of flatter grades.

2.7.2 **Arterials**

2.7.2.1 Rural Arterials

The design criteria for undivided and divided rural arterials are:

A. Design Speed

The design speed shall be either the maximum speed for the terrain or a speed based on the anticipated off-peak 85th percentile speed within the range of speeds for the terrain. Refer to Section 2.6.1 of this chapter for guidance on design speed and Chapter 5, Section 5.2.4 of this manual for methods to determine the off-peak 85th percentile speed. The range of design speeds based on the terrain are:

Terrain	Minimum Design Speed	Maximum Design Speed
Level	60 km/h	110 km/h
Rolling	60 km/h	100 km/h
Mountainous	60 km/h	80 km/h

B. Lane Width

Determine from Table 2-3.

C. Shoulder Width

Determine from Table 2-3.

D. Bridge Roadway Width

Determine from NYSDOT Bridge Manual, Section 2.

E. Grade

Determine maximum from Table 2-3.

F. Horizontal Curvature

Determine minimum radius from Table 2-3. For curves flatter than the minimum radius, the radius and superelevation on each horizontal curve shall be correlated with the design speed in accordance with the appropriate e_{max} table (Table 2-13 for $e_{max.}$ = 6% or Table 2-14 for $e_{max.}$ = 8%).

G. Superelevation

8% maximum. A 6% maximum may be used in suburban areas to minimize the effect of negative side friction during peak periods with low travel speeds.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum distances from Table 2-3.

I. Horizontal Clearance

The minimum horizontal clearance to obstructions (measured from the edge of traveled way) is 3.0 m where no barrier is provided. Where barrier is provided, the minimum is the shoulder width but never less than 1.2 m, except on bridges where the NYSDOT Bridge Manual, Section 2 allows less than 1.2 m.

J. Vertical Clearance

Determine minimum from NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

1.5% minimum to 2% maximum.

L. Rollover

Between travel lanes = 4% maximum.

At edge of traveled way = 8% maximum. When the superelevation rate exceeds 6%, a maximum rollover rate of 10% at the edge of traveled way may be permitted. Refer to Chapter 3, Section 3.2.5.1 Shoulder Cross Slopes and Rollover Limitations of this manual for further guidance.

M. Structural Capacity

Determine from NYSDOT Bridge Manual, Section 2.

N. Pedestrian Accommodation

To assure access for persons with disabilities, pedestrian facilities shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities*.

O. Median Width (only for multilane, divided, rural arterials)

Median = 1.2 m minimum without left turn lanes. Where left turn lanes are provided, the median = 3.6 m minimum (3.0 m left turn lane with 0.6 m median separation).

Table 2-3 Design Criteria for Rural Arterials

Design speed (km/h)	Travel Lane Width (m) [1,2,3] Design Year ADT				Maximum % Grade			Min. Stopping Sight Distance (m)	Min. Radius Curve (m) e_{max}= 6%	Min. Radius Curve (m) e_{max}= 8%
	ADT Under 400	ADT 400 to 1500	ADT 1500 to 2000	ADT over 2000	Level	Rolling	Moun-tainous			
60	3.3	3.3	3.3	3.6	5	6	8	85	123	113
70	3.3	3.3	3.3	3.6	5	6	7	105	184	168
80	3.3	3.3	3.6	3.6	4	5	7	130	252	229
90	3.3	3.3	3.6	3.6	4	5	6	160	336	304
100	3.6	3.6	3.6	3.6	3	4	6	185	437	394
110	3.6	3.6	3.6	3.6	3	4	5	220	560	501

Shoulder Width (m) [3]				
Un-divided (right shoulder)	1.2	1.8	1.8	2.4
Divided [5]	Right shoulder = 2.4 Left shoulder = 1.2			

Notes:
1. Width of travel lane may remain 3.3 m on reconstructed highways where accident history is satisfactory and the route is not designated as a Qualifying Highway.
2. Routes designated as Qualifying Highways on the national network of Designated Truck Access Highways require 3.6 m travel lanes.
3. For bridges, determine the lane and shoulder width from the NYSDOT Bridge Manual, Section 2.
4. For turning lanes, use Table 2-4 of this chapter.
5. Refer to Section 2.6.17 of this chapter for a definition of divided.

2.7.2.2 Urban Arterials

The design criteria for urban arterials are:

A. Design Speed

The design speed shall be either the maximum speed for the area character or a speed based on the anticipated off-peak 85th percentile speed within the range of speeds for the area character. Refer to Section 2.6.1 of this chapter for guidance on design speed and Chapter 5, Section 5.2.4 of this manual for methods to determine the off-peak 85th percentile speed. The range of design speeds based on the area character are:

Area Character	**Minimum Design Speed**	**Maximum Design Speed**
Suburban and Developing Areas	60 km/h	100 km/h
Central Business District	50 km/h	100 km/h

B. Lane Width

Determine from Table 2-4.

C. Shoulder Width

Determine from Table 2-4.

D. Bridge Roadway Width

Determine from NYSDOT Bridge Manual, Section 2.

E. Grade

Determine maximum from Table 2-4.

F. Horizontal Curvature

Determine minimum radius from Table 2-4. For curves with radii larger than the minimum radius, the radius of curve and superelevation on each horizontal curve shall be correlated with the design speed in accordance with Table 2-12 for $e_{max} = 4\%$. The superelevation distribution in this table provides a gradual increase in the unresolved lateral forces on a vehicle as the curve radii decreases. This distribution of superelevation is based on Method 5 in Chapter III of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004. |

For low-speed (70 km/h and below) urban streets in heavily built-up residential, commercial, and industrial areas (where building fronts, drainage, sidewalks, or driveways would be substantially impacted by added superelevation), the use of superelevation can be minimized by placing greater reliance on side friction to counter lateral acceleration. This distribution of superelevation is based on Method 2 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004. Below are the minimum radii at 4% superelevation using this method. |

Design Speed (km/h)	Minimum Curve Radius ($e_{max} = 4\%$) (m)
30	22
40	47
50	86
60	135
70	203

For radii larger than the above minimum radius for $e_{max} = 4\%$, determine the superelevation rate using Table 2-11.

G. Superelevation

4% maximum.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum and desirable from Table 2-4.

I. Horizontal Clearance

The minimum horizontal clearance to obstructions (measured from the face of curb) is 0 m if barrier is provided, 0.5 m in areas without barrier, and 1 m at intersections.

J. Vertical Clearance

Determine minimum from NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

Travel lanes = 1.5% minimum to 2% maximum.

Parking lanes = 1.5% minimum to 5% maximum.

L. Rollover

Between travel lanes = 4% maximum.

At edge of traveled way = 8% maximum.

M. Structural Capacity

Determine from the NYSDOT Bridge Manual, Section 2.

N. Pedestrian Accommodations

To assure access for persons with disabilities, pedestrian facilities shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.*

Table 2-4 Design Criteria for Urban Arterials

Lanes[1]	Width (m)	
Travel Lanes -	Minimum	Desirable
Low speed (<80 km/h)	3.3	-
High speed (≥80 km/h)	3.6	-
For highly restricted areas with no or little truck traffic (0 to 2%)	3.0	-
Routes designated as Qualifying Highways on the national network of Designated Truck Access Highways	3.6	-
Wide travel lane adjacent to curbing or parking lane to accommodate bicyclists in low-speed segments [2]	3.6	4.2
Turning Lanes -		
Left and Right for principal arterials (truck volume ≤ 2%)	3.0	3.6
Truck volume > 2%	3.3	3.6
Continuous median left turn lanes	3.3	4.8
Parking Lanes -		
Future provision for travel lane	3.3	3.6
Future provision for turn lanes	3.0	3.6
Future provision for turn lane on 60 km/h or less arterial	2.7	3.6
No future provisions for turn lanes	2.4	3.6
Shoulders[1]	**Width (m)**	
Curbed -	Minimum	Desirable
Left shoulder for divided arterials	0	0.3 - 0.6
Right shoulder with no accommodation for bicyclists [2], breakdowns, turning movements, etc.	0	0.3 - 0.6
Right shoulder for bicycling [2], lateral offset, etc.	1.5	-
Right shoulder for breakdowns and turning movements in addition to bicycling, lateral offset, etc.	1.8	3.0
Uncurbed -	Refer to Table 2-3	

Design Speed (km/h)	Maximum Percent Grade			Minimum Stopping Sight Distance (m)	Minimum Radius Curve (m) $e_{max} = 4\%$
	Level	Rolling	Mountainous		
50	8	9	11	65	86
60	7	8	10	85	135
70	6	7	9	105	203
80	6	7	9	130	280
90	5	6	8	160	375
100	5	6	8	185	492

Notes:
1. For bridges, determine lane and shoulder width from NYSDOT Bridge Manual, Section 2.
2. Wide travel lanes may be used in low-speed segments. Refer to Chapter 18 of this manual for bicycle accommodations. Note that bicyclists have the same rights and responsibilities as motorists except as provided in Sections 1230 - 1236 of the *New York State Vehicle and Traffic Law*.

2.7.3 **Collector Roads and Streets**

2.7.3.1 Rural Collectors

The design criteria for rural collectors are:

A. Design Speed

The design speed shall be the maximum design speed for the terrain and volume or a speed based on the anticipated off-peak 85th percentile speed within the range of design speeds for the terrain and volume. Refer to Section 2.6.1 of this chapter for guidance on design speed and Chapter 5, Section 5.2.4 of this manual for methods to determine the off-peak 85th percentile speed. The range of design speeds based on terrain and volume are:

Type of Terrain	**Range of Design Speeds (km/h)** Design Year ADT		
	0 to 400	400 to 2000	2000 and over
Level	60 - 100	80 - 100	100
Rolling	50 - 100	60 - 100	80 - 100
Mountainous	30 - 100	50 - 100	60 - 100

B. Lane Width

Determine minimum from Table 2-5. For bridges, determine the lane width from the NYSDOT Bridge Manual, Section 2.

C. Shoulder Width

Determine minimum from Table 2-5. For bridges, determine the shoulder width from the NYSDOT Bridge Manual, Section 2.

D. Bridge Roadway Width

Determine minimum from NYSDOT Bridge Manual, Section 2.

E. Grade

Determine maximum from Table 2-5.

F. Horizontal Curvature

Determine minimum radius from Table 2-5. For curves flatter than the minimum radius, the radius and superelevation on each horizontal curve shall be correlated with the design speed in accordance with the appropriate $e_{max.}$ table (Table 2-13 for $e_{max.}$ = 6% or Table 2-14 for $e_{max.}$ = 8%).

G. Superelevation

8% maximum. A 6% maximum may be used in suburban areas to minimize the effect of negative side friction during peak periods with low travel speeds.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum distances from Table 2-5.

I. Horizontal Clearance

The minimum horizontal clearance to obstructions (measured from the edge of traveled way) is 3.0 m where no barrier is provided. Where barrier is provided, the minimum is the shoulder width but never less than 1.2 m, except on bridges where the NYSDOT Bridge Manual, Section 2 allows less than 1.2 m.

J. Vertical Clearance

Determine minimum from the NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

Travel lanes = 1.5% minimum to 2% maximum.

L. Rollover

Between travel lanes = 4% maximum.

At edge of traveled way = 8% maximum. When the superelevation rate exceeds 6%, a maximum rollover rate of 10% at the edge of traveled way may be permitted. Refer to Chapter 3, Section 3.2.5.1 Shoulder Cross Slopes and Rollover Limitations of this manual for further guidance.

M. Structural Capacity

Determine from the NYSDOT Bridge Manual, Section 2.

N. Pedestrian Accommodations

To assure access for persons with disabilities, pedestrian facilities shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.*

Table 2-5 Design Criteria for Rural Collectors

Design Speed (km/h)	Travel Lane Width (m) [1] Design Year ADT				Turn Lane (m)		Maximum Percent Grade [2]			Min. Stopping Sight Distance (m)	Min. Radius Curve (m) $e_{max=}6\%$	Min. Radius Curve (m) $e_{max=}8\%$
	ADT Under 400	ADT 400 to 1500	ADT 1500 to 2000 [3]	ADT over 2000 [3]	Min.	Des.	Terrain: Level	Terrain: Rolling	Terrain: Moun-tainous			
30	3.0[4]	3.0	3.3	3.6	3.0	Match Travel Lane Width	7	10	12	35	21	20
40	3.0[4]	3.0	3.3	3.6			7	10	11	50	43	41
50	3.0[4]	3.0	3.3	3.6			7	9	10	65	79	73
60	3.0[4]	3.3	3.3	3.6			7	8	10	85	123	113
70	3.0[4]	3.3	3.3	3.6			7	8	10	105	184	168
80	3.0[4]	3.3	3.3	3.6			6	7	9	130	252	229
90	3.3	3.3	3.6	3.6			6	7	9	160	336	304
100	3.3	3.3	3.6	3.6			5	6	8	185	437	394

Shoulder Width (m)				
All Speeds	0.6 [5]	1.5 [6]	1.8	2.4

Notes:
1. Routes designated as Qualifying Highways on the national network of Designated Truck Access Highways require 3.6 m travel lanes.
2. Short lengths of grade in rural areas, such as grades less than 150 m in length, one-way downgrades, and grades on low-volume (<1500 vpd) rural collectors may be up to 2% steeper than the grades shown above.
3. 3.3 m lanes may be retained were accident rates are acceptable.
4. 2.7 m lanes may be used for design volumes under 250 vpd.
5. Minimum width is 1.2 m if roadside barrier is utilized. 1.2 m shoulder is desirable if the shoulder is intended for regular pedestrian and/or bicycle use.
6. Shoulder width may be reduced to 1.2 m for speeds of 60 km/h to 100 km/h.

2.7.3.2 Urban Collectors

The design criteria for urban collectors are:

A. Design Speed

The design speed shall be 100 km/h or a speed based on the anticipated off-peak 85th percentile speed within the range of acceptable design speeds (50 km/h to 100 km/h). Refer to Section 2.6.1 of this chapter for guidance on design speed and Chapter 5, Section 5.2.4 of this manual for methods to determine the off-peak 85th percentile speed.

B. Lane Width

Determine minimum from Table 2-6.

C. Shoulder Width

Determine minimum from Table 2-6.

D. Bridge Roadway Width

Determine minimum from NYSDOT Bridge Manual, Section 2.

E. Grade

Determine maximum from Table 2-6.

F. Horizontal Curvature

Determine minimum radius from Table 2-6. For curves with radii larger than the minimum radius, the radius of curve and superelevation on each horizontal curve shall be correlated with the design speed in accordance with Table 2-12 for e_{max} = 4% table. The superelevation distribution in this table provides a gradual increase in the unresolved lateral forces on a vehicle as the curve radii decreases, with a bias that minimizes the unresolved lateral forces on a vehicle as for curves with large radii. This distribution of superelevation is based on Method 5 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004.

For low-speed (≤70 km/h) urban streets in heavily built-up residential, commercial, and industrial areas (where building fronts, drainage, sidewalks, or driveways would be substantially impacted by added superelevation), the use of superelevation can be minimized by placing greater reliance on side friction to counter lateral acceleration. This distribution of superelevation is based on Method 2 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004. Below are the minimum radii at 4% superelevation using this method. |

Design Speed (km/h)	Minimum Curve Radius (e_{max} = 4%) (m)
30	22
40	47
50	86
60	135
70	203

For radii larger than the above minimum radius for e_{max} = 4%, determine the superelevation rate using Table 2-11.

G. Superelevation

4% maximum.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum from Table 2-6.

I. Horizontal Clearance

The minimum horizontal clearance to obstructions (measured from the face of curb) is 0 m if barrier is provided, 0.5 m in areas without barrier, and 1 m at intersections.

J. Vertical Clearance

Determine minimum from the NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

Travel lanes = 1.5% minimum to 2% maximum.

Parking lanes = 1.5% minimum to 5% maximum.

L. Rollover

Between travel lanes = 4% maximum.

At edge of traveled way = 8% maximum.

M. Structural Capacity

Determine from the NYSDOT Bridge Manual, Section 2.

N. Pedestrian Accommodations

To assure access for persons with disabilities, pedestrian facilities shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.*

Table 2-6 Design Criteria for Urban Collectors

Lanes [1,4]	Width (m) Minimum	Width (m) Desirable
Travel Lanes (curbed) -	Minimum	Desirable
Residential & Commercial	3.0 m	3.6
Industrial areas without severe ROW limitations	3.6	-
Industrial areas with severe ROW limitations	3.3	-
Wide travel lane adjacent to curbing or parking lane to accommodate bicyclists in low-speed segments [2]	3.6	4.2
Travel Lanes (uncurbed)	Refer to Table 2-5	
Turning Lanes -		
Truck volume ≤ 2%	3.0	3.6
Truck volume > 2%	3.3	3.6
Continuous median left turn lanes (trucks ≤ 2%)	3.0	4.8
Continuous median left turn lanes (trucks > 2%)	3.3	4.8
Parking Lanes -		
Commercial / Industrial	2.4	3.3
Residential	2.1	2.4

Shoulders [2]	Width (m) Minimum	Width (m) Desirable
Curbed -	Minimum	Desirable
Left shoulder for divided urban collectors	0	0.3 - 0.6
Right shoulder with no accommodation for bicyclists [2], breakdowns, turning movements, etc.	0	0.3 - 0.6
Right shoulder for bicycling [2], lateral offset, etc.	1.5	-
Right shoulder for breakdowns and turning movements in addition to bicycling, lateral offset, etc.	1.8	3.0
Uncurbed	Refer to Table 2-5	

Design Speed (km/h)	Maximum Percent Grade [3]			Minimum Stopping Sight Distance (m)	Minimum Radius Curve (m) $e_{max} = 4\%$
	Level	Rolling	Mountainous		
50	9	11	12	65	86
60	9	10	12	85	135
70	8	9	11	105	203
80	7	8	10	130	280
90	7	8	10	160	375
100	6	7	9	185	492

Notes:

1. For bridges determine the lane and shoulder width from the NYSDOT Bridge Manual, Section 2.
2. Wide travel lanes may be used on low speed (≤ 70 km/h) urban collectors. Refer to Chapter 18 of this manual for bicycle accommodations. Note that bicyclists have the same rights and responsibilities as motorists except as provided in Sections 1230 - 1236 of the *New York State Vehicle and Traffic Law*.
3. Maximum grades of short length (less than 150 m) and on one-way down grades may be 2% steeper.
4. Routes designated as Qualifying Highways on the national network of Designated Truck Access Highways require 3.6 m travel lanes.

2.7.4 **Local Roads and Streets**

2.7.4.1 Local Rural Roads

The design criteria for local rural roads are as follows:

A. Design Speed

The design speed shall be 100 km/h or a speed based on the anticipated 85th percentile speed within the range of functional class speeds. Refer to Section 2.6.1 of this chapter for guidance on design speed and Chapter 5, Section 5.2.4 of this manual for methods to determine the off-peak 85th percentile speed. The maximum design speed is 100 km/h and the minimum design speeds are:

Minimum Design Speeds (km/h)

Type of Terrain	Design Year ADT					
	Under 50	50 to 250	250 to 400	400 to 1500	1500 to 2000	2000 & over
Level	50	50	60	80	80	80
Rolling	30	50	50	60	60	60
Mountainous	30	30	30	50	50	50

B. Lane Width

Determine minimum from Table 2-7.

C. Shoulder Width

Determine minimum from Table 2-7.

D. Bridge Roadway Width

Determine minimum from NYSDOT Bridge Manual, Section 2.

E. Grade

Determine maximum from Table 2-7.

F. Horizontal Curvature

Determine minimum radius from Table 2-7. For curves flatter than the minimum radius, the radius and superelevation on each horizontal curve shall be correlated with the design speed in accordance with the appropriate e_{max} table (Table 2-13 for e_{max} = 6% or Table 2-14 for e_{max} = 8%).

G. Superelevation

8% maximum. A 6% maximum may be used in suburban and developing areas to minimize the effect of negative side friction during peak periods with low travel speeds.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum and desirable from Table 2-7.

I. Horizontal Clearance

Without Barrier	**With Barrier**
2.0 m for low-speed (≤70 km/h) segments 3.0 m for high-speed (≥80 km/h) segments	Shoulder width but not less than 1.2 m except on bridges where the NYSDOT Bridge Manual, Section 2 allows less than 1.2 m.

J. Vertical Clearance

Determine minimum from the NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

Travel lanes = 1.5% minimum to 2% maximum.

L. Rollover

Between travel lanes = 4% maximum.

At edge of traveled way = 8% maximum. When the superelevation rate exceeds 6%, a maximum rollover rate of 10% at the edge of traveled way may be permitted. Refer to Chapter 3, Section 3.2.5.1 Shoulder Cross Slopes and Rollover Limitations of this manual for further guidance.

M. Structural Capacity

Determine from the NYSDOT Bridge Manual, Section 2.

N. Pedestrian Accommodations

To assure access for persons with disabilities, pedestrian facilities shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.*

Table 2-7 Design Criteria for Local Rural Roads

Design Speed (km/h)	Travel Lane Widths (m) Based on Design Year ADT [1]				Turn Lane (m)		Max. Percent Grade			Minimum Stopping Sight Distance (m)	Minimum Radius Curve (m)	
							Terrain					
	ADT under 400	ADT 400 - 1500	ADT 1500 to 2000	ADT 2000 & Over	Min.	Des.	Level	Rolling	Moun-tainous		e_{max}= 6%	e_{max}= 8%
30	2.7 [2]	3.0 [3]	3.3	3.6 [4]	3.0	Match Travel Lane Width	8	11	16	35	21	20
40	2.7 [2]	3.0 [3]	3.3	3.6 [4]			7	11	15	50	43	41
50	2.7 [2]	3.0 [3]	3.3	3.6 [4]			7	10	14	65	79	73
60	2.7 [2]	3.0 [3]	3.3	3.6 [4]			7	10	13	85	123	113
70	3.0	3.3	3.3	3.6 [4]			7	9	12	105	184	168
80	3.0	3.3	3.3	3.6 [4]			6	8	10	130	252	229
90	3.3	3.3	3.6 [4]	3.6 [4]			6	7	10	160	336	304
100	3.3	3.3	3.6 [4]	3.6 [4]			5	6	-	185	437	3944

Width of Shoulder (m) [1]				
All Speeds	0.6 [5]	1.5 [6,7]	1.8	2.4

Notes:

1. For bridges determine the lane and shoulder width from the NYSDOT Bridge Manual, Section 2.
2. Minimum travel lane width is 3.0 m for routes designated as Access Highways and for routes within 1.6 km of Qualifying Highways on the national network of Designated Truck Access Highways.
3. For roads in mountainous terrain with design volume of 400 to 600 ADT, use 2.7 m lanes (except when note 2 applies).
4. 3.3 m lanes may remain where accident history is acceptable.
5. Minimum width is 1.2 m if roadside barrier is used on low-volume roads.
6. For roads in mountainous terrain with design volume of 400 to 600 ADT, use 0.6 m shoulders.
7. Shoulder may be 1.2 m where speeds are > 60 km/h

2.7.4.2 Local Urban Streets

The design criteria for local urban streets are:

A. Design Speed

The design speed shall be 50 km/h or a speed based on the anticipated off-peak 85th percentile speed within the range of acceptable design speeds (30 km/h to 50 km/h). Refer to Section 2.6.1 for guidance on design speed and Section 2.5.1.4 for methods to determine the off-peak 85th percentile speed.

B. Lane Width

Determine minimum from Table 2-8.

C. Shoulder Width

Determine minimum from Table 2-8.

D. Bridge Roadway Width

Determine minimum from NYSDOT Bridge Manual, Section 2.

E. Grade

Grades for local streets = 15% maximum in residential areas and 8% maximum in commercial and industrial areas.

F. Horizontal Curvature

Determine minimum radius from Table 2-8. For curves with radii larger than the minimum radius, the radius of curve and superelevation on each horizontal curve shall be correlated with the design speed in accordance with Table 2-12 for e_{max} = 4% table,. The superelevation distribution in this table provides a gradual increase in the unresolved lateral forces on a vehicle as the curve radii decreases. This distribution of superelevation is based on Method 5 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004.

Local urban streets in heavily built-up residential, commercial, and industrial areas (where building fronts, drainage, sidewalks, or driveways would be substantially impacted by added superelevation), the use of superelevation can be minimized by placing greater reliance on side friction to counter lateral acceleration. This distribution of superelevation is based on Method 2 in Chapter 3 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004. |
Below are the minimum radii at 4% superelevation using this method.

Design Speed, km/h	Minimum Curve Radius (e_{max} = 4%) (m)
30	22
40	47
50	86

For radii larger than the above minimum radius for e_{max} = 4%, determine the superelevation rate using Table 2-11.

G. Superelevation

4% maximum.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum and desirable from Table 2-8.

I. Horizontal Clearance

The minimum horizontal clearance to obstructions (measured from the face of curb) is 0 m if barrier is provided, 0.5 m in areas without barrier, and 1 m at intersections.

J. Vertical Clearance

Determine minimum from the NYSDOT Bridge Manual, Section 2.

K. Travel Lane Cross Slope

Travel lane = 1.5% minimum to 2% maximum.

Parking lanes = 1.5% minimum to 5% maximum.

L. Rollover

Between travel lanes = 4% maximum. At edge of traveled way = 8% maximum.

M. Structural Capacity

Determine from the NYSDOT Bridge Manual, Section 2.

N. Pedestrian Accommodations

To assure access for persons with disabilities, pedestrian facilities shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities*.

Table 2-8 Design Criteria for Local Urban Streets

Lanes [1]	Width (m)	
Travel Lanes (with curbing)	minimum	desirable
Residential without severe ROW limitations & Commercial	3.0	3.3
Residential with severe ROW limitations	2.7	3.0
Industrial areas with out severe ROW limitations	3.6	-
Industrial areas with severe ROW limitations	3.3	-
Wide travel lane adjacent to curbing or parking lane to accommodate bicyclists in low-speed segments [2]	3.6	4.2
Travel Lanes (Without curbing)	Refer to Table 2 -7	
Turning Lanes -		
Truck volume $\leq$ 2%	2.7	3.0
Truck volume > 2%	2.7	3.6
Continuous median left turn lanes	3.0	3.3
Parking Lanes -		
Commercial & Industrial	2.4	3.3
Residential	2.1	2.4

Shoulder [1]	Width (m)	
Curbed	minimum	desirable
Left shoulder for divided urban streets	0	0.3 - 0.6
Right shoulder with no accommodation for bicyclists [2], breakdowns, turning movements, etc.	0	0.3 - 0.6
Right shoulder for bicycling [2], lateral offset, etc.	1.5	-
Right shoulder for breakdowns and turning movements in addition to bicycling, lateral offset, etc.	1.8	3.0
Uncurbed	Refer to Table 2 -7	

Grade	Maximum
Residential	15%
Commercial / Industrial	8%

Design Speed (km/h)	Min. Stopping Sight Distance (m)	Minimum Radius Curve (m) e_{max}= 4%
30	35	22
40	50	47
50	65	86

Note:
1. For bridges, determine the lane and shoulder width from the NYSDOT Bridge Manual, Section 2.
2. Wide travel lanes may be used on local urban streets. Refer to Chapter 18 of this manual for bicycle accommodations. Note that bicyclists have the same rights and responsibilities as motorists except as provided in Sections 1230 - 1236 of the *New York State Vehicle and Traffic Law*.

2.7.5 **Other Roadways**

2.7.5.1 Parkways

Parkways that are multilane, divided freeways, or expressways with occasional at-grade intersections should follow the standards in Section 2.7.1.2 Other Freeways. Parkways that are two-lane highways or multilane, divided highways with signalized intersections should follow the standards of the design classification established for the subject parkway.

2.7.5.2 Ramps (Turning Roadways for Grade-Separated Highways)

Ramps are turning roadways to accommodate high volumes of turning movements between grade-separated highways. Ramps are functionally classified based on the higher-type highway they service. For example, all the ramps to and from an interstate are considered part of the Interstate System. The design criteria for ramps are:

A. Design Speed

A ramp speed study is not required to determine the ramp design speed. The ramp design speed for the design criteria applies to the sharpest ramp curve, usually on the ramp proper. The ramp design speed does not apply to the ramp terminals, which should include transition curves and speed change lanes based on the design speeds of the highways and ramps involved.

Desirably, ramp design speed should approximate the off-peak running speeds (50th percentile speeds) on the higher speed intersecting highway, but not exceed 80 km/h. Ramps with design speeds over 80 km/h should be designed using Section 2.7.1 of this chapter. The minimum design speeds based on ramp type (as illustrated in Exhibit 10-55 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004) are:

- Loop ramps - 40 km/h minimum for highways with design speeds of more than 80 km/h.
- Semidirect connection ramps - 50 km/h minimum.
- Direct connection ramps - 60 km/h minimum; 80 km/h preferred.
- Diagonals, outer connections, and one-quadrant ramps - Below is the minimum ramp design speed related to the highway design speed. The highway design speed is the higher design speed of the interchanging roadways.

Highway Design Speed (km/h)	60	70	80	90	100	110	120
Min. Ramp Design Speed (km/h)	30	40	40	50	50	60	70

B. Lane Width

Determine minimum lane widths from Table 2-9. For one-lane, one-way ramps, Case II, which provides for passing a stalled vehicle, should normally be used.

C. Shoulder Width

Determine minimum shoulder widths from Table 2-10.

D. Bridge Roadway Width

The lane and shoulder widths should be carried across all ramp structures.

E. Grade

Determine maximum from Table 2-10.

F. Horizontal Curvature

Determine minimum radius from Table 2-10. For curves flatter than the minimum radius, the radius and superelevation on each horizontal curve shall be correlated with the design speed in accordance with the appropriate e_{max} table (Table 2-13 for $e_{max.}$ = 6% or Table 2-14 for $e_{max.}$ = 8%).

G. Superelevation

8% maximum. A 6% maximum may be used in urban and suburban areas to minimize the effect of negative side friction during peak periods with low travel speeds.

H. Stopping Sight Distance (Horizontal and Vertical)

Determine minimum and desirable stopping sight distance from Table 2-10.

I. Horizontal Clearance

Right side = shoulder width but never less than 1.8 m and left side = 1.0 m minimum. Where ramps pass under structures, there should be an additional 1.2 m clearance beyond the outside of shoulders to bridge piers or abutments.

J. Vertical Clearance

Determine minimum from the NYSDOT Bridge Manual, Section 2. Ramps should have the same vertical clearance as the higher functional classification of the interchanging roadways.

K. Travel Lane Cross Slope

1.5% minimum to 2% maximum.

L. Rollover

Between travel lanes = 4% maximum. At edge of traveled way = 8% maximum. When the superelevation rate exceeds 6%, a maximum rollover rate of 10% at the edge of traveled way may be permitted. Refer to Chapter 3, Section 3.2.5.1 Shoulder Cross Slopes and Rollover Limitations of this manual for further guidance.

M. Structural Capacity

Determine from the NYSDOT Bridge Manual, Section 2.

N. Level of Service (interstate ramps only)

Exit ramps with poor levels of service can cause backups onto the mainline. Ramps shall meet acceptable levels of service, as listed below, and shall be determined on the basis of design year volumes in accordance with TRB's *Highway Capacity Manual*.

The following levels of service are the criteria for interstates:

Rural, level terrain	LOS = B minimum
Rural, rolling terrain	LOS = B minimum
Rural, mountainous terrain	LOS = C minimum
Urban and suburban [1]	LOS = C minimum

[1] In heavily developed sections of metropolitan areas, conditions may necessitate LOS D minimum. Scoping closure and design approval documents should include documentation of the heavily developed metropolitan area conditions.

Some interstate projects, especially in urban areas, will provide levels of service below those above due to social, economic, and environmental and/or policy/intergovernmental decisions during project scoping and design. Such decisions for lesser levels of service should be made in accordance with National Environmental Policy Act (NEPA) and/or State Environmental Quality Review Act (SEQR) procedures and, where applicable, with the Major Metropolitan Transportation Investment process. These decisions should be supported and documented in the design approval documents.

O. Control of Access (interstate and other freeway ramps only)

Access along freeway ramps and terminals on the crossroad shall be fully controlled. Such control shall either be acquired outright prior to construction or reconstruction.

Access along the crossroad should be provided beyond the ramp terminals by purchasing access rights or providing frontage roads. Such control should extend beyond the ramp terminal at least 30 m in urban areas and 90 m in rural areas (see Chapter 6 of this manual for more specific details).

P. Pedestrian Accommodation

To assure access for persons with disabilities, pedestrian facilities located at the ramp terminal with a crossroad shall be located and constructed in accordance with Chapter 18 of this manual and the *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.*

2.7.5.3 Speed Change Lanes

Acceleration lanes, deceleration lanes, and combination acceleration-deceleration lanes have the same lane width as the adjacent travel lanes. The minimum shoulder width is 1.8 m on interstates and other freeways and 1.2 m on other roadways. All other critical design elements (grades, stopping sight distance, etc.) are the same as apply for the adjacent roadway.

The lengths of acceleration and deceleration lanes are not critical design elements. However the lengths, as determined from Chapter 10 in AASHTO's, *A Policy on Geometric Design of Highways and Streets*, 2004 should be provided. If these lengths are not provided an explanation must be included in the design report.

Table 2-9 Traveled Way Widths for Ramps and Turning Roadways

Radius on Inner Edge of Traveled Way, R (m)	Traveled Way Width (m): Case I — One-lane, One- way Operation - No Provision for Passing a Stalled Vehicle				Case II — One-lane, One-way Operation- With Provision for Passing a Stalled Vehicle				Case III — Two-Lane Operation - Either One-Way or Two-Way				
	Design Traffic Condition [1]												
	A	B	C	D	A	B	C	D	A	B	C	D1	D2
15	5.4	5.5	7.0	15.1	6.0	7.8	9.2	16.6	9.4	11.0	13.6	18.4	30.1
25	4.8	5.0	5.8	8.4	5.6	6.9	7.9	9.6	8.6	9.7	11.1	11.4	16.6
30	4.5	4.9	5.5	7.5	5.5	6.7	7.6	8.7	8.4	9.4	10.6	10.6	14.8
50	4.2	4.6	5.0	5.9	5.3	6.3	7.0	7.0	7.9	8.8	9.5	9.5	11.5
75	3.9	4.5	4.8	5.3	5.2	6.1	6.7	6.7	7.7	8.5	8.9	8.9	9.9
100	3.9	4.5	4.8	5.3	5.2	5.9	6.5	6.5	7.6	8.3	8.7	8.7	9.2
125	3.9	4.5	4.8	5.3	5.1	5.9	6.4	6.4	7.6	8.2	8.5	8.5	8.7
150	3.6	4.5	4.5	5.3	5.1	5.8	6.4	6.4	7.5	8.2	8.4	8.4	8.4
Tangent (≥300 m)	3.6	4.2	4.2	4.2	5.0	5.5	6.1	6.1	7.3	7.9	7.9	7.9	7.9
Width Modification Regarding Edge of Traveled Way Treatment:													
No Stabilized Shoulder	None				None				None				
Sloped Curb	None				None				None				
Vertical-Faced Curb (adj. to traveled way) One Side	Add 0.3 m				None				Add 0.3 m				
Vertical-Faced Curb (adj. to traveled way) Two Sides	Add 0.6 m				Add 0.3 m				Add 0.6 m				
Stabilized Shoulder, One or Both sides	Lane width for conditions B & C on tangent may be reduced to 3.6 m where combined shoulder is 1.2 m or wider				Deduct combined right and left shoulder width; use minimum travel lane width as under Case I				Deduct 0.6 m where either shoulder is 1.2 m or wider				

Note:

1. The design traffic conditions are defined:
   - A Predominantly P vehicles, but some consideration for SU trucks. Accommodates occasional WB 12 trucks.
   - B Sufficient SU vehicles to govern design, but some consideration for semitrailer vehicles. Generally SU plus semitrailer vehicles = 5 to 10% of the total traffic volume. Accommodates occasional WB 12 trucks.
   - C Sufficient bus and combination-types of vehicles to govern design (over 10% of total traffic volume). Accommodates occasional WB 15 trucks.
   - D Use on ramps and turning roadways with a WB 20 design vehicle (e.g., ramps connecting to Qualifying Highways on the national network of Designated Truck Access Highways (1982 STAA highways)). Values are from Exhibit 3-54 of AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004. Design Traffic Condition D values are reduced by as much as 0.6 m for Case I and as much as 1.2 m for Cases II & III to account for reduced lateral clearance permitted for turning roadways with a combination of large vehicles and sharp radii. Case I, Design Traffic Condition D assumes WB 20 vehicle with no provision for passing a stalled passenger vehicle. Case II, Design Traffic Condition D assumes WB 20 passing P vehicle.
   - D1/ D2 For Case III, use Condition D1 for one-way, two-lane ramps and Condition D2 for two-way, two-lane ramps. Case III, Design Traffic Condition D1 assumes passenger car overtaking a WB 20 vehicle. Case III, Design Traffic Condition D2 assumes opposing WB 20 vehicles.

Table 2-10 Design Criteria for Turning Roadways

Design Speed (km/h)	Shoulder [1] (m)		Maximum Percent Grade	Minimum Stopping Sight Distance (m)	Minimum Radius (m) (measured to inside edge of the traveled way)		
	Left	Right [2]			e_{max} = 4%[3]	e_{max} = 6%	e_{max} = 8%
15 [4]	1.0	2.0	8	15	-	-	-
20	↓	↓	8	20	8	8	7
30	↓	↓	8	35	22	21	20
40	↓	↓	7	50	47	43	41
50	↓	↓	7	65	86	79	73
60	↓	↓	6	85	135	123	113
70	↓	↓	5	105	203	184	168
80	↓	↓	5	130	–	252	229

Notes:

1. For urban turning roadways with curbing, no shoulder is required. A 0.6 m curb offset is desirable.
2. For direct connection ramps with design speeds over 60 km/h, use a 2.4 m minimum right shoulder.
3. Only for Free-Flow Turning Roadways for at-grade intersections. See §2.7.5.4.B.
4. Refer to Chapter 9 of AASHTO's *A Policy on Geometric Design for Highways and Streets*, 2004 for minimum radii.

2.7.5.4 Turning Roadways - Channelized for At-Grade Intersections

Channelized right-turning roadways are sometimes called right-turn slip lanes or right-turn bypass lanes. There are two types of channelized right-turning roadways for at-grade intersections: right-turning roadways with corner islands and free-flowing, right-turning roadways. Further information on these roadways is provided in Chapter 5, Section 5.9.4 of this manual.

A. Turning Roadways with Yield, Stop, or Signal Control

Turning roadways with yield, stop, or signal control often have channelized islands and do not include taper- or parallel-type acceleration lanes. Design criteria is not required for these types of turning roadways.

For layout, the design speed may range from 15 km/h to 40 km/h. Refer to Chapter 5, Section 5.9.4.6 A of this manual for additional guidance.

B. Free-Flow Turning Roadways

Free-flow turning roadways are essentially ramps for at-grade intersections. They generally include speed-change lanes. The design speed may be equal to or as much as to 30 km/h less than the design speed of the higher speed intersecting highway. The acceptable range of design speeds is 15 km/h to 80 km/h.

- Determine the lane widths from Table 2-9.
- Determine the shoulder widths, grade, stopping sight distance, and minimum radii from Table 2-10.
- A maximum superelevation rate of 4% is used for urban areas, 6% for rural areas where traffic is likely to stop on the turning roadway, and 8% for rural areas where traffic is unlikely to stop on the turning roadway. For superelevation rates on curves with radii above the minimum radius, use Tables 2-12, 2-13, or 2-14 for e_{max} equal to 4%, 6%, or 8%, respectively.
- The minimum horizontal clearance to obstructions (measured from the edge of traveled way) on the right side is the larger of the shoulder width or 1.8 m.
- The minimum horizontal clearance to obstructions (measured from the edge of traveled way) on the left side is 1.2 m.
- Determine the remaining critical design elements from Section 2.7.5.2.

2.7.5.5 Collector-Distributor Roads

The difference between the design speed of a collector-distributor road and the adjacent mainline roadway should not exceed 20 km/h. However, for freeways with 80 km/h or 90 km/h design speeds, the minimum design speed for the collector-distributor road is 80 km/h. The design criteria should be the same as that of the adjacent mainline roadway. However the other critical design elements (horizontal curve, stopping sight distance, etc.) should be modified appropriately if a design speed less than the mainline design speed is used.

2.7.5.6 Frontage Roads (Service Roads)

The design criteria for frontage roads should be consistent with the design criteria for the functional class of the frontage road.

2.7.5.7 Climbing Lanes

Climbing lanes should have the same lane width as the adjacent travel lanes. The minimum shoulder width for a climbing lane is 1.2 m, or the shoulder width of the highway, whichever is less. Desirably the climbing lane shoulder should match the shoulder for the adjacent segments of highway. All other critical design elements (grades, stopping sight distances, etc.) are the same as applies for the adjacent roadway.

2.7.5.8 Tunnels

The design criteria used for tunnels should not differ materially from those used for grade separation structures. Refer to AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2004 for further guidance regarding tunnel design.

2.7.5.9 Shared Roadway

A roadway which is open to both bicycle and motor vehicle travel upon which no bicycle lane is designated. Examples may include roads with wide curb lanes and roads with shoulders. Refer to various tables within Section 2.7 of this chapter as well as Chapter 18 *Facilities for Pedestrians and Bicyclists* of this manual for shoulder / lane width guidance.

Table 2-11 Minimum Radii and Superelevation for Low-Speed Urban Streets

e (%)	V_d = 20 km/h R (m)	V_d = 30 km/h R (m)	V_d = 40 km/h R (m)	V_d = 50 km/h R (m)	V_d = 60 km/h R (m)	V_d = 70 km/h R (m)
-2.0	10	27	60	116	189	297
-1.5	9	27	59	113	183	286
0	9	25	55	104	167	257
1.5	9	24	51	96	153	234
2.0	9	24	50	94	149	227
2.2	8	23	50	93	148	224
2.4	8	23	50	92	146	222
2.6	8	23	49	91	145	219
2.8	8	23	49	90	143	217
3.0	8	23	48	89	142	214
3.2	8	23	48	89	140	212
3.4	8	23	48	88	139	210
3.6	8	22	47	87	138	207
3.8	8	22	47	86	136	205
4.0	8	22	47	86	135	203

Notes:

1. For low-speed ($\leq$70 km/h) urban streets in heavily built-up residential, commercial, and industrial areas (where building fronts, drainage, sidewalks, or driveways would be substantially impacted by added superelevation), sharper curves are allowed.
2. Computed using AASHTO Superelevation Distribution Method 2.
3. For segments using a normal crown of 2%, curves with radii that are larger than those required for e = -2.0% may retain normal crown. Curves with radii requiring superelevation rates between e = -2.0% to e = 0% require removal of the adverse cross slope. Curves with radii requiring superelevation rates between e = 0% and e = 2% require superelevation at e = 2%.
4. For segments using a normal crown of 1.5%, curves with radii that are larger than those required for e = -1.5% may retain normal crown. Curves with radii requiring superelevation rates between e = -1.5% to e = 0% require removal of the adverse cross slope. Curves with radii requiring superelevation rates between e = 0% and e = 1.5% require superelevation at e = 1.5%.

Table 2-12 Minimum Radii for Design Superelevation Rates, Design Speeds, and e_{max} = 4%

e (%)	V_d = 20 km/h R (m)	V_d = 30 km/h R (m)	V_d = 40 km/h R (m)	V_d = 50 km/h R (m)	V_d = 60 km/h R (m)	V_d = 70 km/h R (m)	V_d = 80 km/h R (m)	V_d = 90 km/h R (m)	V_d = 100 km/h R (m)
1.5	163	371	679	951	1310	1740	2170	2640	3250
2.0	102	237	441	632	877	1180	1490	1830	2260
2.2	75	187	363	534	749	1020	1290	1590	1980
2.4	51	132	273	435	626	865	1110	1390	1730
2.6	38	99	209	345	508	720	944	1200	1510
2.8	30	79	167	283	422	605	802	1030	1320
3.0	24	64	137	236	356	516	690	893	1150
3.2	20	54	114	199	303	443	597	779	1010
3.4	17	45	96	170	260	382	518	680	879
3.6	14	38	81	144	222	329	448	591	767
3.8	12	31	67	121	187	278	381	505	658
4.0	8	22	47	86	135	203	280	375	492

Notes:

1. Computed using AASHTO Superelevation Distribution Method 5.
2. Curves with radii greater than that needed for e = 1.5% may retain normal crown. Curves with radii requiring e= 1.5% to less than e = 2.0% require removal of the adverse cross slope.

Table 2-13 Minimum Radii for Design Superelevation Rates, Design Speeds, e_{max} = 6%

e (%)	V_d = 20 km/h R (m)	V_d = 30 km/h R (m)	V_d = 40 km/h R (m)	V_d = 50 km/h R (m)	V_d = 60 km/h R (m)	V_d = 70 km/h R (m)	V_d = 80 km/h R (m)	V_d = 90 km/h R (m)	V_d = 100 km/h R (m)	V_d = 110 km/h R (m)	V_d=120 km/h R (m)
1.5	194	421	738	1050	1440	1910	2360	2880	3510	4060	4770
2.0	138	299	525	750	1030	1380	1710	2090	2560	2970	3510
2.2	122	265	465	668	919	1230	1530	1880	2300	2670	3160
2.4	109	236	415	599	825	1110	1380	1700	2080	2420	2870
2.6	97	212	372	540	746	1000	1260	1540	1890	2210	2630
2.8	87	190	334	488	676	910	1150	410	1730	2020	2420
3.0	78	170	300	443	615	831	1050	1290	1590	1870	2240
3.2	70	152	269	402	561	761	959	1190	1470	1730	2080
3.4	61	133	239	364	511	697	882	1100	1360	1600	1940
3.6	51	113	206	329	465	640	813	1020	1260	1490	1810
3.8	42	96	177	294	422	586	749	939	1170	1390	1700
4.0	36	82	155	261	380	535	690	870	1090	1300	1590
4.2	31	72	136	234	343	488	635	806	1010	1220	1500
4.4	27	63	121	210	311	446	584	746	938	1140	1410
4.6	24	56	108	190	283	408	538	692	873	1070	1330
4.8	21	50	97	172	258	374	496	641	812	997	1260
5.0	19	45	88	156	235	343	457	594	755	933	1190
5.2	17	40	79	142	214	315	421	549	701	871	1120
5.4	15	36	71	128	195	287	386	506	648	810	1060
5.6	13	32	63	115	176	260	351	463	594	747	980
5.8	11	28	56	102	156	232	315	416	537	679	900
6.0	8	21	43	79	123	184	252	336	437	560	756

Notes:
1. Computed using AASHTO Superelevation Distribution Method 5.
2. Curves with radii greater than that needed for e = 1.5% may retain normal crown. Curves with radii requiring e= 1.5% to less than e = 2.0% require removal of the adverse cross slope.

Table 2-14 Minimum Radii for Design Superelevation Rates, Design Speeds, and e_{max} = 8%

e (%)	V_d = 20 km/h R (m)	V_d = 30 km/h R (m)	V_d = 40 km/h R (m)	V_d = 50 km/h R (m)	V_d = 60 km/h R (m)	V_d = 70 km/h R (m)	V_d = 80 km/h R (m)	V_d = 90 km/h R (m)	V_d = 100 km/h R (m)	V_d = 110 km/h R (m)	V_d=120 km/h R (m)
1.5	184	443	784	1090	1490	1970	2440	2970	3630	4180	4900
2.0	133	322	571	791	1090	1450	1790	2190	2680	3090	3640
2.2	119	288	512	711	976	1300	1620	1980	2420	2790	3290
2.4	107	261	463	644	885	1190	1470	1800	2200	2550	3010
2.6	97	237	421	587	808	1080	1350	1650	2020	2340	2760
2.8	88	216	385	539	742	992	1240	1520	1860	2160	2550
3.0	81	199	354	496	684	916	1150	1410	1730	2000	2370
3.2	74	183	326	458	633	849	1060	1310	1610	1870	2220
3.4	68	169	302	425	588	790	988	1220	1500	1740	2080
3.6	62	156	279	395	548	738	924	1140	1410	1640	1950
3.8	57	144	259	368	512	690	866	1070	1320	1540	1840
4.0	52	134	241	344	479	648	813	1010	1240	1450	1740
4.2	48	124	224	321	449	608	766	948	1180	1380	1650
4.4	43	115	208	301	421	573	722	895	1110	1300	1570
4.6	38	106	192	281	395	540	682	847	1050	1240	1490
4.8	33	96	178	263	371	509	645	803	996	1180	1420
5.0	30	87	163	246	349	480	611	762	947	1120	1360
5.2	27	78	148	229	328	454	579	724	901	1070	1300
5.4	24	71	136	213	307	429	549	689	859	1020	1250
5.6	22	65	125	198	288	405	521	656	819	975	1200
5.8	20	59	115	185	270	382	494	625	781	933	1150
6.0	19	55	106	172	253	360	469	595	746	894	1100
6.2	17	50	98	161	238	340	445	567	713	857	1060
6.4	16	46	91	151	224	322	422	540	681	823	1020
6.6	15	43	85	141	210	304	400	514	651	789	982
6.8	14	40	79	132	198	287	379	489	620	757	948
7.0	13	37	73	123	185	270	358	464	591	724	914
7.2	12	34	68	115	174	254	338	440	561	691	879
7.4	11	31	62	107	162	237	318	415	531	657	842
7.6	10	29	57	99	150	221	296	389	499	621	803
7.8	9	26	52	90	137	202	273	359	462	579	757
8.0	7	20	41	73	113	168	229	304	394	501	667

Notes:
1. Computed using AASHTO Superelevation Distribution Method 5.
2. Curves with radii greater than that needed for e = 1.5% may retain normal crown. Curves with radii requiring e= 1.5% to less than e = 2.0% require removal of the adverse cross slope.

2.8 REQUIREMENTS FOR JUSTIFICATION OF NONSTANDARD FEATURES

2.8.1 Definition and Procedures

A nonstandard feature is created when the established design criteria for a critical design element is not met. All nonstandard features to be retained must be listed, justified, and approved in accordance with this chapter and the *Project Development Manual*.

Since many of the values for the critical design elements are dependent on the design speed, the selection and justification of a nonstandard design speed is not permitted (per 23 CFR 625). Instead, the design speed should be determined in accordance with Section 2.7 and any nonstandard critical design elements individually justified. (Note that most of the critical design elements can usually be designed to the required design speed, leaving only one or two nonstandard features.)

In addition to the critical design elements covered in this chapter there are other design elements with established values or parameters that must be considered. These elements are important and can have a considerable effect on the project's magnitude. Any decisions to vary from recommended values or accepted practices need to be explained and documented as nonconforming features in the scoping / design approval documents. Refer to Chapter 5, Section 5.1 for further information on these design elements.

2.8.2 Technical Discrepancies

There are technical discrepancies between the metric and U.S. customary values in AASHTO's *A Policy on Geometric Design of Highways and Streets*. The discrepancies are from the independent development of the criteria using the two systems of measurement. Since metric conversion was not intended to create nonstandard features, a nonstandard feature justification is not necessary if the feature is to be retained and it meets the U.S. customary values in AASHTO's *A Policy on Geometric Design of Highways and Streets*.

2.8.3 Documentation

To support the designer's rationale for the nonstandard feature, the information in Table 2-15 must either be provided, or an explanation given as to why the information was not considered to be applicable. This information is only required for the design alternative for which design approval is sought.

The following is additional guidance for completing Table 2-15 for a nonstandard feature:

- Similar features with similar accident histories may be justified with a single form. Examples of features that may be grouped together include: a series of curves with similar radii, shoulders on a grouping of similar ramps, and bridge widths for a series of bridges to be rehabilitated or replaced in a future project.
- Recommended Speed - The recommended speed is defined in Section 230 of 17B of NYCRR (a.k.a. NYS MUTCD). The recommended speed may be determined by calculating the speed from the existing geometry and formulas from Chapter 5, Section 5.7.3 of this manual. The recommended speed for horizontal alignment may also be determined using a ball bank indicator reading of 10° or, when the radius and superelevation are known, by using Figure 231-1 of the NYS MUTCD. Note that the results will differ slightly for each of these methods.
- Accident Analysis - Refer to the Chapter 5, Section 5.3 of this manual.
- Cost Estimates - An approximate (or order of magnitude) construction cost estimate should be used when cost is not a major factor (e.g., due to major environmental impacts) or the B/C ratio is very small. When cost is a major factor the B/C ratio should be determined and should consider accident cost, user delay, etc.
- Mitigation Measures - Consult the Regional Traffic Group and go to the accident reduction factors on the Department's internet site for a list of measures to consider and to help evaluate their effectiveness.

Strict application of each item in all instances may be inappropriate. These items should serve as a guide since the information outlined is generally applicable to the range of critical design elements. In addition, if a sidewalk, ramp, curb ramp, stairway, or other pedestrian facility cannot fully comply with the accessibility standards found in the Americans with Disabilities Act Accessibility Guidelines (ADAAG), it must be made accessible to the maximum extent practicable.

> Note: Specific public rights-of-way accessibility guidelines are under development by the United States Access Board and will be incorporated into ADAAG when they are completed. Until that time, the existing provisions of ADAAG and "best practices" endorsed by the FHWA and/or the Access Board must continue to be used for the design and construction of Department projects.

The reasons that full compliance with the guidelines are not feasible must be documented in the Design Approval Document and be consistent with the reasons for infeasibilities (refer to Chapter 18 of this manual, Section 18.6.7) and ADAAG justification requirements.

Other references that may be used to support the retention of nonstandard and nonconforming features include:

- *Proposed Treatments for the Rehabilitation of the National Register Eligible Long Island Parkways*, December 1997.
- *Recommendations of the Parkway Standard Task Force*, January 1989 (amended 10/25/90).
- NYS Scenic Byways Program: Individual *Corridor Management Plans*.

These references should only be used to supplement the nonstandard feature justification required above to address accident history, environmental impacts, cost to correct, etc.

Table 2-15 Nonstandard Feature Justification Form

Main Line Design (in accordance with HDM §2.7)			
PIN:		NHS (Y/N):	
Route No. & Name:		Functional Class:	
Project Type:		Design Classification: (AASHTO Class)	
% Trucks:		Terrain:	
ADT:		Truck Access Rte.:	

1. Description of Nonstandard Feature			
Type of Feature (e.g., horizontal curve radius):			
Location:			
Standard Value:		Design Speed:	km/h (mph)
Existing Value:		Recommended Speed:	km/h (mph)
Proposed Value:		Recommended Speed:	km/h (mph)
2. Accident Analysis			
Current Accident Rate:		acc/mvm	
Statewide Rate (based on similar type highways):		acc/mvm	
Is the nonstandard feature a contributing factor?		☐ YES	☐ NO
Anticipated Accid.: Rate / Severity / Cost			
3. Cost Estimates			
Cost to Fully Meet Standards:		$	
Cost(s) For Incremental Improvements:		$	
4. Mitigation (e.g., increased superelevation and curve warning signs for a nonstandard horizontal curve):			
5. Compatibility with Adjacent Segments & Future Plans:			
6. Other Factors (e.g., Social, Economic & Environmental):			
7. Proposed Treatment (i.e., Recommendation):			

Table 2-16 Design Criteria Table

Main Line Design (in accordance with HDM §2.7)			
PIN:	1234.56	NHS (Y/N):	Y
Route No. & Name:	I-87 Northway	Functional Class:	Rural Principal Arterial Interstate
Project Type:	Reconstruction	Design Classification (AASHTO Class)	Rural Interstate
% Trucks:	5%	Terrain:	Rolling
ADT:	50,000	Truck Access Rte.:	Qualifying Highway

	Element	**Standard Criteria**	**Existing Conditions**	**Proposed Conditions**
1	Design Speed (See Note 1)	110 km/h	125 km/h 85th%	
2	Lane Width	3.6 m	3.6 m	3.6 m
3	Shoulder Width: Left = Right (rolling & level) = Climbing Lane Shoulder =	1.2 m 3.0 m 1.2 m	1.2 m 3.0 m	1.2 m 3.0 m
4	Bridge Roadway Width (total) = Lane = Left Shoulder = Right Shoulder =	Approach Width 3.6 m 1.2 m 3.0 m	Approach Width 3.6 m 1.2 m 3.0 m	Approach Width 3.6 m 1.2 m 3.0 m
5	Grade	4%	5%*	5%*
6	Horizontal Curvature	500 m @ e=8.0%	560 m @ e= 6%*	560 m @ e= 8%
7	Superelevation Rate	8.0 % maximum	6.0% maximum*	8.0% maximum
8	Stopping Sight Distance (Horizontal & Vertical)	220 m minimum	180 m*	180 m*
9	Horizontal Clearance Without barrier = With Barrier =	3.0 m 1.2 m or full shoulder width, which ever is greater	9.0 m 1.2 m left 3.0 m right	9.0 m 1.2 m left 3.0 m right
10	Vertical Clearance	4.9 m minimum	4.3 m*	5.05 m
11	Pavement Cross Slope	1.5 % to 2.0 %	2.0%	2.0%
12	Rollover - between lanes = at edge of traveled way =	4.0 % max 8.0 % max	4.0 % max 8.0 % max	4.0 % max 10.0 % max*
13	Structural Capacity - Replace = Rehabilitation =	MS 23 MS 20	MS 20	MS 20
14	Level of Service	B for rural area	C*	C*
15	Control of Access	Full	Full	Full
16	Pedestrian Accommodations	NA	NA	NA
17	Median Width	11.0 m	15.0 m	15.0 m

* Nonstandard Feature

Note:

1. The Regional Traffic Engineer has concurred with the selected design speed.

2.9 REFERENCES

1. *A Policy on Design Standards, Interstate System*, July, 1991, American Association of State Highway and Transportation Officials, Suite 225, 444 North Capitol Street, N.W., Washington, D.C. 20001.

2. *A Policy on Geometric Design of Highways and Streets*, 2004, American Association of State Highway and Transportation Officials, Suite 225, 444 North Capitol Street, N.W., Washington, D.C. 20001.

3. *Americans with Disabilities Act Accessibility Guidelines*, United States Access Board, 1331 F Street NW, Suite 1000, Washington, DC 20004-1111 (www.access-board.gov)

4. Bridge Manual, Structures Design and Construction Division, New York State Department of Transportation, State Office Campus, Albany, NY 12232.

5. *Guide for the Development of Bicycle Facilities*, 1999, American Association of State Highway and Transportation Officials, Suite 225, 444 North Capitol Street, N.W., Washington, D.C. 20001.

6. Guidelines for Highways Within the Adirondack Park, 1996, New York State Department of Transportation, State Campus, Albany, NY 12232.

7. *Highway Capacity Manual*, 2000, Transportation Research Board, National Research Council, 2101 Constitution Avenue, N.W., Washington D.C., 20418.

8. *Highway Safety Design and Operations Guide*, 1997, American Association of State Highway and Transportation Officials, Suite 225, 444 North Capitol Street, N.W., Washington, D.C. 20001.

9. NCHRP Synthesis 299 *Recent Geometric Design Research for Improved Safety and Operations*, 2001, K. Fitzpatrick & M. Wooldridge, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

10. Official Compilation of Codes, Rules and Regulations of the State of New York (NYCRR), 2001, Volume 17B, Uniform Traffic Control Devices, Department of State, 41 State Street, Albany, NY 12231.

11. Official Description of Designated Qualifying and Access Highways in New York State, April 2001, Traffic and Safety Division, New York State Department of Transportation, State Office Campus, Albany, NY 12232.

12. Project Development Manual, Design Quality Assurance Bureau, New York State Department of Transportation, State Office Campus, Albany, NY 12232.

13. Relationship of Highway Design Standards to Accidents, Injuries and Fatalities, March, 1995, Transportation Research Center, University of Florida, 512 Weil Hall, Gainesville, FL 32611-2083.