

## 6. ROADWAY GEOMETRICS

### 6.1 General

Horizontal or vertical street curves, sight distance, grades, and tangents will be based on the current edition of AASHTO standards, and the Standards contained herein. A design proposal that differs from the AASHTO standards may be approved by the Public Works Director upon the review of a deviation request, if the deviation is justified to minimize grading, avoid excessive run-off or topographic conditions affecting the development site, or to implement traffic calming techniques when warranted.

### 6.2 Design Speeds

Design speed is a speed selected to determine the various geometric design features of a roadway. Design speed shall be used to determine stopping sight distance (SSD), entering sight distance (ESD), and intersection sight distance (ISD) requirements for new road facilities. Refer to Section 6.7 for a full discussion of sight distance analysis.

Table 6-1 contains the required design speed for street design and new construction in the City of Des Moines. Speed limit designations on specific streets within the City are published in the *Comprehensive Transportation Plan* and codified by DMMC Chapter 10.20.

**Table 6-1. Design Speeds**

	<b>Design Speed (Miles Per Hour [MPH])</b>	<b>Posted Speed (MPH)</b>
Principle Arterial	Posted Speed + 5 MPH	35-45
Minor Collector	Posted Speed + 5 MPH	35-40
Collector	Posted Speed	30-35
Neighborhood Collector	Posted Speed	25-30
Local Road	Posted Speed (25)	25 <sup>1</sup>
Alley	Posted Speed (20)	20 <sup>2</sup>

<sup>1</sup> Not all Local Roads will be posted.

<sup>2</sup> Speed Limit Signs shall not be posted on Alleys.

### 6.3 Design Vehicles

The minimum design vehicle for a Collector and above is a Single Unit (SU) Vehicle . The minimum design vehicle for all other classifications is a passenger vehicle. Additional factors, such as designated school bus routes and land use may necessitate the need to use multiple design vehicles.

### 6.4 Horizontal Alignment

The values for design of horizontal alignment shall be based on the current edition of the AASHTO standards. Superelevation is not required unless determined by a licensed professional engineer and/or the Public Works Director in the design of horizontal curves. However, additional pavement width may

be required on horizontal curves to provide for vehicle maneuvers where no superelevation is used and the minimum horizontal curve criteria are not met. Calculations for widening shall comply with Chapter 3 of the AASHTO Green Book or Chapter 6 of the WSDOT Design Manual.

Upon approval of a deviation request from the Public Works Director, superelevation may be used on local roads as necessary to meet terrain and right-of-way conditions. However, horizontal curves must be designed based on design speed and selected cross section as provided in current AASHTO standards.

Each horizontal curve design shall provide stopping sight distance for the design speed at all points on the road. Refer to Section 6.7 for sight distance requirements.

## 6.5 Vertical Alignment

Vertical curves shall be designed to ensure that minimum stopping sight distance is provided per current AASHTO standards. Sight distance is discussed in detail in Section 6.7.

Sag vertical curves on residential streets that do not meet the minimum SSD indicated in Section 6.7 may be approved by the Public Works Director through a deviation request if no practical design exists and if acceptable illumination is provided throughout the curve and is maintained by a franchise utility. The illumination design shall be consistent with Section 7.11.

## 6.6 Grades

### 6.6.1 Maximum Grades

The maximum grade on any new or reconstructed road shall not exceed the limits shown in Table 6-2. Grade transitions shall be constructed as vertical curves except at new intersections where the difference in grade is one percent or less. Refer to Section 4.2.4 for additional grade at intersection requirements.

Maximum roadway grade as shown in Table 6-2 may be exceeded for short distances of 300 feet or less, upon showing that no practical alternative exists through a deviation request. Exceptions, which exceed 14 percent, will require verification by the Fire Marshal that additional fire protection requirements will be met and show what method will be used to ensure drainage will be controlled. The grade shall not exceed 15 percent.

**Table 6-2. Maximum Road Grades**

Principal Arterials	8%
Minor Arterial	8%
Collector Arterial	10%
Neighborhood Collector	12%
Local Road	14%

Note: % = percent.

## 6.6.2 Grade Transitions

Grade transitions shall be constructed as smooth vertical curves, without angle points, except in intersections where the difference in grade is one percent or less and upon approval of the Public Works Director. Refer to Section 4.2.4 for additional grade at intersection requirements.

## 6.7 Sight Distance

### 6.7.1 General

Sight distance criteria established in this section are based upon A Policy on Geometric Design of Highways and Streets, AASHTO, current edition, except as superseded herein.

Each new intersection or access point connection must meet the SSD, ESD, and ISD requirements established herein.

Sight distance requirements in this section are based on passenger car operation and do not account for heavy vehicle operating characteristics. Access points or intersections that will handle significant numbers of heavy vehicles or trucks, as determined by the Public Works Director, shall be designed in accordance with Chapter 9 of the AASHTO Green Book.

### 6.7.2 Documentation of Sight Distance

To verify acceptable sight distance, the Public Works Director may require a developer to evaluate and document an existing sight distance condition. The evaluation and documentation of sight distance shall include the following, or such additional information as may be necessary to make a determination:

- Plan, profile and cross-section drawings along the sight line

- Posted speed, and/or speed study data

- Right-of-way and easement limits (existing and proposed)

When the Public Works Director determines from the documentation presented that a location has insufficient sight distance, a plan to improve the sight distance, including public street improvements, to meet these standards will be required.

### 6.7.3 Stopping Sight Distance

SSD is the distance needed for a vehicle traveling at or near design speed to stop before reaching a stationary object in its path. SSD shall be calculated as provided in the current AASHTO Green Book. Design speed shall be used to determine SSD requirements for new facilities. Refer to Section 6.2. The posted speed limit shall be used to determine the SSD for existing facilities. SSD is measured along the centerline of the vehicle's travel lane.

#### 6.7.3.1 Effect of Grade on Stopping Sight Distance

The grade of the roadway has an effect on the vehicle's stopping sight distance. Stopping sight distances are based on flat road grades. The stopping distance is increased on downgrades and decreased on upgrades. When evaluating sight distance with a changing grade, use the grade for which the longest sight distance is needed.

For downgrades or upgrades of 3 percent or greater, SSD requirements are shown in the current AASHTO standards.

## 6.7.4 Entering Sight Distance

ESD is the distance necessary for the driver of a vehicle stopped at an intersection to decide when to enter or cross the intersecting roadway, and for the driver of a vehicle traveling at or near the posted speed on the intersecting roadway to reduce speed to avoid overtaking a vehicle that has entered the roadway.

Entering sight distance applies on driveways and streets approaching intersections as set forth in Sections 4.2 and 4.4. Specific ESD values for required design speeds are shown in the current AASHTO standards.

When provision of sight distance is a condition of an application approval, it shall be the applicant's responsibility to accomplish any activities necessary to provide sight distance, such as trimming or removal of vegetation or regrading of earth.

When determining or measuring ESD, the height of the driver's eyes in the entering vehicle assumed to be 3.5 feet, and the height of the object to be seen, assumed to be another vehicle, is 3.5 feet above the pavement. For new construction and reconstruction, ESD shall be measured 14.5 feet back from the edge of traveled way. The edge of the traveled way shall be the outside edge of the travel lane. Bicycle lanes, walkways or paved shoulders are not included.

## 6.7.5 Intersection Sight Distance

Drivers approaching intersections should have a sufficient, unobstructed view of the intersection and approaches to safely permit control of all vehicles through the intersection. ISD refers to that length of highway along the intersecting road that the driver on the approach should have. ISD can be affected by the horizontal and vertical geometry of the approaches to the intersection. The AASHTO manual shall be used as a guide for providing adequate ISD, except as superseded herein.

## 6.7.6 Clear Sight Triangles

At any intersection or access point connection, there must exist clear sight triangles to allow drivers approaching the intersection from both approaches to see other approaching vehicles.

This area, along the intersection approach legs and across their included corners, must be clear of obstructions that might block a driver's view of potentially conflicting vehicles. Visibility applies not only to drivers on the minor road, but also drivers on the major road, allowing them to see vehicles stopped at an intersection and to prepare to slow or stop, if necessary.

The "triangle" is defined by the line-of-sight from a vehicle stopped on a minor road to a vehicle approaching on the major road and back to the intersection.

The line-of-sight defining one side of the clear sight triangle may cross private property and be obstructed by objects or vegetation outside the existing public right-of-way. To ensure that sight distance is maintained, the area within a clear sight triangle shall either be acquired and conveyed to the City as new public right-of-way or a sight distance easement recorded to allow maintenance of the clear sight triangle.

## 6.7.7 Passing Sight Distance

Passing sight distance requirements for the design or reconstruction of roads shall be as provided in the current AASHTO standards.