Chapter 8

Street Design and Pavement Thickness

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Section Topic Page

Chapter 8

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8.1 General

8.1.1 This chapter sets forth the design and technical criteria to be used in the preparation of all roadway plans. Where design information is not provided herein, the current edition of *"A Policy on Geometric Design of Highways and Streets"* (AASHTO Standards) shall be used.

8.2 Access Management

8.2.1 Access.

8.2.1.1 Access Defined. Access is defined as any connection, driveway, street, turnout, or other means of providing for the movement of vehicles to or from the public roadway system. Access is further defined as any full movement access, right in right out movement, or partial movement access.

Access management is defined by the Transportation Research Board National *Access Management Manual* as the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway. It also involves roadway design applications, such as median treatments and auxiliary lanes and the appropriate spacing of traffic signals. The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system. The contemporary practice of access management extends to concept of access design and location control to all roadways—not just limited access highways, streets, or interstates.

Access management principals and history can be reviewed in the *Access Management Manual* published by the Transportation Research Board. The City of Sioux Falls implements access management principals. Using access management techniques reduces crash rates while keeping the traffic flowing.

The Office of the City Engineer may initiate an access management plan or corridor study that would supersede the design standards for access along an arterial or major collector street. Preparation of the study shall be the responsibility of the City of Sioux Falls, South Dakota Department of Transportation, and/or private individuals, or jointly prepared. However, the study must be prepared by a licensed professional engineer with experience in transportation planning. The access plan or corridor study shall be approved by the Office of the City Engineer and/or South Dakota Department of Transportation.

Access planning that has not been identified in any type of study in existing development areas will be considered on a case-by-case basis. Retrofit techniques will adhere to best access management practices as identified in the National *Access Management Manual*.

8.2.1.2 Access Permit. Access to arterial street public right-of-way (ROW) may be required to be permitted and approved by the City Engineer. An access permit is defined as a permit issued by a governmental agency for the construction, maintenance, and use of a driveway or public street that connects to a roadway. Access locations shall all be measured from the centerline of ROW to centerline of ROW or driveway.

The City Engineer's Office will permit and approve the standard 1/4-mile street locations along all arterial corridors. This permit will be referred to as the Administrative Access Permit. The City will facilitate coordination with all affected landowners before the access permit is approved for the 1/4-mile locations.

The Development Access Permit is a nonstandard access permit that will be completed by the property owner with a supporting map documenting the requested location of each direct or indirect access to arterial public ROW.

All types of access permits will be reviewed based on access category criteria, dimensions from centerline of the ROW from adjacent streets, traffic analysis conducted by City staff, surrounding access points, and any other information relevant to the operation of the access point. The access permit shall conform to the requirements listed in ordinance.

8.2.1.3 Access Category. Access category is defined as a classification system for regulating access that is used to assign a set of access management standards to roadways or roadway segments. The City has four categories of arterial streets and the official access category map is on file at the City Engineer's Office.

Regional—Routes which provide continuity regionally. Full access is spaced at 1-mile intervals and may be spaced at 1/2-mile intervals in regional commercial areas. Traffic signal spacing is typically 1-mile distance apart.

Arterial I—Routes which provide continuity across and are spaced approximately 3 miles from the next parallel Arterial I classification. These routes primarily serve high commercial and commuter need.

> Full movement access is generally allowed at the 1/4-mile locations. Traffic signal spacing will be 1/4-mile distance apart. Other types of access movements will be evaluated with a traffic analysis conducted by City Engineering.

Arterial II—Routes that typically have continuity across the city. These routes serve a mixture of commercial and residential need.

Full movement access is generally allowed at the 1/4-mile locations. Traffic signal spacing will be 1/4-mile distance apart. Other types of access movements will be evaluated with a traffic analysis conducted by City Engineering.

Arterial III—Routes that typically do not continue across the city. These routes serve mainly residential and neighborhood commercial uses.

Full movement access is allowed at the 1/4-mile locations. Traffic signal spacing will be 1/4-mile distance apart. Other types of access movements will be evaluated with a traffic analysis conducted by City Engineering. An additional full movement access at approximately 660 feet from the major intersection may also be considered.

Table 8.0 Access Spacing

Classification	Signal Spacing	Median Opening	Unsignalized Intersection Spacing
Regional Arterial/Expressway	1/2 mile	1/2 mile	2640
Arterial I	1/4 mile	1/4 mile	1320
Arterial II	1/4 mile	1/4 mile	varies
Arterial III	1/4 mile	660	varies

8.2.2 Spacing of Direct and Indirect Access, Angle of Intersection, and Offsets.

8.2.2.1 Spacing. For collectors and local streets in a subdivision, four-legged intersections will normally be spaced at least 300 feet apart.

8.2.2.2 Angle of Intersection. Proposed streets and driveways must intersect one another at 90° angles or as close to 90° as topography permits (no less than 80°).

8.2.2.3 Offsets. When “T” intersections are used, the centerlines of the streets not in alignment must normally be offset by a minimum of 150 feet on local streets and 300 feet on nonresidential local and collector streets.

8.2.3 Functional Street Classification.

8.2.3.1 Major Street Plan. The functional street classification of the City’s street network is shown on the latest version of the Major Street Plan kept in the Office of the City Engineer. The right-of-way requirements are noted in Section 157.098(e) of the Sioux Falls Code of Ordinances—Subdivision Ordinance. The functional classification is a system used to group public roadways into classes according to their purpose in moving vehicles and providing access to the public.

8.2.3.2 Regional Arterial or Expressway. A regional arterial street or expressway is a general term denoting a roadway designed or operating with the following characteristics:

A. Defined as a roadway designed for relatively uninterrupted, high volume mobility between areas, access to which is limited, may include a mixture of intersections (at grade) and interchanges (grade-separated).

B. Posted speed limits of greater than or equal to 45 miles per hour.

C. Anticipated traffic volumes in excess of 25,000 vehicles per day within the corridor. This arterial is designed to carry regional traffic.

D. Direct intersections with local streets and access from adjacent properties shall not be allowed except for existing lots with no other method of access.

E. The indirect access intersections will be with arterials or major collectors and will normally be spaced at one-mile intervals and may be at one-half-mile intervals for commercial areas.

F. Traffic control devices may be provided to enhance through traffic movements.

G. No on-street parking will be allowed.

H. Detached bicycle and/or pedestrian facilities shall normally be constructed.

I. Right-of-way is typically 200 feet in width.

8.2.3.3 Principal Arterial. A principal arterial street is a general term denoting a roadway designed or operating with the following characteristics:

A. Defined as a primary roadway intended to serve regional traffic, where access is carefully controlled; generally roadways of regional importance, intended to serve high volumes of traffic traveling relatively long distances and at higher speeds.

B. Anticipated traffic volumes in excess of 15,000 vehicles per day within the corridor. Posted speed limits of greater than or equal to 40 miles per hour.

C. Designed to accommodate through traffic, intersecting with minor arterial and collector streets only. Intersections with local streets and access from adjacent properties shall not be allowed except for existing lots with no other method of access. The number of intersections will normally not be spaced less than one-half mile. ("T" intersections will be considered an intersection for half-mile spacing purposes.)

D. Continuous for several miles through the urban area and are typically on section line right-of-ways. Right-of-way is 120 feet in width.

E. Provides continuity for rural arterials which intercept the urban boundary.

F. Traffic control devices provided to enhance through traffic primarily by signal control and/or limited access. Right turn lane and/or acceleration/deceleration lanes should be considered at the arterial/collector street intersections.

G. No on-street parking will be allowed.

8.2.3.4 Minor Arterial. A minor arterial street is a general term denoting a roadway designed or operating with the following characteristics:

A. Defined as a major roadway intended primarily to serve through traffic, where access is carefully controlled; generally roadways of community importance, intended to serve moderate to high volumes of traffic traveling relatively long distances and at high speeds.

B. Anticipated traffic volumes in excess of 10,000 vehicles per day within the corridor. Posted speed limit of greater than or equal to 35 miles per hour.

C. Designed to accommodate through traffic and serve adjacent major developments. Intersections with local streets will not be allowed. Development access will use shared driveways and be encouraged to utilize collector streets. The number of intersections will normally not be spaced less than one-quarter mile. ("T" intersections will be considered an intersection for spacing purposes.)

D. Continuous for several miles and are typically on section line right-of-ways. Right-of-way is typically 100–120 feet in width.

E. Provides continuity for rural arterials which intercept the urban boundary.

F. Traffic control devices provided to enhance through traffic primarily by signal control. Right turn lanes and/or acceleration/deceleration lanes should be considered at the collector street intersections or high traffic generators.

G. No on-street parking will be allowed.

8.2.3.5 Major Collector. A major collector street is a general term denoting a roadway designed or operating with the following characteristics:

A. Defined as roadways intended to serve moderate volumes of traffic from local roads to arterials.

B. Anticipated traffic volume generally greater than 5,000 vehicles per day. Posted speed limit of greater than or equal to 25 miles per hour.

C. Typically, but not limited to, located on the 1/2-mile location of a section. Right-of-way is 80 feet. A traffic impact study may determine if there is extra width required to handle a development’s traffic.

D. Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways.

E. Traffic control is provided generally by signs.

F. On-street parking may be allowed.

G. Access locations will not be allowed within 300 feet from the intersection with an arterial street.

H. Generally, serves multi-family residential, commercial, and/or industrial uses. Major collector standards shall apply to street sections where RD-1 zoning is located across the street from multi-family.

I. Major collectors could transition into minor collectors if approved by the City Engineer.

8.2.3.6 Minor Collector. A minor collector street is a general term denoting a roadway designed or operating with the following characteristics:

A. Defined as roadways intended to move traffic from local roads to arterials.

B. Anticipated traffic volume generally less than 5,000 vehicles per day. Posted speed limits of greater than or equal to 25 miles per hour.

C. Should be designed in a way that does not promote through traffic in residential areas. Generally located on the 1/4 and 3/4 points along a section line.

D. Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways.

E. Generally, adjacent land use is single-family residential. Minor collector standards shall apply to street sections where RD-1 zoning is on both sides of the street or across from single-family.

F. On-street parking may be permitted.

G. Right-of-way width is 66 feet. When minor collectors intersect with arterials, the right-of-way is required to be 80 feet within a minimum of 300 feet of the centerline of the arterial street right-of-way.

H. Traffic control is by signage or rules for uncontrolled intersections.

8.2.3.7 Local Street. A local street is a general term denoting a roadway designed or operating with the following characteristics:

A. Posted speed limit not in excess of 25 miles per hour.

B. No criteria for traffic volumes.

C. Limited continuity.

D. Designed for ease of access to adjacent developments.

E. Traffic control is by signage or rules for uncontrolled intersections.

F. On-street parking permitted.

G. Does not intersect with an arterial street.

H. Right-of-way is 60 feet.

8.2.3.8 Private Street. Private streets may be allowed when serving a limited number of parcels if right-of-way constraints exist and when all maintenance responsibilities are detailed within the easement. Private street requirements are noted in Section 157.098(g) of the Sioux Falls Code of Ordinances—Subdivision Ordinance.

8.3 Roadway Design and Technical Criteria

The City of Sioux Falls has adopted a Major Street Plan based on traffic volumes, land use, and expected growth. This Street Plan designates streets as local, minor, and major collector, minor, and principal arterial. The highway design speed shall be used to establish features such as superelevation rate, critical length of grade, vertical and horizontal curves, intersections, etc. See Table 8.1 for design standards for each of these street classifications.

8.3.1 Traffic Lane Widths.

8.3.1.1 The standard traffic lane width shall be 11 feet. Lower lane widths may be used for traffic calming with approval of the City Engineer. For arterial streets and streets with anticipated truck traffic count in excess of 3% of the total traffic count, the lane width shall be 12 feet.

8.3.1.2 In the design of local streets, the number of lanes for moving traffic will be a secondary consideration.

Table 8.1

Minimum Street Design Criteria

Design Elements	Local: Residential Cul-de-sac **	Local: Single-Family	Collector: Minor	Collector: Major	Arterial: Minor	Arterial: Regional or Principal
Design Speed (mph)	—	—	35	40	45	50
Driving Lanes	—	—	2	2-4	4	4 or more
Right-of-Way (ft.)	50	60	66	80	100 +	120 +
Roadw ay Width* (ft.)	29	33	39	39	41-53	65 or more
Min.-Max. Grade (%)	0.6-8.0	0.6-8.0	0.6-7.0	0.6-7.0	0.6-6.0	0.6-6.0
Curb Return Radii (ft.)						
- intersect local	13.5	13.5	20	20	--	--
- intersect collector	20	20	25	25	30	30
- intersect arterial	--	--	30	30	35	35
Horizontal Curve Radius (ft.)	150	150	AASHTO Standards			
Vertical Alignment	AASHTO Standards					
Grade at Intersection*** (%)						
- intersect local	3	3	3	3	—	—
- intersect collector	2	2	2	2	—	—
- intersect arterial	—	—	2	2	2	2

* All dimensions are measured to back of curb. Traffic impact study may warrant additional width.
** Nonresidential cul-de-sac dimensions will differ.
*** In addition to the intersection grade requirements listed on this table, intersection design must also comply with the pedestrian street crossing requirements outlined in the Accessible Sidewalk Requirements chapter of the Engineering Design Standards.

8.3.2 Separate Turning Lanes.

8.3.2.1 Separate turning lanes may be constructed on arterial and collector streets but will, as a rule, not be found on local streets.

8.3.2.2 Where separate turning lanes are constructed on the basis of a capacity analysis at the intersection, a width of 12 feet will be used for arterial streets where truck traffic is involved and 11 feet in width for other streets.

8.3.2.3 A directional median, 3/4 turn or partial opening is allowed in a median section and allows for right in, right out, and left in and/or U-turn movements. The left out movement is prohibited. This directional median opening improves safety at intersections and has been proven to reduce crash rates.

8.3.3 Parking.

8.3.3.1 Parking lanes will not be allowed on arterial streets. Parking lanes may not be allowed on major collector streets.

8.3.3.2 Diagonal or perpendicular parking shall not be allowed on any City street, except by City Council resolution.

8.3.3.3 Where on-street parking is provided on collector streets, the parallel lane width shall be a minimum of 8 feet, including the gutter pan.

8.3.4 Medians.

8.3.4.1 A median is a physical barrier that separates traffic traveling in opposite directions. Medians should be constructed on arterial streets with four or six lanes of through travel. Medians should be constructed at arterial to arterial intersections to provide additional capacity, increased safety, and better traffic operations.

Median openings are normally designated at collector street intersections. These intersections are normally at each quarter-mile location intersecting the arterial street. These openings may be full movement intersections that provide both left in and left out maneuvers. These openings also may be controlled by a traffic signal.

8.3.4.2 Full median breaks shall not be allowed closer than 1,000 feet from an arterial to arterial intersection, unless an exception is approved by the City Engineer.

8.3.4.3 The median width to accommodate a left turn lane is typically 16 feet. The minimum width of a median may be 4 feet back of curb to back of curb.

8.3.4.4 Medians and center boulevards are not typically desired on local streets. However, when permitted, the median or center boulevard shall conform to the same design standards as set forth for arterial streets.

8.3.4.5 Median design may include an irrigation system and landscaping plan to enhance the street corridor. A median landscape design plan shall be approved by the City Engineer. The plan shall include type of groundcover, trees, low shrubbery, and/or other vegetation which will be approved by the City Engineer. If the median width is less than 6 feet wide, other treatments may be explored; for example, colored and/or stamped concrete, concrete pavers. Asphalt is not considered an acceptable paving material for medians. The slopes across a median should be at a minimum 1% from back of curb to the middle of the median to allow for proper drainage

8.3.4.6 U-turns at arterial and collector street intersections may be considered and approved if acceptable right-of-way width is acquired and/or dedicated. U-turns will be allowed at traffic signalized and unsignalized intersections where it is signed appropriately.

In addition, property access to the arterial can be improved by constructing a front or rear service road from a collector street to intersect the arterial street at a traffic signalized intersection. These connections should be explored to compliment U-turn accessibility.

8.3.4.7 Splash guards may be designed in the median. The minimum splash guard width shall be 18 inches.

8.3.5 **Roundabouts.** Roundabouts are considered a form of traffic control. Roundabouts shall be considered as two types: (a) modern roundabouts; and (b) mini-roundabouts.

Purpose. The roundabout is a traffic control device in lieu of a multi-way stop or a traffic signal. Roundabouts may assist in improving the performance of intersections that have the following characteristics:

a. High number of crashes

b. High delays

c. Four legs or more or usual geometry

d. Frequent U-turns

e. High left-turn movements

8.3.5.1 Modern Roundabouts. Modern roundabouts shall be specially designed to the need on high traffic volume streets and used to improve traffic flow.

1. Design Basis. The design shall be in accordance with *NCHRP 672, Roundabouts: An Informational Guide, Second Edition*, or other design criteria approved by the City Engineer. Each design shall have a peer review.

2. Design Vehicle. Modern roundabouts shall be designed to accommodate a WB-67 design vehicle.

3. Roadway Width. The circulatory roadway width shall be a minimum of 1.2 times the width of the widest entering roadway. This width may include the apron when approved by the City Engineer. Truck aprons with a minimum width of 8 feet shall be provided on the perimeter of the central island.

   Each roadway section shall be analyzed to conditions at a particular intersection. Such items as available right-of-way, special or existing features, number of lanes, and roadway width entering the intersection shall be considered in determining the width of the roundabout roadway.

4. Design Entry Speed. Maximum design entry speed for urban roundabout shall not exceed 25 mph. Maximum design entry speed for rural roundabout shall not exceed 30 mph.

5. All modern roundabouts landscaping plans need to be approved by the City Engineer.

8.3.5.2 Mini-Roundabouts. Mini-roundabouts may be allowed in a neighborhood setting to improve intersection characteristics. Mini-roundabouts may be designed in conditions where a maximum of one lane may be entering per approach. The center median of a mini-roundabout may be designed so that the median may be mountable in some cases.

1. Design Basis. The design shall be performed in accordance with *NCHRP 672, Roundabouts: An Informational Guide, Second Edition*, or other design criteria approved by the City Engineer. Each design shall have a peer review.

2. Design Vehicle. Mini-roundabouts shall be designed to accommodate a WB-50 design vehicle. Consideration to emergency vehicles must also be explored with the City during design.

3. Roadway Width. Each roadway section shall be analyzed to conditions that are available to that particular intersection. Such items as available right-of-way, special or existing features, and roadway width entering

the intersection shall be considered in determining the width of the mini-roundabout.

4. All mini-roundabouts landscaping plans need to be approved by the City Engineer.

8.3.6 Traffic Calming. Traffic calming is the process by which vehicular speeds and volumes on local streets are reduced to acceptable levels. This is achieved through the installation of approved devices such as traffic circles, flares, and center islands. Traffic calming serves the purpose of reducing cut-through traffic, truck traffic, excessive speeding, noise, vibration, air pollution, and accidents in an attempt to provide a safer environment for motorists and pedestrians.

Traffic calming is limited to residential streets with a posted speed limit of 25 mph and defined by the Major Street Plan as “Local.”

Traffic calming devices may be installed if the traffic volume exceeds, or is projected to exceed, 1,000 vehicles per day; and if the 85th percentile speed of traffic exceeds, or is reasonably expected to exceed, 30 mph.

Traffic calming devices shall be designed to accommodate emergency vehicles that may use the local street. All final construction plans are to be approved by the City Engineer.

Landscaping agreements for the continued care of vegetation within traffic circles and center islands shall be considered with adjacent property owners and determined on a case-by-case basis.

8.3.6.1 Flares. A flare is a roadway narrowing used to achieve speed reductions. Flares are usually coupled with sidewalks and serve to make streets more pedestrian friendly by reducing the amount of roadway the pedestrian is exposed to. They also draw motorists’ attention to pedestrians via the raised peninsulas.

1. Street Characteristics: Flares may be installed on streets that have on-street parking. Flares can be located at street intersections or mid-block.

2. Pedestrian Generators: Flares should be considered on streets adjacent to pedestrian generators such as schools, parks, and bike paths.

3. Width of Flares: Flares shall be constructed so that driving lanes are no less than 10 feet wide.

8.3.6.2 Center Islands. Center islands are raised islands located at the centerline of a street that narrows the travel lanes at that location. When used in conjunction with sidewalks, center islands can provide a refuge area for pedestrians to wait while traffic passes. Center islands can be located near intersections or mid-block.

1. Street Characteristics: Center islands may be used downstream of intersections to reduce the speed of turning vehicles. Center islands may also be used on curves to reduce vehicle speeds and prevent motorists from driving into the path of oncoming vehicles.

2. Length of Center Islands: Center islands should be constructed in short interruptions rather than as a long median that channelizes and separates opposing flows. Island lengths shall be between 25 feet and 75 feet.

3. Width of Center Islands: Center islands shall be constructed such that the driving lane, excluding drainage gutter, is limited to 11 feet in each direction.

4. Pedestrian Characteristics: Center islands may be required to accommodate pedestrians.

8.3.7 Railroad Overpass Policy.

The City of Sioux Falls has many streets that cross railroad facilities. The majority of these crossings are at-grade, where the transportation facility and the railroad facility are at the same elevation. The remainder of the crossings are grade-separated, where the transportation facility and the railroad facility are separated by a bridge or an underpass. Grade-separated crossings allow continuous vehicle and pedestrian flow, reduce conflicts with the railroad facility, and increase safety. The City of Sioux Falls encourages grade-separated crossings whenever economically and geometrically feasible.

Other communities in surrounding states, various state Departments of Transportation, and the Federal Highway Administration have been consulted on what policies and guiding objectives they use to determine the needs for grade-separated crossings. The majority of these agencies indicated they do not follow an “official” grade-separation policy, but construct them when feasible due to safety and pedestrian/traffic flow.

The following evaluation process is used by the City of Sioux Falls when evaluating the need for a grade-separated crossing. These factors, combined with engineering design criteria and financial and geometric considerations are essential in determining the need for a grade-separated crossing.

8.3.7.1 Design Criteria for a Grade-Separated Crossing.

A grade-separated crossing should be considered when one or more of the following criteria exist:

1. The roadway is designated as an arterial street on the Major Street Plan.

2. The roadway design speed is at least 45 mph.

3. The roadway has a projected average annual daily traffic (AADT) that exceeds 10,000 vehicles per day.

4. The rail line has a design speed of at least 49 mph.

5. The rail line carries an average of three or more trains per day at the location under consideration.

The analysis of all relevant factors identified below should be completed when a location meets one or more of the above-listed design criteria.

8.3.7.2 Analysis of Factors.

Five factors commonly used to analyze a grade-separated crossing are safety, vehicle and pedestrian accessibility, street connectivity, driver delay, and train noise. These factors are indirectly related to the above design criteria and are all considered the same priority in the analysis. The information below should be analyzed and considered to determine if a grade-separated crossing is a better choice than an at-grade crossing.

1. *Safety*

   Safety brings forth much emotion, publicity, and urgency. Vehicle-train crashes, while infrequent, do occur at at-grade crossings and can cause severe injuries and fatalities. Safety is a critical factor to be considered when evaluating possible grade-separated crossing locations.

2. *Vehicle and Pedestrian Accessibility*

   In some areas, it may be relatively easy to bypass an at-grade crossing that is occupied by a train by accessing the nearest grade-separated crossing. In the urban core of Sioux Falls, there are multiple local and arterial streets that provide an alternative if a crossing is blocked, although at times the nearby streets could also be occupied by a train.

   However, in the newer areas of the city, the philosophy of constructing multiple crossings has changed due to the Rail Authority design objectives of reducing crossing conflicts, improving safety, and costs of crossing construction and maintenance. Therefore, crossings occur mainly at arterial streets and may be a mile or more apart. In these locations, the time to bypass the at-grade crossing may actually be longer than the time it takes to wait for the train. This accessibility is an important factor when considering a grade-separated crossing.

3. *Street Connectivity*

   Roadways with grade-separated crossings connect major trip generators and employment centers within a community. These roadway facilities tend to be a higher classification such as arterials and expressways because their main function is mobility versus access to a public right-of-way.

   Because of the increased construction costs of a grade-separated crossing, it is important to locate a grade-separated crossing where it will receive the highest usage.

4. *Driver Delay*

   It is generally recognized that user costs are incurred by drivers waiting for trains at an at-grade crossing. However, that is not the only user cost which may result from delaying drivers at rail crossings. The time it takes for a train to pass can be life threatening to a trauma victim on the way to an emergency room. Therefore, it is important to include the full range of social costs associated with delay at at-grade crossings when looking at delay as a factor in a grade-separated crossing.

5. *Train Noise*

   Train and train whistle horn noise are a significant quality-of-life issue for many communities. The human voice cannot be heard over the noise of a train horn. Phone calls and conversations can be interrupted by the train noise, which may have an impact to property values. Measures, such as banning horn blowing, would create obvious safety concerns and are not supported by the Rail Authority. If an at-grade crossing is replaced with a grade-separated crossing, the need to blow a horn for the crossing is eliminated. Therefore, it is imperative to consider concerns about noise as a factor in evaluating a grade-separated crossing.

Consideration of establishing a *Whistle Free Zone* as described in the Federal Rail Authority (FRA) Regulations also needs to be considered as part of the evaluation. This process is lengthy and would need to be approved by the FRA and Local Rail Authority. Typically, this process would evaluate multiple crossings in an area to show a benefit to the surrounding land uses.

If an at-grade crossing is determined to be the most feasible crossing type, additional crossing improvements are required at each location and include: the installation of crossing gates and arms, the installation of a center median in the arterial street for a minimum of 110 feet back from the rail crossing, signal crossing lights, and protected and signed pedestrian crossings. These costs are generally the responsibility of the agency requesting the rail crossing.

8.4 Shared Use Paths

8.4.1 General. A shared use path shall be constructed on at least one side of all new construction arterial streets and considered on all reconstruction projects.

8.4.2 Design Guidelines. Multi-use, shared use, and bicycle facility designs shall comply with the current AASHTO publications *Guide for the Development of Bicycle Facilities* and *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide* and *Urban Street Design Guide*, the Institute of Transportation Engineers (ITE) *Designing Urban Walkable Thoroughfares*, *Public Rights-of-Way Accessibility Guidelines* and other current design flexibility guidelines defined by the Federal Highway Administration. Design shall also comply with requirements in Chapter 16 Accessible Sidewalk Requirements.

A shared use path is physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Most shared use paths are designed for two-way travel and are a supplemental network to on-road bicycle facilities and should not be used an alternate for an on-road bikeway. Shared use paths may be used by bicycles, pedestrians, skaters, and other nonmotorized users. A side path is a type of shared use path that runs adjacent to the roadway and should only be used when other shared use path options are not available. Vertical clearance to obstructions shall be 100 inches minimum and 120 inches desired.

The same considerations (design speed, horizontal alignment, superelevations, grade, etc.) that go into designing a highway system also apply to shared use facilities. The AASHTO *Guide for the Development of Bicycle Facilities* contains many useful design parameters and considerations.

8.4.3 Width. A shared use path shall have a minimum width of 12 feet. Under special circumstances, the City Engineer may allow a narrower path.

8.4.4 Shoulder. A shared use path shall have 24-inch-wide vegetated shoulders on both sides.

8.4.5 Vertical Clearance to Structure. Shared use paths which go under a roadway or structure shall have a minimum clearance of 8 feet from the top of the path to the lowest part of the structure.

8.4.6 Structure Width. Structures or tunnels constructed for shared use paths shall have a minimum 12-foot horizontal clearance from wall to wall. The entrances and exits to tunnel sections shall be as visually free of trees, shrubs, and other obstructions to facilitate a wide field of view when exiting tunnels.

8.4.7 Tunnel Lighting. Tunnel sections shall be lit according to current AASHTO lighting guidelines. It is recommended that the ceilings in the tunnel are painted white.

8.5 Drainage

Drainage systems shall be designed in accordance with Chapter 11—Drainage Improvements. Development plans, including drainage studies, shall be considered as part of the street design and will be required for concurrent review with the street construction plans. Safe conveyance of traffic is the major function of streets; the storm drainage function of the street must therefore be designed to the limits set forth in Chapter 11—Drainage Improvements.

8.5.1 Valley Gutters. Valley gutters shall be constructed in accordance with the City of Sioux Falls Standard Plates. Valley gutters are not permitted across arterial streets and are discouraged across collector streets. Valley gutters are not allowed on streets with storm sewer systems.

8.5.2 Inlets. Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by the storm runoff. Refer to Chapter 11—Drainage Improvements for curb capacity. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation. Due to the presence of curb ramps, inlets are not allowed in the curb return, but will be located at the tangent points of the curb returns. In general, inlets shall be placed on the upstream side of the intersection so as to intercept the water before it reaches the pedestrian crosswalk.

8.5.3 Cross-slope. Except at intersections or where superelevation is required, streets, in general, shall be level from top of curb to top of curb (or flowline to flowline) and shall have a crown between 1.5% and 3% as measured from centerline to lip of gutter, or lip of median gutter to lip of outside curb on roadways with medians. Where the crown is not centered in the street, it can be no further than the quarter point of the street.

8.5.4 Temporary Erosion Control. Temporary erosion control is required at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with Chapter 12—Erosion Control and with the Subdivision Ordinance of the City of Sioux Falls.

8.5.5 Sidewalk. Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks, but shall drain to the roadway by use of storm sewers. Sidewalk chases will not be allowed unless specifically approved by the City Engineer. If permitted, sidewalk chase sections shall not be located within a driveway.

8.6 Horizontal Alignment

8.6.1 Horizontal Curves. Any angular break in horizontal alignment of more than 2° shall require a horizontal curve (see Table 8.1).

8.6.2 Curb Return Radius. Minimum curb return radius shall be as shown in Table 8.1. Where truck traffic is significant, curb return radii shall be provided in accordance with AASHTO standards.

8.6.3 Construction Signs and Barricades. Design and construction shall comply with the requirements of the *Manual on Uniform Traffic Control Devices*, latest edition. Details shall be shown on the construction drawings, and installation shall be provided by the contractor and/or owner.

8.6.4 Superelevation. The use of superelevation is discouraged on all streets. However, where superelevation is required for curves on arterial streets and collector streets, horizontal curve radius and superelevation shall be in accordance with the recommendations of the AASHTO standards. Superelevation shall not be used on local roadways. All roadway designs utilizing superelevation are subject to review and acceptance by the City Engineer.

8.6.5 Spiral Curves. Spiral curves shall not be used on streets within the city except upon written acceptance of the City Engineer.

8.6.6 Cul-de-sacs. The following criteria shall be used for the horizontal geometry of cul-de-sac turnarounds:

(1)	Minimum property line radius:	Residential	55.0 feet
		Nonresidential	65.0 feet
(2)	Minimum back of curb radius:	Residential	40.5 feet
		Nonresidential	50.5 feet
(3)	Maximum length of cul-de-sac measured along centerline, between the radius point of the turnaround and the R.O.W. line of the abutting street		500.0 feet

8.6.7 Transition Length. If lanes are added, deleted, or adjusted, it will be necessary to construct a transition section for the safe conveyance of traffic. The following formula shall be applied to the taper or lane change necessary for this transition:

$$L=WS^2/60$$

where:

L = Length of transition in feet
W = Width of offset in feet
S = Speed limit or 85th percentile speed

8.7 Vertical Alignment

8.7.1 Changing Grades. The use of grade breaks, in lieu of vertical curves, is not encouraged. However, if a grade break is necessary and the algebraic difference in grade does not exceed eight tenths of a percent (0.008 ft/ft), the grade break will be permitted.

8.7.2 Vertical Curves. Design controls for vertical alignment must be in accordance with AASHTO standards. When the algebraic difference in grade (A) is at or exceeds eight-tenths of a percent (0.008 ft/ft), a vertical curve is to be used. All vertical curves shall be labeled, in the profile, with length of curve (L) and K (defined as L/A).

8.7.3 Intersections. The following criteria shall apply at intersections:

8.7.3.1 Intersection design must comply with the grade requirements outlined in the Accessible Sidewalk Requirements chapter of the Engineering Design Standards.

8.7.3.2 The grade of the “through” street shall take precedence at intersections. At intersections of roadways with the same classification, the more important roadway, as determined by the City Engineer, shall have this precedence.

8.7.3.3 The elevation at the end of curb return on the through street is always set by the grade of the through street in conjunction with normal pavement cross-slope.

8.7.3.4 Carrying the crown of the side street into the through street is not permitted.

8.7.3.5 Dipping the flowline to the extent that the lip of gutter is dipped is not permitted, except as specified by Standard Plates concerning curb opening inlets. Tipping an inlet for the benefit of drainage is also not permitted.

8.7.3.6 A more detailed review shall be performed for arterial-arterial intersection to maximize driveability.

8.7.3.7 Flowline profiles and pavement cross-slopes shall be shown through an intersection until a normal cross-section is obtained. Elevations on a 15-foot grid shall be shown on a plan view drawing. This information shall be submitted using a scale of 1" = 20' horizontally and 1" = 2' vertically.

8.7.3.8 Parabolic or curved crowns are not allowed. In no case shall the pavement cross-slope at intersections exceed the grade of the through street.

8.7.3.9 The rate of change in pavement cross-slope, when warping side streets at intersections, shall not exceed 1% every 25 feet horizontally on a local roadway, 1% every 37.5 feet horizontally on a collector roadway, or 1% every 56.5 feet horizontally on arterial roadways.

8.7.4 Curb Returns. Minimum fall around curb returns shall be 0.6%, but shall not exceed grades established by the Accessible Sidewalk Requirements Chapter of the Engineering Design Standards.

8.7.5 Connection with Existing Roadways.

8.7.5.1 Existing grade(s) shall be shown for a sufficient distance to assure that horizontal and vertical curve requirements are being or can be met with field verified as-builts showing stations and elevations at 25-foot intervals. In the case of connection with an existing intersection, these as-builts are to be shown within a 100-foot radius of the intersection. This information shall be included in the plan and profile that shows that proposed roadway. Limits and characteristics of the existing improvement are the primary concern in the plan view. Such characteristics include horizontal alignment, offset intersections, limits of the improvements, etc.

8.7.5.2 Previously approved designs for the existing improvement are not an acceptable means of establishing existing grades; however, they are to be referenced on the construction plan where they occur.

8.7.5.3 The basis of the as-built elevations shall be the same as the design elevations (both flowline or both top of curb, etc.) when possible.

8.7.6 Sight Distance

8.7.6.1 Design of roadway alignment, intersections, and accesses shall comply with standards outlined in *A Policy on Geometric Design of Highways and Streets"* (AASHTO Standards).

8.8 Off-Site Design

The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued, in the same plan and profile as the proposed design, for at least 300 feet or to its intersection with another roadway. This limit shall be extended to 600 feet when arterial roadways are being designed.

8.9 Construction Traffic Control

8.9.1 Pedestrian Accommodations Through Work Zones.

8.9.1.1 When pedestrian facilities are impacted due to maintenance or construction, pedestrian accommodations must be provided to the maximum extent feasible. These accommodations must have accessibility features up to the level of the disturbed route. Signage and temporary barricades must be provided to direct pedestrians safely through the work zone.

8.9.1.2 Temporary pedestrian access routes shall be designed in compliance with *Public Rights-of-Way Accessibility Guidelines* and *Manual on Uniform Traffic Control Devices* requirements.

8.9.2 Vehicular Traffic.

8.9.2.1 Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the *Manual on Uniform Traffic Control Devices*, latest edition. A traffic control plan shall be submitted to and approved by the City Engineer, or designated agent, prior to start of any construction.

8.9.2.2 For construction of new facilities, traffic control should strive to keep the motorist from entering the facility. The primary means to accomplish this are by use of temporary barricades, located in advance of the construction area, and with appropriate signing. New construction shall not be opened to traffic, and the construction traffic control removed, without the approval of the Project Engineer and the City Engineer.

8.9.2.3 The details of the traffic control plan must be shown on a map. For minor projects or local roadways, a neat sketch of the roadways and the proposed control devices will suffice. For major projects or major roadways, the traffic control plan shall be superimposed on as-builts, construction plan drawings, or other detailed map.

8.9.2.4 The *Manual on Uniform Traffic Control Devices*, latest edition, shall be the basis upon which the traffic control plan is designed, in concert with proper, prudent, and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc., shall be shown on the plan.

8.9.2.5 Any plan for traffic control during construction that indicates a complete closure of an arterial or collector street must show detour routes and must be approved by the City Engineer. Requirements as to rerouting of traffic, signing, time of closure, and length of closure will be determined on a case-by-case basis. When a local street is to be closed to traffic, the City Engineer must be notified, preferably 48 hours in advance.

8.9.2.6 Directional access on roadways may be restricted (minimum travel lane width in construction area is 10 feet), but proper controls including flagging must be indicated. Removal of on-street parking shall be considered and noted where applicable.

8.10 Turn Lanes

The design of the arterial street system depends upon the proper control of access to developments and turn lanes at collector street intersections. The location and design of access points must minimize traffic hazards and interference to through-traffic movements. In order to ensure proper access control, the following standards for turn lanes have been established.

8.10.1 Where Required. Turn lanes may be required along segments of arterial or collector streets if the proposed development constitutes a potential for creating a traffic hazard or unnecessarily impedes through-traffic movements as determined by the Traffic Impact Report or the City Engineer. A turning lane must be provided at a high volume access to allow the driver to maneuver out of the main travel lanes before slowing down. Left turn lanes must be provided in the center or median of the road for left turning traffic at a high volume access. If such lanes cannot be provided, left turns will be restricted.

Turn lanes for right turning movements will be required as necessary at intersections for capacity and safety. Turn lanes for access points shall be according to Table 8.2

Table 8.2: Volume Warrants for Turn Lanes at Access Points for Right Turning Movements

	POSTED SPEED OF STREET IN MPH				
	Less than 25	26 to 40	41 to 50	51 or greater	For
If the design hour volume of the high-way lanes will exceed	500	400	200	150	2-lane streets
	1400	1200	800	600	4 or more lanes
and the design hour volume of the access approach will exceed	50	40	20	15	2-lane streets
	70	60	40	25	4 or more lanes

For streets with four or more through travel lanes, design hour volumes shall be measured only in the direction of the access approach.

8.10.1.1 For left turning movements, turn lanes will be required as necessary at intersections for capacity and safety. Turn lanes for access points shall be according to Table 8.3

Table 8.3: Volume Warrants for Turn Lanes at Access Points for Left Turning Movements

	POSTED SPEED OF STREET IN MPH				
	Less than 25	26 to 40	41 to 50	51 or greater	For
When design hour volume of the high-way will exceed	500	400	200	150	2-lane streets
	1000	900	600	400	4 or more lanes
and the left turning design hour volume into the access approach will exceed	50	40	20	15	2-lane streets
	70	60	40	25	4 or more lanes

For streets with four or more through travel lanes, design hour volumes shall be measured only in the direction of the median turn lane.

8.10.1.2 For both tables, where the existing street design hour volume is below the values in the tables, a prediction using the Metropolitan Planning Organization horizon year planning model shall be made and compared to the table.

8.10.1.3 Where public safety so requires, due to specific site conditions, such as sight distance, a turn lane may be required even though the warrants in Tables 8.2 and 8.3 are not met. Where the design hour volume of the street is twice the street design hour volume in Tables 8.2 and 8.3, the City may require a minimum turn lane for any access approach.

8.10.2 Turn Lane and Acceleration Lane Design.

8.10.2.1 On highway arterial and collector streets in the city, the design of acceleration/deceleration lanes shall meet the minimum requirements as shown in Tables 8.4 and 8.5, providing sufficient off-site right-of-way is available. These minimum requirements were developed recognizing the severe limitations that currently exist on right-of-way availability for most of the urban street network. Where grades are significant, modifications to these lengths will be required by the City. If off-site right-of-way is insufficient, lanes will be designed to maximize the use of available right-of-way at the time that construction plans receive final approval. The percentile queue values are determined by Synchro or other similar traffic analysis software. The queue blockage should be considered in the design.

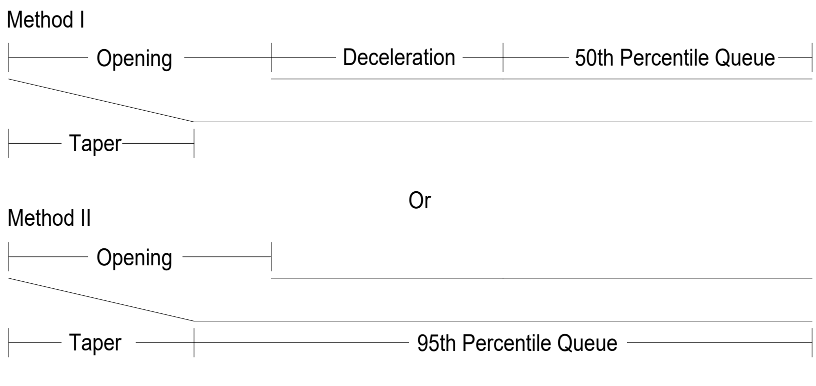
Table 8.4: Acceleration Lane Lengths

(1) SPEED (MPH)	LANE LENGTH		TAPER LENGTH
	Stop Condition	From 15 mph (2)	
30	150'	125'	120'
35	175'	150'	150'
40	250'	200'	180'
45	300'	250'	180'

(1) 85th percentile speed.
(2) Assumes vehicles start at 15 miles per hour.

Table 8.5: Turn Lane Lengths

Posted Speed	Taper	Opening	Deceleration	50th Percentile Queue	95th Percentile Queue
30 mph	60'	60'	75'	Values determined by software analysis	
35 mph	60'	85'	75'		
40 mph	90'	120'	100'		
45 mph	120'	150'	125'		



Use the larger of the two design methods for each turn lane

8.10.3 Exemptions. Requests for an exemption from deceleration lane requirements shall be based on a traffic engineering study that presents trip generation data for the proposed development in terms of impacts on through-traffic flows. An exemption will not be granted if through-traffic would be impeded more than 3% of the total time or more than 5% of the time during peak traffic flow periods. Other unique circumstances may warrant special design considerations and prohibit an exemption. Exemptions must be approved by the City Engineer following a review of the traffic engineering study.

8.11 Pavement Thickness/Street Section

Design of pavement thickness for collector and arterial streets and local streets in industrial and commercial zoned areas shall be based on *AASHTO Guide for Design of Pavement Structures*, latest edition. Pavement design shall be based on an inherent reliability of 75%. For traffic conditions where the equivalent 18 kip/single axle loading is less than 1,000,000, the low-volume road design method may be used. Recommendations and subgrade properties developed by the Geotechnical Exploration Report shall be used in the design of the pavement structure.

8.11.1 Industrial and arterial streets must be designed for pavement thickness on an individual street-by-street basis. However, in no event may the pavement thickness be less than that specified in Table 8.6. Local residential streets need not be designed on an individual basis, but must meet the minimum pavement thickness as set forth in Table 8.6.

8.11.2 Minimum compressive strength for Portland cement concrete paving shall be 4000 psi at 28 days.

8.11.3 **Traffic Data.** Where traffic data is available, actual counts shall be used along with projections of traffic growth in determining the pavement design. If traffic data is not available, Table 8.7 may be used to provide data for the pavement design. Traffic data for all arterial streets will be determined by the City Engineer.

Table 8.6
Minimum Pavement Thickness Requirements

	Local Residential Streets	Commercial, Industrial & Collector Streets	Arterial Streets
Portland Cement Concrete (Requires Aggregate Cushion)	6"	8"	8"
Hot Mix Asphalt with Aggregate Base	4" HMA / 6" Aggregate	5" HMA / 9" Aggregate	6" HMA / 12" Aggregate

Table 8.7
Traffic Volumes

Street Classification	**ADT** (2 way)	**No. of** Lots	18-kip **ESAL** Traffic	AASHTO **Traffic** Level
Cul-de-sacs and Local Residential	200	20–30	10,000–50,000	Low
Local, Local Multi-Family, or Commercial	300–700	60–140	50,000–300,000	Low
Local Industrial	200–700		400,000–600,000	Medium
Collector	7,000		400,000–1,000,000	High
Arterial	To be determined by the City Engineer			

8.12 Rural Section Street Standards (Inside City Limits)

Design of rural section streets within city limits shall conform to the current editions of the AASHTO *Policy on Geometric Design of Highway and Streets* and the AASHTO *Roadside Design Guide.* All rural section streets shall be approved by the City Engineer.

Where bicycle facilities are included as part of the design, reference should be made to the current edition of the AASHTO *Guide for the Development of Bicycle Facilities.*

8.13 Rural Subdivision Road Standards

8.13.1 New subdivisions outside of the city limits and within the extraterritorial platting jurisdiction shall comply with these requirements.

8.13.2 Access shall be determined by street classification. Roadway serving the subdivision must be hard surfaced as approved by the City Engineer.

8.13.3 Driveways shall be hard surfaced and comply with Figure 5.3 of the Engineering Design Standards.

8.13.4 Minimum width of the driving surface shall be 24 feet with 2-foot shoulders. Minimum street section shall be 4-inch asphalt with 6-inch aggregate base. Ditches shall have a maximum 4:1 side slope. Additional width may be required for higher traffic roadways as determined by the City Engineer.

8.13.5 A plan and profile for connection to existing trunk sanitary sewer and its extension upstream is required. Where trunk sewers cross roadways, the ultimate roadway grade shall be called out.

8.13.6 An access road agreement or other arrangements for maintenance of detention ponds and/or BMP facilities shall be provided by association or other perpetual contract.

8.13.7 Culverts in the street right-of-way shall comply with county requirements. Flared end sections or slope concrete headwalls are required on all culverts within the road right-of-way.

8.13.8 The size of culverts shall be determined by a drainage study for the entire subdivision.

8.13.9 The City Engineer's Office will be responsible for accepting final street and drainage plans and coordination of road access and approach permits with county, township, and SDDOT officials.

8.13.10 Traffic control signs and street name signs shall be properly posted. Street names shall be approved by the City Street Naming Committee.

8.14 Minimum Street Requirements for Annexation of Existing Developments

Rural infrastructure may remain after a rural neighborhood or individual property is annexed, provided it meets the minimum standards below. Design standards shall follow guidance in the AASHTO Policy on Geometric Design of Highway and Roadside Design Guide.

8.14.1 Width of local and collector roadways shall be a minimum of 24 feet from edge to edge of driving surface. When fire hydrants are located along roadway, the minimum width shall be 26 feet from edge to edge of driving surface.

8.14.2 Collector roads shall be asphalt surfaced with minimum thickness of 4 inches of asphalt or as approved by the City Engineer. Local roads may be gravel surfacing as approved by the City Engineer.