

## SECTION 500 CITY STREET CONSTRUCTION

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**SECTION 500 CITY STREET CONSTRUCTION****510.00 GENERAL**

## 511.00 Applicability

This Section contains design and testing criteria that must be met on all newly designed and constructed streets and public parking lots in the City.

## 511.01 Situation Variances

Where any particular requirements contained in this Section of these STANDARDS AND SPECIFICATIONS can be shown to be inappropriate when applied to an out-of-the-ordinary situation, exemptions to said minimum requirements will be considered and may be authorized by the Director(s). The proposed variance in the requirements must result in a level of safety, service, and quality equal to or greater than that intended by the application of said requirements.

## 511.02 Complete Streets

The purpose of this section is to establish a procedure by which the City shall incorporate Complete Streets in the routine planning, design, implementation, and operation of transportation infrastructure to accommodate the needs of all users in a safe, efficient, and reliable manner that provides for a livable, connected and sustainable city.

This standard shall be in accordance with other guidelines that relate to the design and operation of public right-of-ways.

## 511.02.01 Definitions

Complete Streets: the practice to promote safe and convenient access for all users along and across travel ways in the context of the overall transportation network, land use patterns, and community needs.

Transportation infrastructure: any facility designed for transporting people and goods including, but not limited to, sidewalks, trails, bike lanes, highways, streets, bridges, runnels, railroads, mass transportation, and parking system.

All Users: Include and are not limited to pedestrians, bicyclists, transit users, emergency responders, freight haulers, motorists, and users of all ages, abilities, and incomes.

## 511.02.02 Procedure

1. Streets and Fleet, as well as all other applicable departments, shall integrate the practice of promoting safe and convenient access for all users into plans, manuals, rules and regulations, and programs, as appropriate.
2. The City shall review all construction, reconstruction, and maintenance projects that affect the City's multimodal transportation infrastructure for Complete Streets. Projects shall be assessed based on the existing and future context of the affected transportation infrastructure within the overall multimodal network, as identified by recognized plans with pedestrian, bicycle, and transit guidelines.

No one design standard, treatment, or typical section constitutes Complete Streets. The practice of promoting safe and convenient access for all users takes guidance from, but not limited to, the most recent versions of the following:

- a. Manual on Uniform Traffic Control Devices (MUTCD)
  - b. National Association of City Transportation Officials (NACTO)
  - c. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
  - d. AASHTO Guide for Development of Bicycle Facilities.
3. Streets and Fleet, as well as all other applicable departments, shall seek opportunities to apply Complete Streets to already funded projects or programs, or shall pursue funding from various resources for projects whose purpose is promoting safe and convenient access for all users, when appropriate.
  4. Developers shall seek to include complete street standards in all proposed projects.

#### 511.02.03 Exceptions

The Director(s) or his designee may approve an exception to this section based upon one or more of the following criteria:

1. Maintenance activities designed to keep transportation facilities in serviceable condition (e.g., mowing, cleaning, sweeping, spot repair and surface treatments such as chip seal, or interim measures on detour routes),
2. Reconstruction of the right-of-way is due to an emergency,
3. Bicycle, pedestrians, and/or motorized vehicles are prohibited by law from using the facility,
4. Contrary to acceptable guidance on public health, safety, or welfare,
5. Cost is excessively disproportionate to the need for probability of use, and
6. Other factors indicate an absence of need, including future need (e.g., parallel facilities provide adequate accommodation for other users).

#### 512.00 Private Street Systems and Parking Lots

Private street systems and public parking lots will be subject to all requirements of these STANDARDS AND SPECIFICATIONS. The Director(s), as provided for in Section 511.01 of these STANDARDS AND SPECIFICATIONS, may allow variances, subject to the review and acceptance.

Parking stall dimensions, lot layout, and circulation pattern shall be reviewed and approved by Streets and Fleet and other departments, as applicable.

#### 513.00 City Capital Improvement Projects

It is recognized that the requirements contained in these STANDARDS AND SPECIFICATIONS are not necessarily sufficient for plans; specifications and contract administration purposes for City administered street capital improvement projects. Accordingly, the Director of Streets and Fleet is authorized to develop and approve such additional requirements and procedures necessary for

bidding, award, and construction administration for such projects. Additional said requirements and procedures must be consistent with these STANDARDS AND SPECIFICATIONS and all applicable provisions of other City codes.

**514.00 Final Overlay**

Final overlay shall not be scheduled until 2 years have expired since the initial construction surface was installed or at 100% built out, or as approved by the Streets and Fleet Director or his designee. Street section prior to final overlay shall provide positive drainage to gutter; ponding of stormwater on asphalt adjacent to and outside of gutter and inlets is not acceptable.

When determined necessary by the Streets and Fleet Director or his designee, prior to installation of the final bituminous surface course, the developer will furnish the Director with two (2) copies of a report, prepared by a Registered Professional Engineer licensed to practice in Colorado, utilizing non-destructive deflection testing to assess and predict the performance of the pavement. The Professional Engineer shall have a past history and knowledge in performing these tests.

The pavement evaluation will be performed in accordance with good engineering practices. The report will generally embody the following testing and pavement evaluation techniques:

- A. Environmental study (frost cycle, drainage, etc.)
- B. Pavement surface evaluation
- C. Soil borings in areas of high deflections
- D. Pavement deflection analysis (Dynaflex, Benkelman Beam, etc.)

The report will evaluate the existing condition of the base and binder course by performance of deflection tests at a minimum of one hundred foot (100') spacing per traffic lane. The report will determine the thickness of the final lift to ensure that the pavement section will meet a twenty (20) year (or greater) pavement life.

The Pavement Evaluation Report will not be considered valid unless the wearing surface is applied during the same construction season as the testing was done.

**515.00 Traffic Control Plan**

Prior to the commencement of any construction within the City right-of-way, the Contractor must prepare and submit for review and approval a Traffic Control Plan in conformance with Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS.

**520.00 DESIGN CRITERIA**

Street design, construction and right of way requirements will conform to the provisions of these STANDARDS AND SPECIFICATIONS. Street design criteria for various street types are listed in Table 500-3, Section 525.00 Vertical Alignment, and the Standard Details. The requirements of the City's Municipal Code and Comprehensive Master Plan will be met. Throughout this

Section reference to a “Qualified Soils Engineer” shall mean a soils engineer who is a Registered Professional Engineer licensed to practice in Colorado.

**521.00 Geometric Cross Sections, Intersections and Street Layout**

Street cross sectional elements will be based on the roadway classification shown on the City of Brighton Transportation Master Plan. Generally, local residential cross sections will be used in areas where average daily traffic (ADT) is not likely to exceed one thousand (1,000) vehicles per day. Collector and arterial streets will be constructed whenever the alignment of the proposed street is generally the same as the collector and arterial streets shown on the Comprehensive Master Plan, and whenever a traffic engineering analysis of the future traffic volumes indicates the need of a cross section greater than that of a local service street.

Additional right of way may be required to satisfy other criteria contained in these STANDARDS AND SPECIFICATIONS. Areas outside the Right of Way will be graded, compacted, and sloped, as required for proper drainage, soil stability, and maintenance accessibility. Cuts and fills proposed on slopes greater than four horizontal to vertical (4:1) will require supporting calculations done by a qualified soils engineer based on a soils analysis.

**521.01 Roadway Functional Classification**

Functional classification is the assignment of roads into systems according to the character of service they provide in relation to the total road network. The three main categories of roads are arterials, collectors and locals. Arterial roadways are further divided into major arterials and minor arterials. Collector sections vary based on the elements required within the roadway section (e.g. parking, turn, or bike lanes).

Average daily traffic and peak traffic volumes shall be considered in the functional analysis of streets and driveways.

**521.02 Alleys**

All alleys, when permitted by the Director, shall be paved to a full width and shall provide paved access to a paved street at both ends. Minimum right-of-way widths are 16’ without utilities and 30’ with utilities. Pavement minimum width is 12’. Dead end alleys are not be permitted. Alleys greater than 600’ in length shall have a secondary access to a residential street. Alleys shall not drain to private property.

**521.03 Emergency Access**

Any public vehicle access must meet the requirements of the requirements of the Streets and Fleet Department as well as the Brighton Fire Protection District. Emergency access roads shall have a minimum clear roadway width of twenty (20) and shall meet the requirements of the Brighton Fire Rescue District. Emergency access roads shall also have a minimum outside curve radius of fifty-two (52) feet with a minimum of twenty (20) feet unobstructed drive access width. Emergency access roads shall be fully contained within appropriate easement or right-of-way.

**521.04 Intersection Design Guide**

The design of at-grade intersections requires strict conformance with standard practice, combined with the experience and creativity of the designer in selecting and applying the most appropriate treatment to accommodate each traffic movement. Uniformity is an important ingredient of intersection design because it is essential that all road users encounter familiar conditions at each intersection. Uniform standards and principles also serve to promote intersection treatments that have proven successful and have been accepted by transportation professionals and road users.

Additionally, each intersection may have unique features that distinguish it in some way from other intersections. Legitimate differences in local preferences have created a set of equally acceptable alternatives for some treatments. This creates a tradeoff between uniformity and flexibility. Clearly, the most appropriate design policy is one that sets forth the standards and principles that must be observed and provides some latitude for choice in areas where choice can be offered.

The purpose of this document is to identify the mandatory requirements and to provide guidelines for choice where alternatives exist. The guidelines represent a combination of material from authoritative references and research reports combined with the consensus of a broad based technical advisory committee of transportation professionals.

**521.04.01 Requirements and Objectives**

The guidelines presented in this document are based on the premise that the design of an intersection must conform in all respects to the provisions of the Colorado Statutes and rules, plus all authoritative references that have been adopted as standards by Colorado Department of Transportation (CDOT).

No physical objects may be placed in the sight triangle area which has a height of greater than thirty (30) inches or may grow to exceed thirty (30) inches. Sight triangle shall follow AASHTO guidelines.

In addition, the design should be such that it provides:

- Safe and convenient operation for all road users, including cyclists and pedestrians;
- Proper accessibility for pedestrians with special needs;
- Adequate capacity for peak-hour demand on all movements;
- Adequate maneuvering space for design vehicles;
- Resolution of conflicts between competing movements;
- Reasonable delineation of vehicle paths;
- Adequate visibility of conflicting traffic;
- Storage for normal queuing of vehicles;
- Appropriate access management application;
- Minimum delay and disutility to all road users;
- Proper drainage of storm water;



- Accommodation for all utilities, both above and below the ground;
- Necessary regulatory, warning and informational messages for all road users;
- Suitable advance warning of all hazards; and
- Uniformity of treatment with similar locations

#### 521.04.02 Intersection Geometric Design Guide

##### General Design Analysis

Geometric design involves the proportioning of the visible elements of highway facilities. It includes the design of horizontal alignment, vertical alignment, and cross section elements such as lane, shoulder, median, curb, barrier, sidewalk, etc. These elements provide the framework for the design of other highway elements including traffic control devices, roadway lighting, pavement design, drainage, and structural design.

Although the design of an intersection may be influenced by constraints unique to its particular location or situation, it conforms generally to the following design principles:

- The design of intersections along a given street or highway should be as consistent as possible.
- The layout of the intersection should be as simple as is practical.
- The design of all intersection elements should be consistent with the approach design speeds.
- The approach roadways should be free from steep grades or sharp horizontal or vertical curves.
- Intersections should be as close to right angle as practical.
- Sight distance should be sufficient for crossing and turning maneuvers.
- The intersection layout should encourage smooth flow and discourage wrong way movements.
- Auxiliary turn lanes should be provided on high-speed and/or high-volume facilities.
- Acceleration lanes are desirable for entrance maneuvers onto high-speed facilities.
- Design must give special attention to the provision of safe roadside clear zones and horizontal clearance.
- The intersection arrangement should not require sudden and/or complex decisions.
- The layout of an intersection should be clear and understandable.
- Special consideration should be given to requirements for accommodating alternative modes, including bicycle and pedestrian movements.

Acceleration and deceleration lanes may be required as a condition of access approval on collector and arterial streets where it is necessary for public safety and traffic operations.

#### 521.04.03 Intersection Control

At-grade intersections on that are typically controlled by stop signs (i.e., stop controlled) or traffic signals (i.e., signalized). The type of intersection control has a direct effect on a number of geometric design features, including sight distance and storage length of auxiliary lanes.

Area type is typically classified as urban or rural. Each of these area types has fundamentally different characteristics with regard to development and types of land use, density of street and highway network, nature of travel patterns and ways in which these elements are related. Consequently, the intersection design requirements for each of these areas vary.

Design speed is a principal design control that regulates the selection of many of the project standards and criteria used to design a roadway project. It must be selected very early in the design process. The selection of an appropriate design speed must consider many factors. The AASHTO Green Book has a thorough discussion on design speed and these factors.

#### 521.04.04 Intersection Vertical Alignment Grade Considerations

The profile grade line defines the vertical alignment for roadway and bridge construction. As with other design elements, the characteristics of vertical alignment are influenced greatly by basic controls related to design speed, traffic volumes, and functional classification, drainage, and terrain conditions. Within these basic controls, several general criteria must be considered, including minimum and maximum grades, vertical curvature, and maximum change in grade without vertical curves, vertical clearance, and design high water.

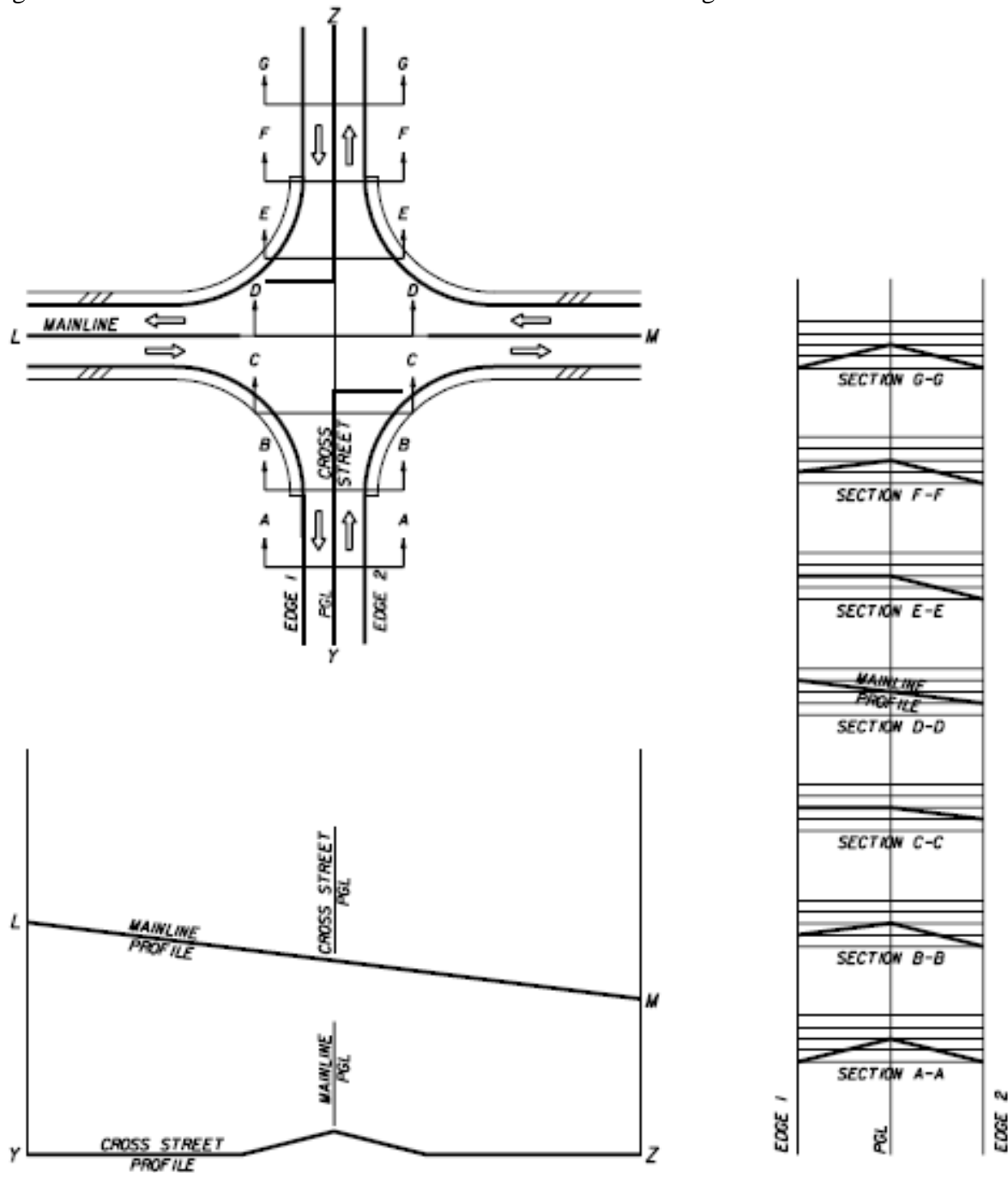
As a rule, the alignment and grades are subject to greater constraints at or near intersections than on the open road. Their combination at or near the intersection should produce traffic lanes that are clearly visible to drivers at all times and clearly understandable for any desired direction of travel, free from sudden appearance of potential conflicts and consistent in design with the portions of the highway just traveled.

Combinations of grade lines that make vehicle control difficult should be avoided at intersections. Substantial grade changes should be avoided at intersections. Adequate sight distance should be provided along both intersecting roads and across their included corners, including where one or both intersecting roads are on vertical curves. The gradients of intersecting roads should be as flat as practical on those sections that are to be used for storage of stopped vehicles.

Most drivers are unable to judge the increase and decrease in stopping or accelerating distance that is necessitated by steep grades. Grades listed in Section 500 City Street Construction should be used on intersecting roads approaching the intersection.

The profile grade lines and cross sections on the intersection legs should be adjusted for a distance back from the intersection proper to provide a smooth junction and proper drainage. Generally, the grade line of the major road should be carried through the intersection and that of the minor road should be adjusted to it. This design involves a transition in the crown of the minor road to an inclined cross section at its junction with the major road, as demonstrated in Figure 521.

Figure 521 Crown Transition through an Intersection



521.04.05 Special Intersection Profiles

To ensure a safe, efficient, well drained, and smooth roadway system, the profiles of some roadway elements requiring special analysis must be provided. These elements include pavement edges or gutter flow line at street intersections, profile grade line, intersection plateau, curb returns and roadway sections requiring special super elevation details. The special profiles shall include details at close intervals and at a scale large enough to clearly identify all construction details of these elements.

**521.04.06 Intersection Plateau**

The profile of the major roadway generally takes precedence over the minor cross street. This results in a hump for the cross street profile which is particularly undesirable for signalized intersections where the cross street traffic may enter the intersections without stopping. In some instances the designer may determine that the cross street should receive the same profile considerations as the major roadway due to similar traffic demands. To provide this equal consideration, a technique commonly known as intersection plateauing is applied. Plateauing refers to the transitioning of the roadway profiles and cross slopes at the approaches of an intersection.

**521.04.07 Cross Slope**

The rate of change in pavement cross slope, when warping side streets at intersections, shall not exceed one percent (1%) every twenty five feet (25') horizontally on local streets/roads, one (1) percent every forty feet (40') horizontally on collector streets/roads, or one (1) percent every sixty feet (60') horizontally on arterial streets/roads to ensure public travel safe transition

**521.05 Cross Slope**

Roadways must be crowned with minimum cross slope of 2% and maximum of 3%, measured from center line to lip of curb or lip of median curb to lip of outside curb on streets with raised center islands. Parabolic or curved crowns or offset crown are not allowed. The top of curb elevation must be the same on both sides of a street, except at intersections or where superelevation is required.

**522.00 Half Streets**

Where half streets are allowed, sufficient additional right of way will be dedicated and additional width will be constructed to allow sufficient paved width to accommodate two directions of traffic and emergency parking by offsetting the geometric cross section.

**523.00 Structural Sections****523.01 Structural Sections for Streets**

Structural sections for streets may be composite sections of base and asphalt or full depth asphalt. Pavement sections shall be placed on compacted subgrade. Concrete pavement sections may be required in areas likely to experience heavy rutting.

Structural sections for streets shall be designed by a qualified soils engineer based on the Equivalent (18 Kip) Daily Load Applications (EDLA) for a twenty (20) year service life and the subgrade support analysis. The soils analysis shall be performed in accordance with AASHTO standard methods of surveying and sampling Soils. The field investigation shall consist of boring subgrade soils to a depth of at least four feet below proposed subgrade elevation (nine (9) feet below proposed subgrade on arterial roadways), at spacing of not more than two hundred fifty (250) feet, or a minimum of one boring for each section of street. The Hveem Stabilometer design method will be used for arterial streets, and either the Hveem Stabilometer or the California Bearing Ratio

(CBR) design method will be used for all other streets. The structural section will consist of a granular base with an asphaltic concrete wearing surface or stabilized subgrade with full depth asphalt. The *preliminary* structural section will be a twenty (20) year design section with a temporary cross slope of 1.2% - 1.6% from flow line to centerline as shown in the Standard Drawings.

The following standards provide the minimum acceptable pavement sections for public roadways in the City of Brighton. These pavement thicknesses may be used for preliminary planning purposes. Final pavement designs must be based on actual subgrade support test results:

	ESAL	Composite Section		Full Depth Section
		Base	Asphalt	Asphalt
Local Residential				
< 50 D.U.	8	8"	4"	7"
> 50 D.U.	10	8"	4"	7"
Collector				
Residential Zoning	30	8"	4.5"	9"
Com./Indust. Zoning	100	9"	6"	9"
Minor Arterial	200	8"	6"	11"
Major Arterial	200	8"	6"	11"

Portland Cement concrete pavement designs may be allowed with Director approval of the design thickness.

#### 523.02 Structural Sections for Parking Lots

Structural sections for parking lots will be designed by a qualified soils engineer based on a soils analysis in accordance with AASHTO standard methods of surveying and sampling soils - AASHTO T-86. The Hveem Stabilometer or the California Bearing Ratio (CBR) design method will be used for parking lots. The structural section will consist of a granular base with an asphaltic concrete wearing surface. Based on the structural sections and the typical daily traffic volumes (shown in Table 500-3 and Section 525.00 Vertical Alignment), the Director(s) will determine into which category a parking lot is placed and consequently which of the standards noted in Section 523.01 of these STANDARDS AND SPECIFICATIONS shall apply.

#### 524.00 Horizontal Alignment

Streets shall generally be aligned to bear a reasonable relationship to topography. All street centerline alignments shall be straight and free of curves within 50' of an intersection. Such measurement shall commence at the distant tangent point of flow line or edge of road radius and extend away from the intersection. Horizontal curves will conform to the street design criteria listed in Table 500-3 and Section 525.00 Vertical Alignment. Minimum spacing between intersection centerlines will be as indicated in Table 500-3.

Where the minimum centerline radius, noted in Table 500-3 and Section 525.00 Vertical Alignment, for through local residential streets cannot be achieved due to difficult parcel configurations and other constraints, a lesser centerline radius with a bulb on the outside of the curve as shown in the Standard Drawings will be allowed. The minimum centerline radii noted in Table 500-3 and Section 525.00 Vertical Alignment are permitted only where sufficient sight distance to the intersection is provided to enable the driver entering the curve and approaching the intersection to perceive that a stop condition exists, warranting at least a voluntary 10 m.p.h. reduction in speed before entering the curve.

Minimum design vehicle for residential and local street classifications shall be a SU-30 and for collector and arterials shall be a WB-50 as detailed by AASHTO.

Angles of intersection should, wherever possible, be maintained at eighty- (80) degrees to ninety- (90) degrees. New intersections should not include skewed angles less than eighty- (80) degrees without special design and control features to mitigate the effects of the skew. These may include more positive traffic control (all stop, traffic signals) and/or geometric improvements such as greater corner sight distance. Horizontal and vertical alignment and right of way limits will be coordinated so as not to obstruct sight distance at intersections, in accordance with the Standard Drawings. Curb return radii will be as shown on Table 500-3 and Section 525.00 Vertical Alignment. Where two different street types connect, the larger curb return radius will apply.

Reverse curves shall be joined by a tangent at least 150 feet in length.

### **525.00 Vertical Alignment**

Street centerline profile grades will be as shown on Table 500-3 and Section 525.00 Vertical Alignment. Continuous changing of grades that create a roller coaster effect shall not be permitted unless written approval is given by the Director(s). Where a street is curved and minimum profile grade is desired, the centerline grade will be adjusted so that the curb line grade on the outside of the radius will be no less than the minimum street grade specified on Table 500-3 and Section 525.00 Vertical Alignment. Safe stopping sight distances are illustrated in the Standard Drawings.

Centerline profile grades will not exceed four percent (4%) for a distance of at least one hundred feet (100') either side of an intersecting centerline. Gutter flow line grades will be no less than eight-tenths percent (0.8%) along curb returns, in cul-de-sacs and bulb areas, and other areas where gutter flow line grades do not directly parallel centerline profile grades.

Connections with existing streets shall be accomplished through smooth transitions and existing grades shall be shown for at least 200 feet on each side of the intersection. With the exception of cul-de-sacs, the grade and ground lines of all streets that dead end shall be continued for 500 feet or to its intersection with an already constructed or designed street.

525.02 Vertical Curve:

Vertical curves to effect gradual changes between tangent grades may be any one of the crest or sag types. Vertical curves should be simple in application and should result in a design that is safe and comfortable in operation, pleasing in appearance, and adequate for drainage. The major control for safe operation on crest vertical curves is the provision of ample sight distances for the design speed selected. It is recommended that all vertical curves should be designed to provide at least the stopping sight distances shown in the approved tables within this document.

Vertical curves are required where the algebraic difference in profile grade equals or exceeds 0.50, except for sump locations in the flow line profile only. Street cross slopes shall meet Table 500-3. Minimum vertical curve length is 50 feet.

#### 525.03 Crest Vertical Curves

Minimum lengths of crest vertical curves based on sight distance criteria generally are satisfactory from the standpoint of safety, comfort, and appearance. Passing sight situations were computed using a height of eye value of 3.5'. Stopping sight situations were computed using an object height of 2'.

K values are based on the formula  $V = K * A$ , where V is the vertical curve length; K is the rate of vertical curvature; and A is the algebraic difference of the intersecting grades.

Minimum crest curve K values are listed in the following two tables.

#### Design Controls for Crest Vertical Curves Based on Stopping Sight Distance

Design Speed (mph)	Stopping Sight Distance (feet)	Minimum K value
15	80	5
20	115	10
25	155	15
30	200	20
35	250	30
40	305	45
45	360	65
50	425	85
55	495	115

**Design Controls for Crest Vertical Curves Based on Passing Sight Distance**

Design Speed (mph)	Passing Sight Distance (feet)	Minimum K Value
20	710	180
25	900	290
30	1090	425
35	1280	585
40	1470	775
45	1625	945
50	1835	1205
55	1985	1410

The lengths of crest vertical curves are substantially longer for minimum passing sight distances than those for stopping sight distances. Generally it is impractical to design crest vertical curves to provide for passing sight distance because of high cost. Passing sight distance on crest vertical curves may be practical on roads with unusual combinations of low design speeds and gentle grades or higher design speeds with very small algebraic differences in grades.

## 525.04 Sag Vertical Curves

There are at least four different criteria for establishing lengths of sag vertical curves. They are headlight sight distance, passenger comfort, drainage control, and general appearance. For overall safety, a sag vertical curve should be long enough that the light beam distance is nearly the same as the stopping sight distance.

Drainage affects design of vertical curves in a sag condition especially in a curbed roadway section. For example, a length of curve that is relatively flat with a “K” value of 51 or greater can locate the actual curve low spot a significant distance from the sag curve point of vertical intersection (PVI). Care must be exercised to ensure all design elements are harmonious.

Minimum sag curve K values are listed in the following two tables



**Design Controls for Sag Vertical Curves**

Design Speed (mph)	Stopping Sight Distance (feet)	Minimum K Value
15	80	10
20	115	20
25	155	30
30	200	40
35	250	50
40	305	65
45	360	80
50	425	100
55	495	115

The designer should further explore the narrative under “Combinations of Horizontal and Vertical Alignment” and “Other Elements Affecting Geometric Design” that is found within the AASHTO Green book starting on Page 283.

**526.00 Cul-de-sacs**

Cul-de-sacs will conform to the Standard Drawings. Lengths of cul-de-sacs are recommended to be between one hundred forty feet (140’) and seven hundred and fifty feet (750’). Cul-de-sacs that are proposed outside this range must be fully justified, based on the following considerations and others that may arise in the course of review:

- A. Intersection vehicular traffic capacity
- B. Emergency vehicle response time
- C. Pedestrian trip time to bus routes
- D. Reduction of double travel distances for service and patrol vehicles
- E. Utility systems, drainage, and open space access

Surface drainage shall be directed toward the intersecting street, or if this is not reasonably practical, a drainage structure and easement will be provided at the end of the cul-de-sac. Specially designed temporary cul-de-sacs may be allowed when approved by the Director.

All cul-de-sacs shall have a right-of-way diameter of at least one hundred feet (100’) with a pavement diameter of ninety feet (90’). Cul-de-sac bulbs allowing on-street parking may require a larger radius to accommodate clear turning radius for an emergency response vehicle. Dead end streets less than one hundred fifty feet (150’) in length in a single-family area may use a “T” turnaround design with approval of the City and Fire District. Minimum design vehicle shall be WB-40.

**527.00 Special Design Elements**

Major structures, such as retaining walls, box culverts and bridges, that are appurtenant to proposed street and/or parking lot construction, will conform to the structural design and loading requirements of the Colorado Department of Transportation Standard Specifications for Road Bridge Construction and the geometric and drainage requirements of the Director. Plans and supporting calculations for major structures must be prepared by a qualified and licensed Colorado Professional Engineer.

Horizontal and vertical alignment continuity will be provided between new and existing streets to achieve safe and aesthetically pleasing transitions. Sufficient data on existing facilities will be depicted on plans, and limits of construction will be designated so as to assure that the desired continuity will be achieved. Drainage and utility facilities are to comply with all applicable sections of these STANDARDS AND SPECIFICATIONS and are to be fully coordinated with the street design and proposed construction. These facilities will be staged to eliminate grade and alignment conflicts and unnecessary damage to existing or newly constructed facilities.

**528.00 Driveway Ramps****528.01 Commercial and Multi-Family Driveway Ramps**

Shall be used at all developments accessing collector and arterial streets or when required by the Director(s).

There shall be a minimum of forty (40) feet between driveway ramps, measured from edge of ramp to edge of ramp, or drive access permits and no more than one curb cut or drive access per lot unless approved by the Streets and Fleet Director or his designee due to an extreme hardship or safety problem caused by only one access. No drive access or curb cut shall be permitted within fifty (50) feet of a corner as measured from the nearest tangent point of the corner radius of the intersecting street to the nearest tangent or edge of the access point or curb opening. Drive access or curb cuts shall not be located within the corner radius and will not be allowed within ten (10) feet of a property line. Drive access or curb cuts shall be a minimum of twenty (20) feet wide and maximum of 40' wide as measured from flowline to flowline..

**528.02 Residential Driveway Ramps**

There shall be a minimum of thirty (30) feet between driveway ramps or drive access points, measured from edge of ramp to edge of ramp, and no more than one curb cut or drive access per lot within urban residential settings. No drive access or curb cut shall be permitted within thirty (30) feet of a corner as measured from the nearest tangent point of the corner radius of the intersecting street. Driveway ramps or access points shall be a minimum of ten (10) feet wide and a maximum of twenty (24) feet wide.

No driveway cut or access point shall be closer than five (5) feet from a property line unless a suitable joint access agreement is executed between the abutting property owners and a common drive is installed.

**529.00 Requirements of Other Jurisdictions**

Where proposed street construction will affect other agencies such as the Colorado Department of Transportation, adjacent cities and counties, utility companies or ditch companies, said construction will be subject to the review of said agencies. A copy of the governing agencies review report shall be submitted to the Director prior to the beginning of construction. Generally, where more than one requirement is imposed, the more restrictive requirement will govern. The Director must authorize exceptions in writing.

**530.00 SITE WORK AND EARTHWORK****531.00 General**

Refer to Section 330.00, Site Preparation Work, and Section 340.00, Earthwork, of these STANDARDS AND SPECIFICATIONS.

All workmanship and materials will be in accordance with the requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, quantities, and the typical cross section shown on the plans, or as directed by the Director.

**532.00 Clearing**

Refer to Section 331.00, Clearing, of these STANDARDS AND SPECIFICATIONS.

**533.00 Demolition and Removal of Structures**

Refer to Section 320.00, Demolition and Removal of Structures and Obstructions, of these STANDARDS AND SPECIFICATIONS.

**533.01 Salvage**

All salvageable material shown on the accepted plans will be removed without unnecessary damage in sections or pieces, which may be readily transported and will be stored by the Contractor in locations approved by the Director. The Contractor will be required to replace any materials lost from improper storage methods or damaged by negligence.

**533.02 Disposal**

Refer to Section 333.00, Disposal, of these STANDARDS AND SPECIFICATIONS.

**533.03 Backfill**

Refer to Section 345.00, Embankment Fill, of these STANDARDS AND SPECIFICATIONS.

**534.00 Protection of Existing Structures and Utilities**

Refer to Section 342.00, Protection of Existing Structures and Utilities, of these STANDARDS AND SPECIFICATIONS.

**535.00 Protection of Public and Private Installations**

Refer to Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS.

The Contractor will take proper precautions at all times for the protection of and replacement or restoration of driveway culverts, street intersection culverts or aprons, storm drains or inlets, fences, irrigation ditches, crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches, and all other public and private installations that may be encountered during construction. The Contractor will have the responsibility of providing each property with access to and from the property during the time of construction. Existing driveways will be cut, filled, and graded as required and as directed by the Director to provide permanent access. Existing driveways will be resurfaced with the presently existing type of surfacing whenever the existing surface is destroyed.

**536.00 Excavation and Embankment**

Refer to Section 340.00, Earthwork, of these STANDARDS AND SPECIFICATIONS.

**537.00 Borrow**

Refer to Section 348.00, Borrow, of these STANDARDS AND SPECIFICATIONS.

**538.00 Subgrade**

The bottom of the excavation for the pavement, or top of the fill, will be known as the pavement subgrade and will conform to the lines, grades, and cross sections shown on the accepted plans. All applicable portions of Section 345.02, Roadway Excavation, Backfill and Compaction, of these STANDARDS AND SPECIFICATIONS, shall apply.

Prior to the street being excavated, all service cuts will be checked to confirm the backfill meets density requirements. If deficient, they will be recompact and brought up to specified density.

After excavation and embankment is completed and the subgrade brought to final grade, it will be rolled with a rubber-tired roller which is a minimum size of eight (8) to twelve (12) tons and other compaction equipment as required to bring the subgrade to the required density and stability. The following standards will be in effect: Soils meeting AASHTO M-145 Soil

Classifications of A-1, A-2-4, A-2-5, and A-3 will be compacted to a minimum of one-hundred (100) percent of maximum dry density as determined by AASHTO T-99. All other soil classifications will be compacted to a minimum of ninety-five percent (95%) of maximum dry density as determined by AASHTO T-99. The minimum moisture content will be not less than two percent (2%) below the "Standard Optimum", more than two percent (2%) above the "Standard Optimum". Additional wetting may be required when the minimum water requirement is not sufficient to produce a stable condition in the subgrade soil. The maximum length of any road section being worked at any one time shall not exceed three hundred feet (300') without the approval of the Director.

No paving, subgrade, or base will be placed on soft, spongy, frozen unstable subgrade, which is considered unsuitable by the Director.

Proof rolling with a fully loaded 3000 gallon or greater water truck will be required as designated on the accepted plans or when required by the Director. Proof rolling shall be completed in accordance with Section 344.00.

Soft and yielding material and portions of the subgrade which show deflection will be scarified and re-rolled or will be removed and replaced with subgrade course material, then placed and compacted as specified herein. Subgrade will not be approved for base course construction until it is uniformly stable and unyielding.

#### 538.01 Sub excavation for Expansive Soils

Soils with a Plasticity Index (P.I.) over ten (10) and less than thirty- (30) shall be sub excavated and recompacted per the soils reports and as approved by the Director.

#### 538.02 Chemical Subgrade Stabilization

Stabilized subgrade shall extend to the back of the sidewalk for streets with attached sidewalks as shown in the Standard Drawings. Stabilized subgrade shall extend to the back of the curb for streets with detached sidewalks. Lime treated subgrade shall conform to Section 307, Lime Treated Subgrade, of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. Flyash may also be used for subgrade stabilization per recommendations of a geotechnical study. Alternative methods of soil stabilization may be allowed with approval of the Director.

### **539.00 Subgrade Construction**

#### 539.01 Materials

Subgrade material will be composed of granular material consisting, essentially, of sand, gravel, rock, slag, disintegrated granite or a combination of such materials. The coarse portions of the material will be sound fragments of the crushed or uncrushed materials enumerated above. Supplied material will be a well-graded mixture containing sufficient soil mortar, crushed dust, or other

proper quality binding material which, when placed and compacted in the roadway structure, will result in a firm, stable foundation.

Material composed of uniform size particles, or which contains pockets of excessively fine or excessively coarse material, will not be acceptable for use.

This material need not be crushed but will be graded within the following limits:

Standard-Size of Sieve	% By Weight Passing Sieve
2-1/2 inch	100
2 inch	95 - 100
No. 4	30 - 60
No. 200	5 - 15
Liquid Limit	35 Maximum
Plasticity Index	6 Maximum

#### 539.02 Construction

The construction of subgrade will consist of preparing the approved subgrade material to form a stable foundation on which to construct base course, in conformity with the lines, grades and typical cross sections shown on the plans, and as staked by the developer's engineer. In addition, subgrade material will be used to replace unsuitable foundation materials at locations shown on the plans, or as directed by the Director.

Each layer of material will be placed and spread so that after compaction it will conform to the width and crown of the typical cross sections. The wetting of subgrade layers will be done with sprinkling equipment of a type, which insures uniform and controlled distribution of the water. All wetting will be done by uniformly sprinkling each layer of material being placed with only that amount of water needed to obtain maximum density of the material.

Travel may be allowed over subgrade to assist in compaction of the material. Mixing and blading of the subgrade material on the street will be required if the material is spotty and non-uniform. However, blading will be held to a minimum in order to avoid the floating of the heavier rock particles to the surface.

Concurrently with the wetting operations, the material will be uniformly compacted by rolling. Rolling equipment will consist of one or more of the following: rubber tired roller, sheep foot roller and flat wheel steel roller.

#### 539.03 Underdrain

Any underdrain systems must be reviewed and approved by the Director(s).

### 540.00 BITUMINOUS CONSTRUCTION

#### 541.00 General

The intent of this section is to specify materials and methods to be used for the construction, overlaying, seal coating and pavement rejuvenating of streets, parking lots, walks, drain ways, and other miscellaneous work requiring the use of aggregates. The work covered will include general requirements that are applicable to aggregate base course, bituminous base and pavements of the plant mix type, bituminous prime coat, bituminous tack coat, rejuvenating applications, and asphalt concrete overlay. All workmanship and material will be in accordance with requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, depths, quantity requirements, and the typical cross section shown on the plans or as directed by the Director.

#### **542.00 Base Course**

This item shall consist of a foundation course composed of crushed recycled concrete and filler, constructed on the prepared subgrade. Crushed gravel or crushed stone may be used with approval of the Director. Materials and construction will be in accordance with the requirements of Section 703.03, Table 703-2, of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. Gradation will be Class 5 (1-1/2" maximum) or Class 6 (3/4" maximum).

The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the accepted plans and as directed by the Director. Base course shall be placed under curb, gutter, and attached sidewalk. Placing and spreading will be done by means of a spreader machine, moving vehicle, motor grader, or by other approved equipment methods. The material will be placed without segregation. Any segregated areas will be removed and replaced with uniformly graded material at the Contractor's expense.

The base material may be placed in lifts of up to six inches (6"), providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds six inches (6"), it will be placed in two or more lifts of approximate equal thickness. If uniform density cannot be obtained by six-inch (6") lifts, the maximum lift will not exceed four inches (4") in final thickness.

Base material shall not be placed on a foundation that is soft or spongy or one that is covered by ice or snow. Base material will not be placed on a dry or dusty foundation where the existing condition would cause rapid dissipation of moisture from the base material and hinder or preclude its proper compaction. Such dry foundations will have water applied to them and will be reworked or recompacted.

Rolling will be continuous until the base material has been compacted thoroughly in accordance with Section 304 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. Water will be uniformly applied as needed during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly placed.

The finished base course surface shall be smooth and free of ruts and irregularities, and will be true to grade and crown as shown on the plans or as directed by the Director. The base course will be maintained in this condition by watering, drying, rolling, or blading or as the Director may direct until the surfacing is placed.

**543.00 Prime Coat**

(Left Blank Intentionally)

**544.00 Hot Bituminous Pavement**

All pavements shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the Director. Materials and construction will be in accordance with Section 403 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, and the following requirements:

- A. The asphalt cement shall be a Superpave Performance graded (PG) binder and content determined by the mix design. Superpave PG asphalt binders shall comply with CDOT Standard Specifications for Road and Bridge Construction. The asphalt contractor shall furnish certified test results from an independent asphalt testing laboratory to show compliance of the proposed Superpave PG asphalt binder with the Superpave requirements for that mix.
- B. The gradation of the mineral aggregate will be grading SG (1 1/2" nominal), or S (3/4" nominal) for new street construction. Grading SX (1/2" nominal) may be used for overlay or in special cases as required on the accepted plans or authorized in writing by the Director.
- C. All mixes shall be designed with 1% lime.
- D. A maximum of twenty percent (20%) Reclaimed Asphalt Pavement (RAP) will be allowed in the bottom and middle lift (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met. RAP shall not be allowed in the top lift of asphalt.
- E. The mix will conform to the job mix formula specified by the Director for the pit-supplied materials, if a current job mix formula is available. A copy of the mix formula will be submitted to the Director for review and approval at least seven (7) days prior to starting paving work.

All testing done throughout this construction period, which is necessary to assure conformance of materials and workmanship to the specifications, will be at the Contractor's expense. Two copies of all test reports will be submitted directly to the Director.

In the event that a current job mix formula is not available for the materials proposed for use, the Contractor will submit a job mix formula prepared by a recognized testing laboratory for review and acceptance by the Director. A report giving the properties of the materials and certifying their conformance to or deviations from the requirements of the specifications will accompany the job mix formula.



When tested in accordance with the requirements of ASTM D-1559, the mixture will conform to the following limits:

**TABLE 500-1  
MIX DESIGN PROPERTIES**

Low EDLA $\leq 40$	
Marshall Stability (minimum) <sup>1</sup>	1800 lb./ S 37
Marshall Flow (minimum) hundredths of an inch	8
Flow (maximum) hundredths of an inch	18
Air voids, total mix, %	3 to 5
VMA <sup>3</sup>	12-13-14
Percent voids filled with bitumen	65-75

High EDLA $\geq 40$	
Marshall Stability (minimum) <sup>2</sup>	2000 lb./ S 39
Marshall Flow (minimum) hundredths of an inch	8
Marshall Flow (maximum) hundredths of an inch	16
Air voids, total mix, %	3 to 5
VMA <sup>3</sup>	12-13-14
Percent voids filled with bitumen	65-75

<sup>1</sup> - Marshall Stability (50 Blow)/Hveem Stability

<sup>2</sup> - Marshall Stability (75 Blow)/Hveem Stability<sup>3</sup> - Refer to Table 500-2

**TABLE 500-2  
VOIDS IN THE MINERAL AGGREGATE<sup>1</sup>**

Nominal Maximum Particle Size	Mix Air Voids, Percent		
	3.0	4.0	5.0
3/4"	12.0	13.0	14.0
1/2"	13.0	14.0	15.0

<sup>1</sup> - Interpolate minimum voids in the mineral aggregate (VMA) for design air void values between those listed.

Determination of the effect of water on the cohesion of the bituminous mixture will be made in accordance with AASHTO T-283 (Lottman). Retained strength will be a minimum of eighty percent (80%). The use of an "anti-stripping" admixture to improve the retained strength characteristics will be permitted only by written permission of the Director. The cost of admixtures will be borne by the Contractor.

All commercial testing and laboratory work necessary to establish the job mix formula and all testing necessary to assure conformance of materials and workmanship to the requirements of the specifications throughout the construction period will be performed at the Contractor's expense. Two copies of all test reports will be submitted directly to the Director.

**544.01 Asphalt/Polymer Combinations**

The Contractor may submit to the Director for his review and acceptance a design for the upper three inches (3") of the pavement section utilizing a polymer modified pavement design. These designs will be reviewed on an individual project basis and must be accepted by the Director prior to construction.

**544.02 Weather Limitations**

Bituminous plant mix shall be placed only on properly constructed and accepted layers that are free from water, snow, or ice. The bituminous mixtures shall be placed only when weather conditions permit the pavement to be properly placed and finished as determined by the Director. The bituminous mixtures shall be placed in accordance with Table 401-3, Placement Temperature Limitations, of the Colorado Department of Transportation Standards and Specifications for Road and Bridge Construction.

Air temperature is taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

Under certain circumstances, the Director may waive minimum temperature requirements for placing prime coats and layers of bituminous mixtures below the top layer of the completed pavement.

**545.00 Tack Coat**

When tack coat is specified on the accepted plans or required by the Director, all materials and construction shall be in accordance with the requirements of Section 407 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. Bituminous material will be SS-1 emulsion, diluted by mixing one (1) gallon of SS-1 emulsion with one gallon of clean water, applied at the rate of five one-hundredths (0.05) to fifteen one-hundredths (0.15) gallons per square yard.

**546.00 Seal Coat**

When seal coat is required, all materials and construction shall be in accordance with the requirements of Section 409 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. The type of bituminous material, cover aggregate, and rates of application will be as shown on the accepted plans.

**547.00 Rejuvenating Agent**

When a rejuvenating agent is specified on the accepted plans or required by the Director, all materials and construction will be in accordance with the requirements of Section 407 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

**548.00 Heating and Scarifying**

When heating and scarifying treatment is specified on the accepted plans or required by the Director, all materials and construction shall be in accordance with requirements of Section 405 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

**549.00 Grinding**

Grinding will consist of “milling”, “grinding”, or “cold planning” the existing pavement surface to establish a new surface profile and cross section in preparation for a bituminous overlay. After grinding, the surface will have a grooved or ridged finish, uniform and resistant to raveling or traffic displacement. This textured surface will have grooves of one-quarter inch (1/4”) ± one-eighth inch (1/8”). The existing surface to be ground will include bituminous pavement, concrete utility patches, and a very small amount of concrete pavement.

“Wedge cut” grinding will consist of grinding the existing pavement surface a minimum of six feet (6’) wide at the existing concrete gutter. The edge of the gutter, end of the finished wedge cut will be one and one-half (1-1/2) inches below the edge of the existing concrete gutter. The centerline of street edge of the wedge cut will be cut one-eighth inch (1/8”). The depth of cut will be determined by measuring to the top of the ridges by placing a five-foot (5’) straight edge perpendicular to the grooving pattern. “Full width” grinding will consist of grinding the existing pavement surface from edge of gutter to a minimum depth of two inches (2”) unless otherwise specified in the contract or directed by the Director.

Grinding around utility castings to the depth of cut before and after encountering the castings will be included in the area of the pavement surface ground. The Contractor may choose to remove the entire existing bituminous pavement around the castings where grinding is not completed, and replace it with bituminous surface course placed and compacted in three inch (3”) lifts. The Contractor will vertically cut the limits of the area to be patched, mechanically compact the existing base course, and prime the bottom and vertical edges before backfilling.

The Contractor will remove the cuttings immediately behind the grind machine by belt loader, end loader, power sweeper and/or by hand. The removed material will be disposed of as approved by the Director.

The grinding machine shall be a power operated, self-propelled machine, having a cutting drum with lacing patterns that will attain a grooved surface and produce grinding chips of less than one inch (1”) in size. The grinding machine will be equipped with a pressurized watering system for dust control. The equipment will be a type that has successfully performed similar work.

The cleaning equipment shall be a type, which will efficiently remove all loosened material and load into trucks for hauling and spreading. Because of the nature of the streets to be ground and the traffic restrictions, a belt loader followed by a power sweeper and manual sweeper is the most desirable method. **FLUSHING INTO THE CITY’S STORM SEWER SYSTEM AS A MEANS OF CLEANUP IS PROHIBITED.**

**550.00 CONCRETE PAVEMENT**

The installation of concrete pavement, including materials, equipment, foundation and construction methods must be in conformance with Section 412, "Portland Cement, Concrete Pavement" of the Colorado Department of Transportation Highways Standard Specifications for Road and Bridge Construction, except as modified herein or as modified with the approval of the Director.

Specifications for concrete work, Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS, must be followed. Concrete pavements will be installed as shown on the accepted plans or as approved by the Director. When concrete pavement is constructed on a curve, flexible forms will be used having a radius of two hundred feet (200') or less, unless otherwise directed by the Director. The Contractor will furnish steel pins to use in setting grades for concrete pavement.

**550.01 Lime Treated Subgrade**

In those instances where deemed necessary by a qualified Soils Engineer and accepted by the Director, Portland Cement treated base may be required. When required, this base shall comply with Section 307, Lime Treated Subgrade, of the Colorado Department of Transportation Standard Specifications for Roads and Bridge Construction.

**560.00 APPURTENANT CONCRETE STRUCTURES****561.00 General**

Curb, curb ramps, gutter, sidewalk, cross pan, and driveway construction will conform to all applicable provisions of these STANDARDS AND SPECIFICATIONS and the Standard Drawings.

**562.00 Materials****562.01 Cement Concrete**

All cement concrete materials, reinforcing steel, and concrete work will conform to the requirements of Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS.

**562.02 Forms**

Forms may be wood or metal and will have a depth equal to or greater than the slab thickness. The face of curbs will be formed, unless otherwise permitted by the Director. Forms will have a cross section and strength and be secured so as to resist the pressure of the poured concrete without springing or settlement. The connection between sections will be performed by a method in which the joint thus formed will be free from movement in any direction. Each section of form will be straight and free from warps or bends. The maximum deviation of the top surface will not exceed one-eighth inch (1/8") inside face not more than one-fourth inch (1/4") from a straight line in ten

feet (10'). Approved flexible forms will be used for construction where the radius is one hundred fifty feet (150') or less.

**563.00            General Requirements****563.01            Curb and Gutter Section**

The section to be constructed will be as identified on the approved plans or as shown on the Standard Drawings.

**563.02            Sidewalks**

Sidewalks will be a minimum of four inches (4") thick where less than six feet (6') wide, or a minimum of six inches (6") thick where six feet (6') wide or greater. Commercial drive ramps and alleys entrances shall be eight (8") inches thick. All other areas of sidewalk that will be crossed by driveways, be constructed in parks, open spaces or greenbelts as indicated on the accepted plans or required by the Director(s) will be constructed with a minimum of six inch (6") thick concrete. Sidewalks shall be constructed to the widths shown on the accepted plans or as required by the Director(s). Walks shall slope towards the street at a maximum cross slope of two percent (2%).

The use of sidewalk chases is discouraged and is allowed only upon written approval of the Director.

**563.03            Drainage Cross Pans and Curb Return Fillets**

Drainage systems shall eb designed in accordance with the latest City requirements. Drainage plans shall be approves before final approval of street plans. Drainage shall not be the primary function of a street.

Drainage cross pans and curb return fillets will be constructed eight inches (8") thick with #4 rebar (place at 18" centers, each way) or ten inches (10") without rebar in residential, commercial and industrial areas. Typical crossspan sections are shown in the Standard Drawing. Where unusual conditions prevail, additional reinforcing steel and special joints may be required by the Director. Minimum flow line grade for curb returns shall be one-half-percent (0.5%).

Drainage pans are not allowed to cross collector or arterial streets. The use of double drainage pans is only allowed where approved by the Director(s).

**563.04            Curb Cuts and Driveways**

Curb cuts in six-inch (6") vertical curbs will be provided at all driveway locations and at additional locations, as shown on the accepted plans for residential lots. Construction of curb cuts will be as shown in the Standard Drawings.

No driveway or curb cut shall be closer than 5 feet (5') of the property line unless a suitable joint access agreement is executed between the abutting property owners and a common drive is installed.

**563.04.01 Residential Driveways**

Residential driveway ramps width shall be governed by the City of Brighton's Land Use Development code.

Residential driveway ramps shall be a minimum of 30 feet (30') between other residential driveway ramps. No drive access or curb cut shall be permitted within 30 feet (30') of a corner as measured from the flow line of the intersection street or within the point of curve return.

**563.04.01 Commercial and Multi-Family Driveways**

Shall be used at all developments access collector and arterial streets or when required by the City.

There shall be a minimum of 40 feet (40') between driveway ramps or access permits and no more than one curb cut or driveway per lot unless approved by the Director(s). No driveway or curb cut shall be permitted within 50 feet (50') of a corner as measured from the flow line of the intersecting street to the nearest edge of the driveway or curb cut.

**563.05 Curb Ramps**

Laws require that curb ramps be installed at intersections and at certain mid block locations for all new construction or reconstruction of curb. Gutter and sidewalk (State of Colorado C.R.S. 43-2-1079(2)). Curb ramps shall also be placed where bike paths meet streets or where indicated by the Director(s). Curb ramps shall be shown at all curb returns and at all "t" intersections in accordance with Colorado Department of Transportation latest M and S Standards, except as modified by these STANDARDS AND SPECIFICATIONS.

All curb ramp locations at intersections involving major streets shall follow City design criteria unless approved by the Director(s).

**564.00 Construction Requirements**

**564.01 Staking and Grade Control**

Control and construction stakes will be set by field parties under the supervision of a Registered Professional Engineer or a Registered Land Surveyor licensed to practice in Colorado who shall be paid by the Contractor. These field parties will be available to check field control and to provide assistance to the Contractor. The Contractor will keep a set of accepted plans on the job site at all times.

It will be the responsibility of the Contractor to maintain the grade and alignment as shown on the accepted plans. The alignment and grade elevation of forms will be checked, and any necessary corrections will be made before placing the concrete. When any form has been

disturbed or any subgrade there under has become unstable, the form will be reset and rechecked after the subgrade has been replaced or recompact.

#### 564.02 Excavation and Embankment

Excavation or fill will be made to the required grade, and the base on which the curbing section is to be set will be compacted to a smooth, even surface. All material placed in fill and the top six inches (6") of the subgrade in cut sections will be compacted to at least ninety-five percent (95%) of maximum dry density as determined by ASTM D-698. Where spongy or unsuitable materials are encountered which will not provide a stable subgrade. The material will be removed and replaced with suitable material and compacted to the specified density.

The subgrade will be compacted within the forms by a vibratory compactor or other approved method whenever any loose subgrade material is present. Immediately prior to placing the concrete, the subgrade will be tested for conformity to the specified cross section. Materials will be removed or added to bring all portions of the subgrade to the correct elevation. The subgrade will be thoroughly compacted and again tested for proper cross section. Concrete will not be placed on any portion of the subgrade that has not been inspected by the Director for correct elevation and proper compaction. The subgrade will also be cleared of any loose material that may have fallen on it.

The subgrade will be in a moist condition to a depth of six inches (6") at the time the concrete is placed. It will be thoroughly wetted a sufficient amount of time in advance of the placing of the concrete to insure that there will be no puddles or pockets of mud when the concrete is placed.

#### 564.03 Form Setting

Forms that have become worn, bent, or broken will not be used. The Contractor will have set and graded a minimum length of three hundred feet (300') of forms prior to placing concrete. In cases where the length of one run is less than three hundred feet (300'), the Contractor will set and grade forms for the entire run.

On curves with radii of one hundred fifty feet (150') or less, flexible forms, which can be readily formed to the desired radius, will be used. Face forms will be preformed to the proper radius. In any case, care will be exercised to insure the maintenance of the required cross section around the entire radius.

The Contractor will provide an approved metal straight edge, ten feet (10') in length, to check the alignment of the forms prior to placing the concrete and also to check the concrete surface during the finishing operation.

Forms, except for curb face, will remain in place at least twelve (12) hours after concrete has been placed against them, or for a longer period if so directed by the Director. Crowbars or other heavy tools will not be used against green concrete in removing the forms. Forms will be thoroughly cleaned before re-oiling and reuse.

#### 564.04 Concrete Placement

When placed in the forms the concrete will be properly graded with the forms and will at no time deviate more than one-quarter inch (1/4") from an accurate straight edge ten feet (10') in length. The concrete will be placed on damp but not wet or muddy subgrade. The operation of depositing and compacting the concrete will be conducted so that the concrete will be smooth and dense, free from honeycomb and free from pockets of segregated aggregate. Sections of segregation or honeycomb revealed by removal of the forms will be removed and replaced or otherwise repaired to the satisfaction of the Director. At the end of the day, or in case of an unavoidable interruption of more than thirty- (30) minutes, a transverse construction joint will be placed at the point of stopping work, provided that the section on which work has been suspended will not be less than five feet (5'). Sections less than five feet (5') in length will be removed. Concrete will not be placed when the weather is stormy, dusty, or otherwise inclement to the point that it precludes good workmanship.

#### 564.05 Joints

All joints will be constructed straight and plumb and will extend through the entire section from edge to back and to the depths specified herein.

- A. Expansion Joints: Expansion joint filler, which is one-half inch (1/2") thick, preformed, non-extruding bituminous-treated fiberboard conforming to AASHTO Specification M-213, will be used to form transverse expansion joints. Expansion joints will be constructed as directed by the Director. Expansion joints will be formed at the contact of the new construction with concrete driveways, intersecting sidewalks or other unyielding structures unless otherwise directed.
- B. Block Joints: The curb and gutter or curb walk will be divided into blocks not less than six feet (6') nor more than ten feet (10') long using metal templates not less than one-sixteenth inch (1/16") nor more than one-quarter inch (1/4") thick. Templates will be a minimum of four inches (4") deep. The block length to be used will be approved by the Director prior to starting construction and will be maintained constant throughout the project. The templates will be designed to attach securely to the forms in such a manner as to prevent movement while the concrete is being placed and consolidated. Templates will be removed prior to the concrete taking its initial set.
- C. If curbing machine or other methods not requiring the use of templates is approved, dummy joints formed by a jointing tool or other acceptable means will be used. Dummy joints will extend into the concrete for at least one-third (1/3) of the depth (no less than two inches [2"]) and will be approximately one-eighth inch (1/8") wide.
- D. Construction Joints: As required at the end of a day's run, construction joints will be made at right angles to the longitudinal axis of the curb and gutter and will be located at the regular spacing designated for block joints unless otherwise specifically permitted by the Director. In no case will any length of curb and gutter be less than five feet between (5') joints. Construction joints will be formed by use of a bulkhead or divider, which will be removed before continuing with the next



run. The construction joints will be edged to form a recess for sealing compound similar to that for expansion joints.

**564.06 Finishing**

Where applicable, finishing will be done with a metal screed designed to give proper shape to the section as detailed. Particular care will be used to finish the gutter flowline to a true, uniform grade. When using face forms, they will be left in place until the concrete has hardened sufficiently so that they can be removed without injury to the curb.

The Contractor will use at all times, a ten-foot (10”) straightedge for finishing curb and gutter sections. When irregularities are discovered, they will be corrected by adding or removing concrete. All disturbed places will be floated with a wooden or metal float, which is not less than three feet (3’) long and not less than six inches (6”) wide, and again straightened. No water or cement will be added to the surface of the concrete to aid in finishing. Before final finishing is complete and the concrete has taken its initial set, edges of the concrete and joints will be carefully finished with an edger having a one-eighth inch (1/8”) radius. Concrete will be finally finished with a wood float and lightly broomed to a slightly roughened surface. On grades less than one percent (1%), the Contractor will check for depressions before final finish so that no water holes exist. Any water holes or “bird baths” larger than one square foot and deeper than three-eighths inch (3/8”) will be cause for removal and replacement of the defective sections of concrete.

**564.07 Marking**

RESERVED

**564.08 Curing**

Curing will be accomplished in accordance with Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS.

**564.09 Protection Against Vandalism**

It will be the responsibility of the Contractor to protect all concrete work against damage or vandalism. When required, a guard will be stationed over fresh work until the concrete is sufficiently set to prevent its being marked by plastic deformation of the exposed surface of the concrete. Expense of the guard will be borne by the Contractor. Concrete damaged in any way by vandals will be removed and replaced at the Contractor’s expense.

**564.10 Cleanup**

Within forty-eight (48) hours after forms are removed, the area behind and in front of the sidewalk or curb will be cleaned, backfilled and graded to provide a smooth even surface.

**564.11 Concrete Testing**

Routine testing will be accomplished in accordance with Section 400.00, Concrete Work, of these STANDARDS AND SPECIFICATIONS. In the case of questionable concrete materials or work, the Director may direct that core tests be made on all questionable concrete placement. The expense of the tests will be borne by the Contractor. If the concrete tested shows inadequate strength or other deficiencies, it will be removed and replaced by the Contractor at his expense. If any core shows a deficiency of thickness greater than one-half inch (1/2"), exploratory cores will be taken in five-foot (5') increments, and all concrete deficient more than one-half inch (1/2") will be removed and replaced by the Contractor at his expense.

**570.00 INSPECTION****571.00 General**

Refer to Section 154.00, Inspections, of these STANDARDS AND SPECIFICATIONS.

**572.00 Required Inspections**

Adequate inspections assure compliance to City requirements and are the basis for the City's recommendation that said streets are accepted for maintenance and for release of performance guarantees. It is the responsibility of the Contractor to contact the Director a minimum, of one (1) working day in advance of the required inspections. Required inspections include:

- A. Concrete - finished excavation, grade, forming, reinforcing steel. Structures - concrete pour, surface finish, and test cylinders. Three inspections are required: (1) prior to placing steel; (2) prior to concrete pour; and (3) during and after final pour.
- B. Street - four inspections are required; (1) subgrade; (2) base course; (3) prime &/or tack, and (4) paving, all of which are required prior to proceeding with the next phase. Locations of required samples for testing will be designated by the Director. Non-destructive deflection testing, as specified in Section 514 of these STANDARDS AND SPECIFICATIONS, will be performed.
- C. Acceptance - a request for an inspection and Construction Acceptance for maintenance or release from performance guarantee must be made only after all preceding inspections have been passed. Acceptance procedures are outlined in Section 200, Acceptance Procedures, of these STANDARDS AND SPECIFICATIONS.

**573.00 Required Testing**

When required by the Director, a Professional Engineer will certify the quality of materials or construction. All testing will be by recognized methods as specified in these STANDARDS AND SPECIFICATIONS and will be at the Contractor's expense.

**574.00 Utility Installations**

Prior to the installation of street subgrade, base, paving and concrete materials, utility installations will be made, service lines stubbed to the right-of-way line, and all trenches will be backfilled and properly compacted.

**575.00 Street Lighting**

At the time of inspection, all street lights will be in place as shown on the approved plans and will be operating as set forth in Section 925.00, Street Lighting Procedure, of these STANDARDS AND SPECIFICATIONS.

**580.00 STREET LANDSCAPING**

Refer to SECTION 1000 PARKS AND RECREATION of these STANDARD AND SPECIFICATIONS.

**TABLE 500-3  
STREET DESIGN CRITERIA**

<b>Design Element</b>	<b>Major Arterial</b>	<b>Minor Arterial</b>	<b>Collector</b>	<b>Local Street</b>	<b>Alley</b>
Flow Line Curb Radius intersecting Major or Minor Arterial	55	55	40	40	N/A
Flow Line Curb Radius intersecting Collector	40	40	30	20	Drive ramp
Flow Line Curb Radius intersecting Local	40	40	20	15	Drive ramp
Design Speed	45 mph	45 mph	35 mph	25 mph	20 mph
Unsignalized full movement Access/Intersection spacing, feet					
100-1000 ADT	N/A	150*	150	150	75
1000-2500 ADT	600	300	300	150	75
>2500 ADT	600	600	300	150	75
Major signalized intersection spacing	½ mile	¼ mile	½ mile	N/A	N/A
Typical Posted Speed Limit	40 mph	40 mph	35 mph	25 mph	20 mph
Maximum Degree of Curve (degrees)	6	7.4	12	32.7	32.7
Minimum Curve Radius (feet)	1200	1200	550	250	175
Final Cross Slope without Super Elevation***	2% to 4%; no inverted crowns without approval of Director				2%-4%, alleys shall not drain to private property
Maximum Longitudinal Street Grade	5%	5%	6%	6%	6%
Minimum Longitudinal Street Grade	0.5%	0.5%	0.5%	0.5%	0.5%
Maximum Grade at Intersection	2% for 300'	3% for 300'	4% for 150'	4% for 150'	4% for 150'

\*Internal street network shall be used if available

\*\* or as supported by an approved traffic study

\*\*\* Super elevation shall follow AASHTO guidelines.