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SECTION 500 ROADWAY & ASHPALT DESIGN**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 parking lots (public or private) in the Town.

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, variances to said minimum requirements will be considered and may be authorized by the Town Engineer. 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.

512.00 Private Street Systems

Private street systems will be subject to all requirements of these STANDARDS AND SPECIFICATIONS. The Town Engineer, as provided for in Section 511.01 of these STANDARDS AND SPECIFICATIONS, may allow variances, subject to the review and acceptance.

513.00 Town 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 Town administered street capital improvement projects. Accordingly, the Town Engineer is authorized to develop and/or 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 Town codes.

514.00 Final Overlay

Final Overlay shall not be scheduled until 2 years have expired since the initial construction surface was installed, at 100% built out, or as approved by the Town Engineer.

When determined necessary by the Town Engineer, prior to installation of the final bituminous surface course, the developer will furnish the Town Engineer 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 will have a past history and knowledge in performing these tests. Qualifications of Professional Engineer must be submitted to the Town Engineer for acceptance before the start of work.

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

Contractor will be responsible for submitting a traffic control plan that was designed and approved by a certified TCS (Traffic Control Supervisor) for review and acceptance prior to construction. The Traffic Control Plan must be 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 Town'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 conform to the Town of Firestone's 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 (1,500) 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 Transportation 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 Alleys

All alleys, when permitted by the Town Engineer, 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 shall be 150' maximum length

and alleys greater than 600' in length shall have a secondary access to a residential street. Any more restrictive requirements by the Fire Department shall supersede these standards.

521.02 Emergency Access

Emergency access roads shall have a minimum of right-of-way width of 20' and a minimum roadway width of 18'.

521.03 Intersection Design Guide

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.

521.03.01 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).

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;
- Uniformity of treatment with similar locations;

521.03.02 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 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 bicycle and pedestrian movements.

521.03.03 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. All roads on section lines shall be designed as arterial streets. All trails located on roads on section lines shall be 10' wide. Collector streets are defined as having projected traffic volumes of 1,500 vehicles per day or more. The design engineer shall consider existing and future traffic flows when designing streets and determining classification.

521.03.04 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.

521.03.05 Intersection Vertical Alignment Grade Considerations

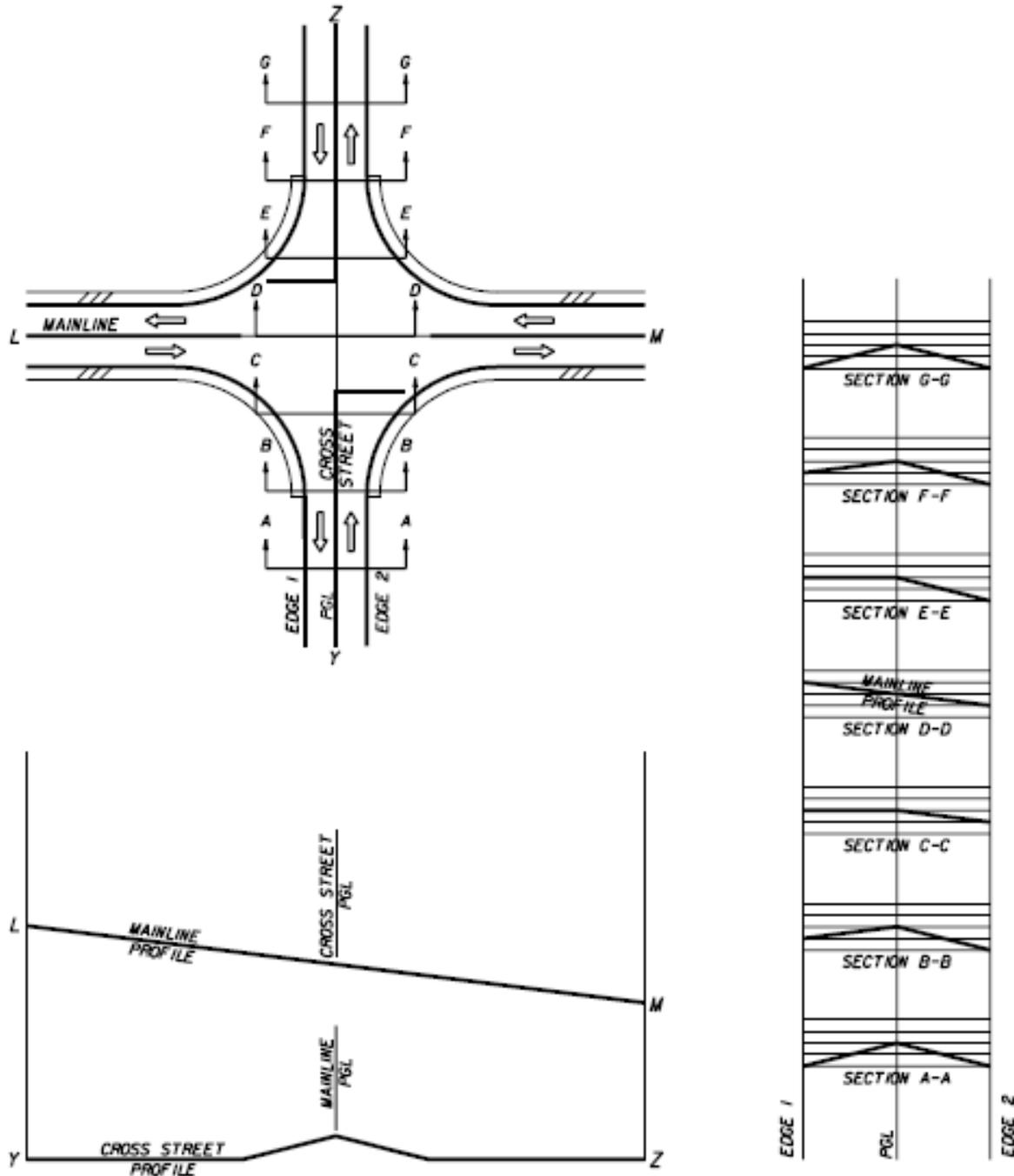
The profile grade line defines the vertical alignment for roadway and bridge construction. As with other design elements, the characteristics of vertical alignment are influenced greatly by basic controls related to design speed, traffic volumes, and functional classification, drainage, and terrain conditions. 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, even 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 necessary because of steep grades, grades listed in Section 500 Town Street Construction should be used on intersecting roads in the vicinity of 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. Normally, 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 the following figure.



521.03.06 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.

521.03.07 Intersection Plateau

The profile of the major highway 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 highway due to similar traffic demands. To provide this "equal treatment", with respect to profile, 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.

521.03.08 Cross Slope

The rate of change in pavement cross slope, when warping side streets at intersections, shall not exceed one (1) percent every twenty five (25) feet horizontally on local streets/roads, one (1) percent every thirty seven and one half (37.5) feet horizontally on collector streets/roads, or one (1) percent every fifty six and one half (56.5) feet horizontally on arterial streets/roads to ensure public travel safe transition.

521.03.09 Auxiliary Lanes

Auxiliary lanes provide for the safe acceleration or deceleration of turning traffic on and off roadways and help reduce the accident potential of turning vehicles. All auxiliary lane requirements are in accordance with the latest edition Colorado Department of Transportation's (CDOT) State Highway Access Code and the Town's Street Design Criteria found in Table 500-3 at the end of Section 500. Background traffic from adjoining developments must be considered to anticipate future street system use. The developer shall be responsible for the cost of all additional auxiliary lanes needed to comply with the Town of Firestone access code.

Right-turn Deceleration Lane

	Minimum Right-Turns to Require Deceleration Lane (vph)	Deceleration Lane and Taper Length (ft)	Taper Rate
Principal Arterial (CDOT NR-A)	25	435	13.5:1
Minor Arterial (CDOT NR-B)	25	370	12:1
Collector (CDOT NR- C)	50	310	10:1

Left-turn Deceleration Lane

	Minimum Left-Turns to Require Deceleration Lane (vph)	Deceleration Lane Including Taper Length (ft)	Taper Rate
Principal Arterial (CDOT NR-A)	10	435 + Storage	13.5:1
Minor Arterial (CDOT NR-B)	10	Storage + Taper	12:1
Collector (CDOT NR-C)	25	Storage + Taper	10:1

Storage Lengths

Turning Vehicles Per Hour	< 30	30-59	60-99	100-199	200-299	>300
Storage Length (ft)	25	40	50	100	200	300

Right-turn Acceleration Lane

	Minimum Right-Turns to Require Acceleration Lane (vph)	Acceleration Lane Including Taper Length (ft)	Taper Rate
Principal Arterial (CDOT NR-A)	50	550	13.5:1
Minor Arterial (CDOT NR-B)	N/A	--	--
Collector (CDOT NR-C)	N/A	--	--

Redirect Tapers for Through Lane

Posted Speed in MPH	30 or less	35	40	45	50	55	60	65	70
Straight Taper Ratio	15:1	20:1	30:1	45:1	50:1	55:1	60:1	65:1	70:1

521.04 Medians

All medians shall be designed so that there is no interference with traffic flow. The nose of medians shall be a minimum of 10 feet behind the flowline of the intersected street. The minimum radius shall be 2 feet to flowline. Only spill curb & gutter should be used to construct all medians unless otherwise approved by the Town Engineer.

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 shall be composite sections of base and asphalt.

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 *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 Town of Firestone. These pavement thicknesses may be used for preliminary planning purposes. Final pavement designs must be based on a geotechnical pavement design.

	EDLA	Composite Section	
		Base	Asphalt
Local Residential			
< 50 D.U.	8	8"	4"
> 50 D.U.	10	8"	4"
Collector			
70' Right-of-way Width	30	8"	4"
80' Right-of-way Width	100	9"	6"
Minor Arterial	200	9"	6"
Principal Arterial	200	12"	8"

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

524.00 Horizontal Alignment

Streets shall generally be aligned to bear a reasonable relationship to topography. 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 follows:

Street Type	Spacing
Local Residential	150'
Collector	400'
Arterial	1000'

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.

Angles of intersection should, wherever possible, be maintained at ninety- (90) degrees. 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.

525.00 Vertical Alignment

Street centerline profile grades will be as shown on Table 500-3 and Section 525.00 Vertical Alignment. 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 (0.5%) 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.

525.01 Roadway Functional Classification

See Section 521.03.03 for definitions.

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.

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. Computations are based on

3.5 feet for height of eye in passing sight situations and 2 feet for height of object for stopping sight situations.

The minimum lengths of vertical curves for different values of A (algebraic difference) to provide the minimum stopping sight distance for each design speed are listed below in the table. K values are based on the following formula $V = K * A$ (V – Vertical Curve Length; K – rate of vertical curvature; A – Algebraic Difference) and the designer should solve for K, to evaluate and compare to the table listed below.

For example: A design speed of 25 mph requires a minimum K value of 15 and anything less than 15 would not satisfy the required 25 mph speed limit for safety and stopping sight distance based on AASHTO criteria.

Design Controls for Stopping Sight Distance and for Crest Vertical Curves

Design Speed (mph)	Stopping Sight Distance (feet)	Rate of Vertical Curvature (K)
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

For minimum passing sight distances the lengths of crest vertical curves are substantially longer 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.

The minimum lengths of vertical curves for different values of A (algebraic difference) to provide the minimum passing sight distance for each design speed are listed below in the table.

Design Controls for Crest Vertical Curves Based on Passing Sight Distance

Design Speed (mph)	Stopping Sight Distance (feet)	Rate of Vertical Curvature (K)
20	710	180
25	900	290
30	1090	425

35	1280	585
40	1470	775
45	1625	945
50	1835	1205
55	1985	1410

525.04 Sag Vertical Curves

There are at least four different criteria for establishing lengths of sag vertical curves recognized to some extent. 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. Given a length of curve that is relatively flat with a “K” value of 51 or greater can drastically change the actual low spot in relation to the sag curve PVI.

The minimum lengths of vertical curves for different values of A (algebraic difference) to provide the minimum stopping sight distance for each design speed are listed below in the table.

K values are based on the following formula $V = K * A$ (V – Vertical Curve Length; K – rate of vertical curvature; A – Algebraic Difference) and the designer should solve for K, to evaluate and compare to the table listed below.

For example: A design speed of 25 mph requires a minimum K value of 15 and anything less than 15 would not satisfy the required 25 mph speed limit for safety and stopping sight distance based on AASHTO criteria.

Design Controls for Sag Vertical Curves

Design Speed (mph)	Stopping Sight Distance (feet)	Rate of Vertical Curvature (K)
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').

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 Town Engineer.

527.00 Major Structures

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 Town Engineer. Plans and supporting calculations for a qualified structural engineer who is a Registered Professional Engineer licensed to practice in Colorado must prepare major structures.

528.00 Design Element Coordination

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.

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 Town Engineer prior to Final Plat approval or the issuance of a permit. Generally, where more than one requirement is imposed, the more restrictive requirement will govern. The Town Engineer 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 Town Engineer.

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 Town Engineer. 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 Town Engineer 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 re-compacted 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 moisture content will be maintained within +/- two percent (2%) of optimum moisture for A-1 through A-5 materials and optimum to two percent (2%) above for A-6 and A-7-6 materials during compaction. 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 Town Engineer.

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

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.

538.01 Subexcavation 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 Town Engineer.

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 Town Engineer.

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

Landscape medians and landscaping next to curb and gutter shall be provided with underdrain to handle sprinkler runoff and nuisance flows. All roads with detached sidewalk and landscaped tree lawns will require curb underdrains. See Standard Details ST 17 and ST 18.

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 Town Engineer.

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 Town Engineer. 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 Town Engineer. 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 Town Engineer. The base course will be maintained in this condition by watering, drying, rolling, or blading or as the Town Engineer 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 Town Engineer. Materials and construction will be in accordance with the latest edition 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) shall be used for top lifts and overlays or in special cases as required on the accepted plans or authorized in writing by the Town Engineer.
- C. All mixes shall be designed with 1% lime.
- D. A maximum of twenty percent (20%) Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.
- E. The mix will conform to the job mix formula specified by the Town Engineer for the pit-supplied materials, if a current job mix formula is available. A copy of the mix formula will be submitted to the Town Engineer 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 Town Engineer.

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 Town Engineer. 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 ≤ 40	
Marshall Stability (minimum) ¹	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 ³	12-13-14
Percent voids filled with bitumen	65-75

High EDLA ≥ 40	
Marshall Stability (minimum) ²	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 ³	12-13-14
Percent voids filled with bitumen	65-75

¹ - Marshall Stability (50 Blow)/Hveem Stability

² - Marshall Stability (75 Blow)/Hveem Stability³ - Refer to Table 500-2

**TABLE 500-2
VOIDS IN THE MINERAL AGGREGATE¹**

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

¹ - 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 Town Engineer. 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 Town Engineer.

544.01 Asphalt/Polymer Combinations

The Contractor may submit to the Town Engineer 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 Town Engineer 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 Town Engineer. 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 Town Engineer 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 Town Engineer, 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 Town Engineer, 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 Town Engineer, 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 Town Engineer.

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 millings immediately behind the grind machine by belt loader, end loader, power sweeper, and/or by hand. The removed material belongs to the Town and will be disposed of as approved by the Town Engineer.

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 TOWN’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 Town Engineer.

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 Town Engineer. 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 Town Engineer. 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 Town Engineer, 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 Town Engineer. 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 six inches (6") thick where detached or attached, unless noted otherwise on the accepted plans, and shall be constructed to the dimensions shown on the accepted plans. All areas

of sidewalk that will be constructed in parks, open spaces or greenbelts as indicated on the accepted plans or required by the Town Engineer will be constructed with six inch (6") thick concrete. Six-inch (6") thick sidewalks shall be constructed to the dimensions shown on the accepted plans or as required by the Town Engineer.

563.03 Crossspans and Curb Return Fillets

Crossspans 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 Town Engineer.

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. Commercial lots shall be eight-inch (8"). Construction of curb cuts will be as shown in the Standard Drawings. Spacing will be as shown in the Standard Drawings.

563.05 Curb Ramps

Curb ramps for the handicapped will be installed at locations designated by the Town Engineer. Curb ramps will be constructed as shown in the Standard Drawings.

563.06 Sidewalk Chase Drains

Where three or more lots drain to a shared lot line swale, a sidewalk chase drain will be installed to convey drainage through the sidewalk to the gutter. In areas with detached sidewalk and trees lawns, the chase will continue through the tree lawn and curb to the gutter.

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 recompacted.

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 Town Engineer 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 Town Engineer. 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 Town Engineer. 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 Town Engineer. 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 Town Engineer 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 Town Engineer. 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

Sidewalks shall have the name of the contractor and the year of construction impressed therein, using block letters not less than one inch (1") high and three-eighths inch (3/8") deep. Impressions will be made in sidewalks at each end of each Town block, or at the end of construction if other than at the end of the block.

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 Town Engineer 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 Town requirements and are the basis for the Town'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 Town Engineer a minimum, of one (1) working day in advance of the required inspections. Required inspections include:

- A. Culverts - trenching, grade, bedding, installation, backfill and compaction. Inspection to be requested when backfill is completed to one-half (1/2) the depth of the culvert.
- B. Concrete - finished excavation, grade, forming, reinforcing steel.
- C. 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.
- D. 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 Town Engineer. Non-destructive deflection testing, as specified in Section 514 of these STANDARDS AND SPECIFICATIONS, will be performed.
- E. Acceptance - a request for an inspection and Initial 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 Town Engineer, 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

581.00 Installation

All installation of landscaping and irrigation in Town Right-of-way must be done in accordance with SECTION 1000 PARKS AND RECREATION of these STANDARD and SPECIFICATIONS.

582.00 Maintenance

The maintenance of landscaping and irrigation located in and/or over Town right-of-way is the responsibility of the adjoining property owner with the exception of landscape medians on Town designated Arterial roadways which are the Town's responsibility. All landscaping shall be maintained in accordance with the follow requirements:

- A. Tree branch growth shall be maintained at a height no lower than ten (10) feet over a public sidewalk, walkway, or trail and no lower than fourteen (14) feet over the travel lanes of a street or alley.
- B. All woody plant growth lower than ten (10) feet shall not encroach upon the plane of a public road, sidewalk, walkway, or trail and must be trimmed back within the inside edge of all sidewalks, walkways, or trails.
- C. Tree branch growth shall be maintained so that branches do not interfere with the proper spread of light along the street from any street light.
- D. Trees and other woody plants growth shall be maintained not to come within three (3) feet of fire hydrants.
- E. Visibility triangle distances shall be maintained to protect visual clearances for motorists and pedestrians. No landscaping plant material shall be allowed within the visibility triangle that exceeds over thirty-six (36) inches higher than the street level in this triangle. Trees located within the visibility triangle must be trimmed at the trunk to at least eight (8) feet above the level of the ground surface, provided that such trees are spaced so that trunks do not obstruct the vision of motorists and pedestrians.

590.00 TRAFFIC CONTROL DEVICES

591.00 General

The installation of traffic control devices and street lighting shall comply with all applicable portions, as from time to time amended, of the CDOT Standard Specifications for Road and Bridge Construction, the Manual on Uniform Traffic Control Devices (MUTCD) and the accepted plans. These STANDARDS AND SPECIFICATIONS and any other requirements determined by the Town Engineer shall apply to all materials supplied, methods and procedures of work. The Town Engineer must approve a traffic control device, sign layout plan, and a street lighting layout plan.

592.00 Signs

592.01 Street Name Signs

Street name signs shall be bought by the Contractor or Developer and will be installed by the Contractor or Developer. Sufficient signs and posts shall be provided to allow installation on two (2) corners of each intersection in business district, on principal arterials and on one corner in the residential areas, as directed by the Town Engineer. All letters shall be Federal Highway Administration Series C2000. Please reference the Street Sign Detail of our Standards & Specifications.

All street signs shall be aluminum 5052-H38 (Conversion coated) minimum thickness of .080.

Retroreflective sheeting for letters and background shall be required in accordance with the MUTCD.

Unless directed otherwise by the Town Engineer, signs shall be installed on square stock tubing at eighteen (18) inches behind the curbwalk or curb and gutter, whichever is closest to the street. Anchors shall be galvanized (G90) 12GA steel with seven-sixteenths (7/16) inch diameter holes, one (1) inch on center, two-one fourth (2 ¼) inch square and three (3) feet in length. During installation, the anchors may only be between a minimum of four (4) and maximum of six (6) inches above the ground. Posts shall be of galvanized (G90) 12GA steel with seven-sixteenths (7/16) inch diameter holes, one (1) inch on center, two (2) inches square and to length to meet mounting requirements

set forth in the M.U.T.C.D. All posts and signs shall be affixed using the appropriate size of bolts, washer and nuts (NO RIVETS).

4" diameter PVC pipe sleeves shall be placed in concrete where sign posts are to be installed to accommodate sign post installation and replacement.

592.02 Illuminated Signs

Internally illuminated street name signs shall be furnished and installed by the Contractor or Developer. Signs shall be installed on each traffic signal mast arm at each intersection. Sign lettering shall be in the ten (10) inch uppercase. Suffixes are to be five- (5) inch uppercase letters. Lettering for supplementary to indicate the type of street or section shall be at least four (4) inches where a two-line application is desired or three (3) inches where a three-line application is desired.

592.02.01 Borders

Reserved.

592.02.02 Spacing

Interline spacing shall be approximately one half (1/2) to three-fourths (3/4) the average of uppercase letter heights in adjacent lines of letters. The spacing to the top and bottom borders shall be equal. The lateral spacing to the vertical edges shall be essentially the same as the height of the largest letter. Spacing used in words, words and arrow, a letter and arrow, or a word and numeral in a line copy should be approximately one (1) to one and one half (1 1/2) times the uppercase letter height used in that line of copy.

592.02.03 Arrows

Arrows shall be in accordance to the MUTCD standards as illustrated in the Standard Highway Sign Handbook.

592.02.04 Color

Letters and numbers are to be white on a green background face. When a "Town Logo" is required, the Town approved logo shall be used.

592.02.05 Sign Housing

The street name sign shall be free swinging or limited swinging. Sign fixture and panels shall withstand 90 mph wind loading, with structural requirements meeting AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminars and Traffic Signals" latest edition. Illuminated street name housing shall be constructed of extruded aluminum. The design shall be rigidly constructed to resist torsional twist and warp. All ferrous parts shall be galvanized or cadmium plated. The front and back sign panels of the cage shall be hinged, to provide access to

the lamps. Neoprene gaskets shall be installed between the sign panels frame and fixture housing to prevent dust and water entrance. The latching devices can be either screw type or latch type to provide a secured attachment of the sign face to the case. Screened weep holes are to be provided on the housing bottom for drainage. The overall weight of the completed sign assembly, including mounting brackets, shall not exceed 90 pounds.

592.02.06 Illumination Source

The entire surface of the sign panel shall be evenly illuminated. The illumination source shall be fluorescent lamps, powered for low temperature operation. There shall be separate ballast for each fluorescent lamp. Photoelectric controls are required and shall be the "hail resistant" type and of the load intended. The reflectors shall have a minimum reflectance of 85%.

592.02.07 Final Layout

Final layout and lettering details are to be submitted to the Town prior to fabrication.

592.03 Stop Signs

Stop signs shall be installed at all approaches to streets designated by the Town as through streets. Stop signs shall be mounted on the same support posts as street name signs where possible.

592.04 Other Signs

Twenty-five (25) MPH speed limit signs shall be installed at all subdivision entrances. Speed limit signs, school signs, and crosswalk signs shall be installed at locations designated by the Town Engineer.

592.05 Private Street Signs

All subdivisions with private streets shall install private street signs as shown in Standard Details-Streets at all entrances to the private streets.

593.00 **Striping**

The Contractor shall submit a striping plan to the Town Engineer for acceptance prior to beginning work. The striping plan shall meet the requirements for such work as outlined in the MUTCD. Yellow centerline and lane line markings shall be applied to streets designated by the Town as through streets. All temporary striping and markings of roadways shall consist of paint pavement marking materials conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction all striping and markings of roadways minus the top lift shall consist of paint pavement marking materials conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and

Bridge Construction. All striping of the top-lifted roadways shall consist of epoxy pavement marking material conforming to Section 713 of the CDOT Standard Specifications for Road and

Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction. All markings of the top-lifted roadways shall consist of preformed thermoplastic marking material conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction. Standard twelve (12) inch wide stop bars shall be provided at all stop locations and intersections adjacent to schools, parks, commercial, and other areas as determined by the Town. Crosswalks will be marked with two (2) foot by eight (8)

foot bars, and layout shall conform to CDOT M&S Standards, typical pavement markings, Standard Plan No. S-627-1.

594.00 Sign Supports

All sign supports or posts shall conform to specifications for perforated square steel tubing and to Standard Specifications for Cold Rolled Carbon Steel Sheets, Commercial Quality, ASTM Designation A-366. The cross section will be square and consist of ten (10) gauge or twelve (12) gauge steel (0.135" U.S.S. Gauge or 0.105" U.S.S. Gauge) carefully rolled to size and continuously welded at the corner and will conform to CDOT M&S Standards, Mounting Data, Standard Plan No. S-614-3. Sign sizes not included in this data shall be:

<u>Total Sign Area</u>	<u>Side Dimensions</u>
Less than 800 sq. inches	2" x 2"
800 to 1000 sq. inches	2" x 2"
Over 1000 sq. inch	CDOT S-614-3

The finished members shall be straight and have a smooth, uniform finish. It will be possible to telescope consecutive sizes of tubes freely with a minimum amount of play. All holes and cut-off ends shall be free from burrs. Seven-sixteenth (7/16) inch diameter holes shall be punched on one (1) inch centers on all sides of the tube. All posts shall be weather protected by galvanizing. Posts shall be formed from cold rolled steel strip that has been zinc coated and is commercial quality (1.25 oz.) conforming to ASTM Specification A-525.

595.00 Street Lighting Procedure To A High Source

The developer shall submit a written request for street light design to the electrical utility company (United Power) along with three sets of street and utility plans and one copy of the plat map. The electrical utility company shall submit the final design to the Town Engineer for review and approval. Developer shall pay the electrical utility company the total costs of installation for all street lighting within thirty (30) days of receipt of written notice.

The developer shall coordinate the location of the mail boxes and the street lighting with the United States Postal Service to ensure adequate light is available at each mail box. Lighting shall conform to the requirements of the United Postal Service.

All luminaries for street lighting must be LED and have written approval of the Director of Planning and Development prior to installation.

The spacing and illumination which will be used is set forth in Table 900-1:

TABLE 500-1

<u>Street Type</u>	<u>Average Foot Candles</u>	<u>Lamp Lumens</u>	<u>Pole Spacing</u>
Local Residential	0.15	9,500	300' ± *
Rural Residential	0.15	9,500	At Intersections
Collector	0.25	9,500 to 27,500	200' ± *
Arterial	0.50	27,500	150' ± *

* Poles shall be placed on alternating sides of the street.

595.01 Residential Street Lighting

All intersections and cul-de-sac bulbs shall have a minimum of one light. If a segment of street between intersections is greater than 450 feet and less than 600 feet, a light shall be installed at the center of the segment. A light shall also be placed at all community mailboxes and trail crossings. Residential lighting shall be 25 feet in height unless otherwise approved by the Town.

595.02 Collector Street Lighting

Collector lighting shall be 250 watt equivalent luminaries on metal or fiberglass poles 25 feet in height. The light fixture shall have a flat lens and the poles shall be dark in color unless otherwise approved by the Town. A minimum of two lights shall be placed on diagonal corners at all intersections and on all corners of a signalized locations. A light shall also be placed at all community mailboxes and trail crossings. Collector lighting shall be 25 feet in height unless otherwise approved by the Town.

595.03 Arterial Street Lighting

Arterial lighting shall be 250 watt equivalent luminaries on metal or fiberglass poles, 35 feet in height. The light fixture shall be 35 feet in height, have a flat lens, and on 10-foot long mast arms unless otherwise approved by the Town. The poles shall be dark in color unless otherwise approved by the Town. A minimum of two lights shall be placed on diagonal corners at all intersections and on all corners of signalized locations.

**TABLE 500-3
STREET DESIGN CRITERIA**

Design Element	Principal Arterial	Minor Arterial	Collector	Residential Collector	Local Street
Right-of-way Width	120'	120'	80'	70'	60'
Flow Line Curb Radius - Arterial	50	50	30	30	**
Flow Line Curb Radius - Collector	30	30	25	25	20
Flow Line Curb Radius - Local	**	**	20	20	15
Design Speed	55 mph	50 mph	45 mph	30 mph	25 mph
Typical Posted Speed Limit *	45 mph	40 mph	35 mph	25 mph	25 mph
Maximum Degree of Curve (degrees)	6	7.4	12	32.7	32.7
Minimum Curve Radius (feet)	955	775	475	300	175
Cross Slope without Super Elevation		Maximum 4% - Minimum 2%			
Super Elevation Maximum	4% required	Reverse crown	Normal crown	Normal crown	Normal crown
Maximum Street Grade	5%	5%	6%	6%	6%
Minimum Street Grade	0.5%				
Maximum Grade at Intersection	2% for 300'	3% for 300'	4% for 150'	4% for 150'	4% for 150'
Min. Approach Tangent @ Intersections	300'	300'	200'	200'	100'
Min. Tangent Between Vertical Curves	50'				

* Posted speeds limits may be changed from based on current engineering studies in accordance with the current State of Colorado Model Traffic Code.

** Intersections of Local streets and Arterial streets are not allowed.