TOWN OF SILVERTHORNE

STREET DESIGN CRITERIA

December 2005

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Public Works Director

I. GENERAL

A. Introduction

The purpose of this document is to establish criteria to be used in the design and construction of streets within the Town of Silverthorne. These criteria are meant to address and ensure uniformity, safety and accessibility as best as possible with respect to use by the general public, emergency service providers and the maintenance responsibilities of the Town's Public Works Department. Unless modified herein, all design and construction shall comply with the following standards and specifications. If necessary, the Town may require compliance with Colorado Department of Transportation (CDOT) and/or American Association of State Highway and Transportation Officials (AASHTO) requirements in certain cases which may not addressed by this document. The following criteria are intended to serve as guidelines for street design. Ultimate responsibility for actual design, however, remains with the design engineer. All street design shall be based on sound engineering judgment.

Designs of streets for construction within the Town of Silverthorne limits shall be approved by the Town prior to such construction. All streets shall be designed by a Registered Professional Engineer licensed to practice in the State of Colorado unless otherwise approved by the Public Works Director or Town Engineer.

The Public Works Director or Town Engineer may amend or increase design and construction requirements if special or unique conditions exist. Design criteria and construction specifications may be promulgated, changed or amended from time to time at the discretion of the Public Works Director and shall be effective upon approval and authorization of the Public Works Director. The Public Works Director shall have the authority to waive, supersede or alter such standards and/or requirements on a case-by-case basis if it is determined that there is sufficient and/or practical reason to do so. Such action by the Director may result in standards which are either more or less stringent than those described in this document. Where deemed necessary, particularly if a topic is not addressed in this document, then CDOT and/or AASHTO guidelines may be referred to for additional standards.

Wherever feasible, new streets shall be aligned in accordance with the Town's Transportation Master Plan to join with planned or existing streets or rights-of-way. Streets shall be designed to bear a logical relationship to the topography as best as possible. Intersections shall be at right angles, unless otherwise approved by the Town in advance. Roads, which are planned for future extension, but which do not yet exist, shall be constructed to and shall terminate at the property line.

B. Street Classifications

The following classifications shall be utilized in determining the criteria under which a street is to be designed.

1. Local Streets - Local Streets typically experience lower volumes of traffic than do Collectors and Arterials. Local roads typically branch from Collectors or Arterials and usually lead to specific destinations and are usually in locations in which they are not part of a larger thoroughfare which may experience more traffic. Local roads typify residential uses. While commercial access from a local road is possible, it is less common. Posted speed limits for Local Streets typically should not exceed 25 mph.

2. Collector Streets - Collector roadways provide access and circulation within residential, commercial and industrial areas. Collector roadways often connect with both Arterial and Local roadways and often serve as a transition between the two. Collector roads often distribute traffic between the highway system and local streets and to and from neighboring developments. Collectors can also provide direct access to individual residential and/or commercial lots. Roads which serve commercial properties typically tend to generate more traffic than in residential areas and as such are usually considered to function as Collectors. However, roadways within residential areas are often considered as being Collectors depending on the size of the development served and the volume of vehicles that use the road.

*A listing of Collector streets can be found in the Town of Silverthorne's Transportation Master Plan (TMP).

3. Major Arterial Streets - Of the three classifications, Arterials are the largest roads and are sized to carry the highest traffic volumes. Unless they are part of the interstate system, arterials are usually signalized. While arterials often provide direct access to directly adjacent properties where no other access points exist, it is preferable to limit access points where feasible in order to reduce turning movements and to achieve steady traffic flows as best as possible. The State Highways, specifically I-70, SH9 and US6 are roadways that function as Arterials within and through the Town of Silverthorne.

C. Soils and Materials Testing

All new design projects shall be based on a project specific geotechnical study which is required to be prepared by a registered Professional Engineer. All designs shall meet or exceed the minimum section standard of 3" of asphalt on 4" of Class 6 roadbase. For roadway improvements to be made within Town right-of-way, soils testing and identification of the existing conditions and the proposed design shall be submitted to the Town fro review and approval. If unsuitable soils are encountered during construction then a modified design shall be submitted by the soils-testing firm to the Town for approval. The Town may delay acceptance of constructed projects or may require a longer warranty period if there are test

failures, if testing has not been completed in accordance with the requirements of this section, or if the road wasn't constructed in accordance with the recommendations made by the design engineer.

All soils and material testing shall be done by a soils/geotechnical firm under the supervision of a Registered Professional Engineer. Reports and recommendations shall be certified by a registered Professional Engineer from that firm. The testing firm will be required to provide subgrade and road base compaction tests, density testing of asphalt and strength testing of concrete, where applicable. Tests shall be made at a frequency of every 200' linear feet, and at every 12" compacted lift of fill placed, and for every lift of asphalt placed and rolled unless determined otherwise by the Town Engineer. Road base and subgrade lifts shall meet or exceed compacted densities of 95% Modified Proctor (ASTM D-1557). Other embankment and fill shall meet or exceed compacted density of 90% Modified Proctor. The Town shall be notified of any failed tests or unsuitable soils on site. Reports shall be provided to the Town. Any locations suspected to be unstable after re-grading and/or recompacting shall be further analyzed, and additional stabilization recommendations may be required.

Compacted, in-place density of asphalt shall be within the range of 92 to 96% maximum theoretical density as determined by the Rice density method (ASTM D-2041). Asphalt aggregate shall comply with State Highway grades S and/or SX.

Concrete shall meet the following requirements:

a) compressive strength of 4000 psi after 28 days of cure time;
b) air content of 6.5% +/- 1.5%; and
c) maximum slump of 3"

The Town may approve a design contingent on soil test results that may come after the preliminary design stage, but prior to construction.

D. Design Speed

The choice of design speed is influenced principally by the character of terrain, type of roadway and historic and/or anticipated traffic volumes. Speeds for Local Streets classification shall range from 20 to 25 miles per hour. Speeds for Collector Streets classification shall range from 25 to 30 miles per hour. Arterial roadways within the Town are limited to the State Highway System, thus determination of design speeds and posted speed limits fall under CDOTs jurisdiction.

E. Public Right-of-Way and Private Access Easements

Public right-of-way

The width of right-of-way (R.O.W.) depends on the street cross-section to be used, topography in the area, and other physical controls. Having sufficient R.O.W. is important for future widening and/or construction other improvements as traffic and travel conditions warrant. Unless otherwise determined by the Public Works Director, the standard for right-of-way width for new projects to be dedicated to the Town shall be 60 feet for Local roads and 75 feet for Collector roads. Where cul-de-sacs are proposed, 130 foot diameter right-of-ways are required. Where medians are proposed, rights-of-ways shall be widened and offset in direct relation to the width of the corresponding median. For example, if a 15 foot wide median is proposed, then the required right-of-way shall be 75 feet in width.

Where retaining walls are proposed, there shall be a minimum of 10 feet horizontal distance between the edge of the pavement and the face of the wall in order to allow for snow storage. In no case shall the right-of-way limits be closer than 10-feet from the edge of the proposed paved roadway. These minimums may increase where necessary to meet all potential side slope, retaining wall, or utility requirements and will be determined during the Subdivision review process.

No private improvements shall be constructed in public right-of-way. This includes but is not limited to improvements such as private landscaping, retaining walls, irrigation systems, monuments, signage, snowmelt systems, and light fixtures.

Privately owned access easements.

Privately owned and maintained shared driveways and access easements have been becoming more common in the Town in recent years. Despite that fact that the Town does not own and maintain the drive surface, the Town, and public utility providers in most cases still will have their infrastructure placed within these easements. Consequently, utility providers need assurance that sufficient room to construct and to gain access to utility infrastructure exists. Platted easements of this nature shall be referred to as "Private Access and Public Utility Easements" and shall be at least 50' in width.

Where these easements are proposed, the corresponding plat shall include a note with the following, or similar verbiage, subject to Town approval:

"Owner dedicates to the Town and other public utility provider(s), underground easements for related utility infrastructure. In the event that repairs are needed within the easement, the Town and/or utility providers, following repairs, will backfill the trenches to grade, but will not be responsible for replacing paving, concrete, landscaping or any other improvements which may be located within the easement and which may have experienced damage as a result of repairs made to water and / or sewer main or other utilities."

Private driveways are also subject to review and approval from the local Fire District and shall satisfy the Fire District's concerns and requirements as they relate to emergency response vehicle accessibility and maneuverability.

Unless otherwise approved by both the Town and Fire District, shared private drives shall not exceed 1000' feet in length, shall serve a maximum of 8 units and shall have a pavement width of 18 feet with 2-foot roadbase shoulders on each side.

Shared driveways shall also be planned and designed in accordance with the surrounding topography and need to show that adequate snow storage along and within the shared driveway exists and is realistically maintainable. Shared driveways will not be approved if it does not appear that adequate and realistic snowstacking space within the shared driveway area exists. This snowstacking space shall be a level surface and not slope sides. Snow from shared private driveways shall not be plowed onto Public right-of-way. Snow storage in the amount of 25% of the paved surface is required and shall be indicated on plan submittals.

Private Ownership and Maintenance signs are required at the accesses shared drives. Stop signs may be required as determined by the Town Engineer.

Addressing and address monuments which may be proposed for shared private drives are subject to Town and Fire District review and approval.

F. Pedestrian/Bicycle Facilities

Pedestrian and/or bicycle improvements shall be constructed in accordance with the Town of Silverthorne's Parks, Trails and Open Space Master Plan. In addition and where applicable, pedestrian and/or bicycle improvements may also be required for connecting new developments or redevelopments to existing bikepath and/or sidewalk facilities. Attached versus detached sidewalks shall be determined by the Public Works Director. Where new developments or redevelopments are proposed which are adjacent to existing pedestrian and bicycle facilities, the developer may be required to improve the existing bike path or sidewalk. Examples of these types of improvements include but are not limited to horizontal realignment / buffering, surface improvements, ramp improvements, signage and lighting.

When pedestrian or bicycle pathways are required, such facilities shall meet the following requirements. Minimum concrete sidewalk width shall be six feet. Minimum asphalt bike pathway width shall be ten feet wide. Shoulders for both sidewalks and bikepaths shall be constructed of compacted Class 6 roadbase, shall be a minimum of 6" thick and 2-feet wide and shall be at or slightly below grade of the adjacent pathway.

Minimum section for both shall be either four inch concrete with one inch base leveling course on a prepared subgrade or three inches asphalt with four inches base on a prepared subgrade comprised of compacted Class 6 road base. Reduced widths for bike paths may be considered where ROW widths are limited, subject to Town review and approval. Terminal

ends of curb sections shall be sloped and tapered for a minimum distance of 5 feet. Materials testing shall comply with requirements in section I.C. Soils and Materials Testing, above.

Pedestrian/bicycle pathways and sidewalks at road crossings shall comply with ADA truncated dome standards. CDOT curb ramp specification M-608-1 illustrates this and have been included as Figures 2a through 2d.

G. Temporary Unpaved Roadbased Streets

Under certain circumstances, the Public Works Director or Town Engineer may allow a delay of final paving of a new street until the following construction season to allow sufficient time for roadway stabilization. In those cases, all street construction up to and including base work shall be completed. Gravel streets shall be graded to a three percent crown and then re-graded and compacted as required by these standards prior to paving. If final paving is delayed on a new street which has not yet been dedicated to the Town then the Town will not accept and maintain the roadway, nor will issue Building Perimts, until it has been paved.

If the first lift of asphalt has been placed, the Town, at its digression, may consider deferring the final lift of asphalt on a new street until the following construction season to allow sufficient time for roadway stabilization. Under this scenario, the Town would own and maintain the road, however the warranty period for the road and underlying utilities would not begin until the second lift of asphalt has been placed. If adjacent concrete improvements, such as curb and gutter are present, then asphalt shall be shimmed or tapered or to the edge of the concrete so to safeguard against potential damage caused by plowing activities. Water valves and manhole covers shall NOT be shimmed, but rather shall be installed at ¼" to ½" below grade of the first lift of asphalt. The covers shall be raised prior to the second lift of asphalt to be placed during the following construction season. Under this scenario, it is possible for Building Permits to be issued.

H. Half Streets

Half streets arise in attempting to locate street centerlines on the perimeters of subdivisions for land parcels. Construction of half streets are not allowed in the Town of Silverthorne.

II. BASIC DESIGN PARAMETERS

Introduction

Improvements to existing roads or construction of new roads for dedication to the Town shall have design plans reviewed and approved by the Town Engineer prior to construction. Unless otherwise approved by the Town Engineer, all such plans shall be designed by a Colorado Registered Professional Engineer.

The purpose of this section is to specify the minimum criteria to be used in the design of streets or street improvements in order to address and ensure uniformity, safety and accessibility with respect to use by the general public, emergency service providers and the maintenance responsibilities Town's Public Works Department.

All streets shall be aligned in accordance with the Town's Transportation Master Plan to join with planned or existing streets. Streets shall be designed to bear a logical relationship to the topography. Intersections shall be at right angles, unless extenuating circumstances exist, in which case must be approved by the Town in advance.

A. Horizontal Alignment

1. *Standard for Curvature* - Table 1 gives minimum centerline radii for curves. The table is based on design speed of the road.

2. *Small Deflection Angles* - For small deflection angles, curves should be of sufficient length to avoid the appearance of a kink in the road.

3. *Reversing Curves* - True reversing curves shall not be used in the Town of Silverthorne except as noted herein. In cases where curves in opposite directions must be used, a tangent between shall be used. A minimum 50 foot tangent shall be used if at all possible between reverse curves to facilitate steering and control. Lesser tangent lengths may be considered with deflection angle curves less than 10 degrees.

4. *Broken Back Curves* - Broken back curves consisting of two curves in the same direction joined by a tangent less than 50 feet shall not be used in the Town of Silverthorne.

5. *Coordination with Vertical Alignment* - Coordination is required between horizontal and vertical alignment to ensure that proper sight distances shall be achieved.

6. *Pavement Transition* - A pavement transition is the area of variable pavement width encountered when changing from one roadway width, or section, to another. Pavement transitions shall be based on the following formula, unless otherwise approved by the Town Engineer:

$$L = \frac{WS^2}{60}$$

Where: L = length of transition or taper (in feet)
S = posted speed limit (in mph)
W= offset in feet

B. Vertical Alignment

1. Grade Line - The grade line is a reference line by which the elevation of the pavement and other features of the highway are established. The grade line shall coincide with the street centerline for all streets.

2. Grade - Maximum grade on streets in the Town of Silverthorne shall be 6 percent. Where topographical constraints exist, the Town may consider short spans of increased grades up to a maximum of 8 percent. The potential for this increase will be evaluated on a case by case basis with respect to the following conditions and criteria:

a) Roadway type and traffic volumes. Lower volume roads are more likely to be considered;

b) Roadway geometry. Increased grades will be considered on straight alignments where good horizontal and vertical visibility exists. Increased grades will not be considered on curved sections;

c) Solar exposure. Generally southern or western facing aspects and areas which are not significantly shaded by trees and thus prone to icing are more apt for consideration than are northern or eastern facing aspects;

d) Intersection / driveway accesses. Increased grades will not be considered in areas where there are or may be street intersections and/or driveways. Where intersections exist, grades will need to be flattened out at these areas. Increased road grades will not be considered where access points to lots either exist or may be proposed;

e) Short distances. Unless otherwise approved by the Town Engineer, the maximum distance where increased grades may be considered shall not exceed 200 feet; and,

f) Limits of disturbance. If the increased grade will make a significant difference in minimizing disturbance to environmentally or geographically sensitive areas.

Other factors unique to the area may also be present which could influence whether or not increased grades for a particular section of roadway are to be considered. The Town Engineer and Public Works Director will evaluate these on a case by case basis.

On new roads to be constructed after the date of adoption of this document, where public roadways intersect, grades from the lower volume street which intersects the higher volume street shall be designed with lower grades at the roadway intersection. Specifically, downhill road grades leading to the intersection shall be reduced to 2% for a distance of 50 feet. Downhill road grades going away from the intersection shall be reduced to 3% for a distance of 50feet.

Minimum grade shall be 0.5 percent. Excessive changes in grade which create an uneven ride surface or a roller coaster effect will not be permitted. Connections with existing streets shall be smooth transitions and existing grades shall be shown in the design for at least 150 feet on all sides of a connection.

3. *Vertical Curves* - Properly designed vertical curves shall provide adequate sight distance, safety, comfortable driving, good drainage, and pleasing appearance. Vertical curves in the Town of Silverthorne shall be parabolic curves. Figure 1 gives the necessary mathematical relations for computing vertical curves, at either a crest or a sag in the road.

4. *Sight Distance* - Designs of roadways in the Town of Silverthorne shall ensure adequate and safe intersection and stopping sight distances. Table 1 includes the minimum stopping and corner sight distances for Local and Collector roads in the Town of Silverthorne.

C. Curb and Gutter

1. *General* - Curbs and gutters shall be used when justified by sound engineering reasons based on the following:

a. Where required for proper drainage;
b. Where needed for channelization, delineation, control of access, or other means of improving traffic flow and safety; and,
c. Where required for protection of pedestrian traffic.

Unless otherwise approved by the Town, where curbs are required, they shall have a two foot pan and shall correspond to either CDOTs Type IIM for mountable curbs or Type IIB for barrier (vertical) curbs. The Town will determine which type, mountable or barrier will be required on a case by case basis, which will likely be influenced by snow maintenance operations as well as maintaining uniformity with existing curb and gutter in the surrounding area.

End sections of curb and gutter shall be tapered for a distance of least 5 feet to the elevation down to the adjacent ground surface. Square or butt ended curb sections complicate snow plow operations, present safety hazards to plow operators and will not be permitted.

D. Cross Pans

a. Unless other approved by the Town Engineer, cross pans for drainage, located at stop intersections, shall be 10 feet wide, 3 inches deep and constructed from concrete having a depth of 6 inches poured over a one inch compacted road base leveling course.

b. Cross pans are not allowed within the drive lane on Collector Roads. They may be placed a stop controlled intersections however.

c. Minimum grade in cross pans shall be 0.5 percent measured along the flowline.

d. Concrete cross pans will be required at driveways for all commercial projects.

e. Concrete specifications: Concrete shall have a compressive strength of 4000 psi after 28 days of curing. "FiberMesh" fibers shall be added to the concrete, for strength, at the rate of 1.5 pounds of fiber per cubic yard of concrete. The air content shall be 6.5% +/- 1.5% and the maximum slump shall not exceed 3 inches.

E. Travel Lane Standards

1. *Cross Slope*

a. Cross slope on all streets shall be a minimum of 2 percent measured from street centerline to edge of asphalt or concrete. In areas of minimum grade, 3 percent cross slopes may be considered.

b. Temporary road based streets shall be crowned to 3 percent.

c. Maximum cross slope shall not exceed four percent, when existing streets are being overlayed.

2. *Width*. Minimum paved widths for Local roads shall be 24' and 26' for Collector roads. Increased widths may be necessary where turn lanes are needed. Street width standards are shown in Table 1. Refer to section I. E. "Public Right-of-Way and Private Access Easements" for specifications related to private driveways.

F. Shoulder Standards / Guardrail / Delineators

Minimum shoulder width at grade with the improved surface shall be two feet and shall be constructed from compacted Class 6 roadbase achieving compacted densities of 95%

Modified Proctor (ASTM D-1557). Shoulder slopes shall be a continuation of the road crown slope for the two foot distance.

Guardrail. The purpose of placing guardrail is to reduce the severity of potential accidents caused by an errant vehicle leaving the roadway down a steep embankment. Because guardrail is also an obstruction which could also be a potential hazard it should only be installed if it offers less potential hazard than an obstacle or embankment slope. Safety considerations as well as CDOT and AASHTO guidelines will be factors in the determination of whether and where guardrail will be necessary. Guardrails shall comply with CDOT and/or AASHTO specifications.

Delineators which define the road edge shall be installed at maximum spacing distances of no more than 100 feet between one another. Unless otherwise approved by the Public Works Director, delineators shall be 6-foot tall green steel T-posts and shall include reflective buttons near the top of each one. Delineators shall be staked into the compacted road shoulder to a depth of one foot. Reflective buttons shall be white to indicate the general road edge, blue to indicate culverts and yellow to indicate roadside structures. Final location of required delineation will be determined in the field during construction. Curved sections of road may require more frequent delineation. Flexible Carsonite delineators may be required on certain sections of curved road.

G. Side slopes and Ditches

All roadside ditches shall be no less than two feet in depth as measured from the finished roadway shoulder, shall have 2:1 (horz:vert) side slopes. Where slopes equal to or steeper than 2:1 are used, special provisions for erosion control and revegetation shall be made. Any proposal to deviate from a maximum 2:1 slope shall be accompanied by a soils study dealing with the slope treatment being proposed if requested by the Town Engineer. Where roadway grades are 5% or steeper gravel and where erosive conditions may be present, ditch checks may be required. Such ditch checks shall be placed at 50 foot intervals and be one foot deep across the ditch section. Extensive runs of roadway grades of 6% or greater may require cobble lining of the ditch. In such cases the ditch section shall be deepened four inches to accommodate the cobbles.

H. Retaining Walls

Where necessary to meet required side slope grades, retaining walls may be utilized. Where utilized, rock retaining walls may not exceed 6 feet in height, unless they are stepped. Retaining walls may not be located closer than 10 feet from the traveled lanes, back of curb or back of sidewalk. (Maximum separation is desired for snow maintenance and drainage reasons). Retaining walls shall be designed by a Registered Professional Engineer and are subject to Town review and approval. Increased right-of-way widths may be required from the Developer during the approval process. No deep utility shall be placed closer than 20 feet horizontally from the face of the wall at the toe, and no utilities shall pass beneath the wall.

Unless otherwise approved by the Town, retaining walls in fill slopes shall be boulder walls, and shall be rock filled timber walls where located in cut slopes. Walls greater than 4 feet in height require designs and geotechnical approvals even if constructed in tiers. Final constructed, as-built, retaining walls will require inspection and final written certification from a Registered Professional prior to acceptance by the Town. The Developer will be responsible for this cost.

I. Intersections

1. Minimum angle of Intersection - Intersections shall approximate right angles as closely as possible. All intersections shall have a paved radius on all four corners in accordance with the specifications shown in Table 1. See Section II.B Vertical Alignment, above, for additional details.

2. Separation - Intersections shall not occur at less than a 300 linear foot separation unless otherwise approved by the Town Engineer. In no case shall two intersections on the same side of the road be within 200 linear foot (edge to edge of R.O.W.) of each other. Separation at intersections also includes instances of intersections which exist on opposing sides of the street. In this scenario, a 4-way intersection is required.

3. Intersection at a Curve - Intersections shall not be placed on a curve unless all applicable sight and stopping distances can be met for each roadway. Table 1 summarizes these criteria.

4. Clear Sight Distance - Intersection sight distance is defined by AASHTO as adequate when a driver has an unobstructed view of the entire intersection and sufficient lengths of the intersecting road to avoid collisions. Within this area there shall be no sight-obscuring or partly obscuring wall, fence, sign, utility transformer or foliage higher than 36 inches, above curb grade or in case of trees, foliage lower than 7 feet. Vertical measurement shall be made at the top of the curb on the street adjacent to the nearest street or if no curb exists, from the edge of the nearest traveled way. This regulation is not intended to prohibit the planting of trees or retention of existing trees in the sight distance triangle, if they are pruned so branches are higher than 7 feet. Installation of traffic control signs or signals, fire hydrants and street lights are exempt from this regulation. Table 1 summarizes these criteria.

J. Cul-de-Sacs

1. Cul-de-sacs - Cul-de-sacs shall be permitted provided that they have a right-of-way diameter of at least 130 feet; and an improved surfaced diameter of 110 feet. The maximum length of cul-de-sacs shall not exceed 1,500 feet, unless otherwise approved by the Public Works Director. Surface drainage shall be directed either outward towards the perimeter of the cul-de-sac. The entire 130 foot right-of-way shall be improved to allow full use by emergency vehicles. A center landscaped median/island may be required during the approval process for the roadway/subdivision. The median/island may also be constructed with service

conduits to allow for landscaping irrigation and electrical streetlight provisions. Maintenance of improvements within median/islands however is the responsibility of the subdivision's Home Owners Association in which it is located. The Town does not maintain these improvements.

Median/island diameter in general should be approximately be 20 to 30 feet, but may vary slightly from case to case. Unless otherwise approved by the Town Engineer, the median shall be constructed with concrete curb and gutter around the perimeter. The median shall be crowned so that it drains away from the center and off of the cul-de-sac.

2. *Dead-end Streets* – Dead-end streets, except for cul-de-sacs, shall be prohibited unless they are designed to connect with future streets in adjacent land which has not yet been developed and/or platted. Hammerheads will only be considered if there is no potentially developable lot which takes direct access from the hammerhead and also if there is a secondary road connection within 200 feet of the dead end hammerhead. A cul-de-sac will be required if a potentially developable lot exists in the subdivision and is adjacent to the road. If a hammerhead is considered, then an easement will be required to be dedicated to the Town. This easement shall extend 100 feet to each side of the street right-of-way and shall be 100 feet deep, unless otherwise approved by the Town Engineer. Dead end streets will be considered on a case by case basis, based on the nature of the adjacent development. Adjacent development most often necessitates cul-de-sacs because of snow maintenance activities. Town consideration of a hammerhead will also be subject to referral comments from the Fire District.

Temporary dead ends, whether cul-de-sacs or hammerheads shall be paved. Where cul-de-sacs are appropriate, whether temporary or permanent, easements or right-of-way in accordance with the cul-de-sac right-of-way standards discussed in the prior section, will be required.

K. Pavement Design

1. General design of the pavement structure is the determination of the thickness of sub-bases, bases, and surfacing to be placed over subgrade soils.

2. *Type of Surfacing* - Bituminous asphalt pavement is required surfacing for road construction in the Town of Silverthorne. In certain instances, subject to Town approval, concrete may be considered as an alternative. Pavement designs shall be based on the following factors:

a. Existing and/or projected traffic loading and volume; and,

b. Soils / geotechnical and/or hydrologic conditions in the area.

3. *Minimum Base and Asphalt (or Concrete) Thickness* – The thickness of the roadway template shall be based on the recommendations of a site specific pavement design

performed by a registered Professional Engineer, subject to Town review, comment and final approval. In no case shall thickness be less than 3" of asphalt on 4" Class 6 roadbase for bituminous paved (asphalt) roads or less than 6" of concrete on a 1" base leveling course for concrete roads. Asphalt roads shall be paved and roller compacted in two separate lifts. Tack coating is required between the two lifts. If concrete is considered by the Town then it shall be a minimum depth of 5-inches.

4. *Plant Mix Pavement and Base Course* – Paving aggregate shall comply with State Highway grades S and/or SX. Base shall be State Highway Class 6. Mix design shall be prepared by a Professional Engineer. Compacted, in-place density of asphalt shall be within the range of 92 to 96% maximum theoretical density as determined by the Rice density method (ASTM D-2041).

5. *Concrete* - Concrete shall have a compressive strength of 4000 psi after 28 days of cure time. The concrete air content shall be 6.5% +/- 1.5%. The maximum slump allowed is 3-inches. "FiberMesh" fibers shall be added to the concrete, for strength, at the rate of 1.5 pounds of fiber per cubic yard of concrete.

All soils and material testing shall be done by a soils/geotechnical firm under the supervision of a Colorado Registered Professional Engineer. Reports and recommendations shall be certified by a registered Professional Engineer from that firm. The testing firm will be required to provide subgrade and road base compaction tests, density testing of asphalt and strength testing of concrete, where applicable. Tests shall be made at a frequency of every 200' linear feet, and at every 12" compacted lift of fill placed, and for every lift of asphalt placed and rolled unless determined otherwise by the Town Engineer. Road base and subgrade lifts shall meet or exceed compacted densities of 95% Modified Proctor (ASTM D-1557). Other embankment and fill shall meet or exceed compacted density of 90% Modified Proctor. The Town shall be notified of any failed tests or unsuitable soils on site. Reports shall be provided to the Town. Any locations suspected to be unstable after re-grading and/or recompacting shall be further analyzed, and additional stabilization recommendations may be required.

L. Parking Lots and Driveways

Introduction: This section describes basic standards related to parking lots and driveways, both publicly and privately owned. Additional and more detailed requirements related to parking lots and parking spaces can be found the Community Development Department's Parking Requirements section of the Silverthorne Town Code. In the event that there is a conflict between the two documents, the Town Code regulations shall supercede the standards presented in this document.

1. *Parking lots* - Parking lots shall meet the following minimum requirements:

Type	Aisle Width

90 degree parking	24foot minimum (commercial)
	24 foot minimum (residential)
60 degree parking	18 foot minimum*
45 degree parking	14 foot minimum

* Drive aisles shall be one way and adequately signed as determined by the Community Development Department and/or the Public Works Department.

a. All parking stalls shall be a minimum of 9 feet wide and 18 feet long, except for parallel parking stalls which shall be a minimum of 8 feet wide by 25 feet long. Handicap parking stalls shall be a minimum 8 feet wide by 18.5 feet long, with a 5 foot wide accessibility lane for standard vehicles or an 8 foot wide accessibility lane for vans and larger vehicles. Striping and signage for handicap spaces shall be ADA compliant. Backup space shall be provided for the end space in dead end lots.

b. No portion of any entrance or exit driveway leading to or from a public or private street shall be closer than 35 feet to the nearest point of an intersection. The nearest point shall be measured from the edge of the driveway entrance to the established roadedge of the intersecting street.

c. Driveway pavement widths within Town right-of-way or within access easements shall not exceed 24 feet, except in C-2 zone districts, where the maximum width shall be 35 feet. A minimum 15' separation from the property line is required in situations where the adjacent lot has not yet been developed and thus does not yet have an established access point.

d. For all zone districts other than R-6 and R-15, no two driveways connecting a public or private street, alley or highway to an off-street parking area shall be within thirty (30) feet of one another as measured by the distance of each physically established driveway edge. For R-6 and R-15 Districts, fifteen (15) feet shall be the minimum distance between the closest points of the physically established edge of driveways.

e. All driveways shall intersect the access street at angles between 70 and 90 degrees unless otherwise approved by the Town Engineer. Only if unusual topographical constraints exist, will variation to this standard be considered. Intersections closest to 90 degrees are preferred.

f. Surface drainage. Facilities shall be graded for proper drainage so that surface discharge is channeled to a natural or improved drainageway without causing nuisance or damage to other properties or the improvements thereon. Driveway drainage shall not drain onto the public roadway. A slight, 2" swale near at near the driveway connection with the public road corresponding to the flowline of the roadside ditch. Figure 3 illustrates this swale. Surface drainage from commercial parking lots will typically be required to drain into detention facilities. Proper drainage shall include the installation of such systems, including culverts if necessary, as will protect all affected public right-of-way.

g. No driveways will be permitted to access collector or major arterial streets unless no the access to the lot exists. New subdivisions proposals are encouraged to provide access on lower volume roads, wherever feasible.

h. Grades. For commercial driveways and parking lots the sustained surface grades for parking facilities shall not be less than five-tenths (0.5%) for concrete surfaces, and not less than one percent (1%) for asphalt surfaces but no more than four percent (4%) for either surface. For residential driveways serving a single family or duplex lot, the maximum surface grade shall not exceed 10%. For residential driveways serving multi-family development, the maximum surface grade shall not exceed 8%. If the driveway is proposed to be heated, the grade may be up to 12% if the Town Engineer's approval is obtained. The driveway grade (a percentage) is calculated as the difference in elevation between the garage slab and the road edge over the length of the driveway as measured from the centerline and then multiplied by 100.

i. Snow storage. All driveway and parking surfaces shall be planned and constructed to ensure that adequate onsite snowstorage will be achieved. Required snowstorage is equal to 25% of the total driveway and parking lot surface area. Site plans for project submittals must show the snowstorage areas and they must be accessible and utilizable for normal onsite snow maintenance operations. Snow storage may be shared with landscaping and drainage facilities as long as the shared uses are compatible and considered in the design and approved by the Town. Snow stacking onto public roads and right-of-way is prohibited.

M. Driveway Culverts

All culverts installed within Town right-of-way shall be a minimum of 18 inches in diameter or equivalent unless otherwise noted in the Master Drainage Plan. Unless otherwise approved by the Town, culverts shall be HDPE plastic (High Density Polyethylene). Culvert ends shall extend 1 to 3 feet beyond each edge of the shouldered paved drive in order to prevent slough accumulation.

Where feasible, cover over all culverts shall be 12 inches from top of pipe to finish road grade, unless otherwise approved by the Town Engineer. Additional cover may be required for larger culverts in accordance with the manufacturer's recommendations.

All roadside ditches shall be sized to handle the storm flows tributary to the street, as defined in the Master Drainage Plan and Town Drainage Design Criteria, unless alternate routes for the major runoff are provided. Refer to the Town of Silverthorne Drainage Master Plan and Drainage Design Criteria for additional drainage system information.

N. Erosion Control

Soil erosion and impacts to water quality and environmental standards are issues that arise out of development and are oftentimes magnified during construction. Soil erosion during and after construction often causes undesirable sedimentation problems on streets and adjacent lands. Adverse effects on recreational uses and aquatic life are both concerns arising from sedimentation and construction runoff. Unchecked and/or non-maintained erosion control measures from construction sites can also cause additional maintenance for the Town's Public Works Department. Streets shall be designed and constructed in a manner which will minimize the total area disturbed as well as to promptly revegetate disturbed areas after construction completion. All areas disturbed within Town right-of-way during street construction shall be covered with topsoil and reseeded in accordance to Community Development Departments revegetation standards.

In accordance with State of Colorado water quality regulations and requirements, prior to excavation and construction, a Construction Stormwater Discharge Permit shall be obtained from the Colorado Department of Public Health and Environment. As part of this process, an approved Stormwater Management Plan (SWMP) is required. The SWMP shall include the methods and locations proposed for erosion control during construction. The approved SWMP shall be complied with throughout the entire course of construction. If erosion control Best Management Practices (BMPs) fall into disrepair, then the contractor shall immediately take corrective action. If, in the opinion of the Town, adequate measures to control erosion are not being taken, the Contractor may be shut down until satisfactory arrangements for control are made.

O. Road cuts and Patching

An Excavation and Encroachment permit shall be obtained from the Town of Silverthorne Public Works Department prior to any cuts within any Town road right-of-way. Any cut in any pavement or surfacing shall be made in a neat manner with square edges and corners. Such cuts shall be made with a pavement saw or any such device that results in neat straight edges and square corners. Prior to patching all damaged areas around the cut shall be removed.

As part of and prior to issuance of an Excavation and Encroachment permit, a Traffic Control Plan (TCP) shall be submitted to the Town for review and comment. The Traffic Control Plan shall comply with Manual on Uniform Traffic Control Devices (MUTCD) standards and requirements, as adopted by the Town. An Excavation and Encroachment permit will not be issued unless an acceptable TCP has been submitted to and approved by the Town Engineer.

Roads must be backfilled and opened to both lanes of traffic at the end of each work day. Road transitions shall be tapered in order to prevent jarring bumps.

Patches shall be made with a minimum of six inches of Class 6 roadbase (compacted to 95 percent Standard Proctor) and three inches of asphalt. If the existing street contains greater

base or pavement, the existing street thickness shall be matched. Prior to placement of pavement, a tack coat shall be applied to all edges of the existing pavement, extending six inches beyond the new seam. The patch shall also be feathered out six inches beyond the seam of the patch.

All cuts and patches shall be made either parallel or perpendicular to the roadway. Angled or irregular shaped patches are not permitted. Patches shall extend to the centerline of the road if the road cut is equal to or less than the width of the road edge to the centerline. Full road width patches are required if the road cut extends beyond the road centerline. Patches shall be infrared heated so to eliminate seams and potential intrusion of moisture. Patches are required to be completed within 14-days after roadcuts have been made.

Any street patches that, in the opinion of the Town Engineer, are performed in an unacceptable manner and will cause an excessive bump or may cause snow plowing problems, shall be removed and replaced, at the contractor's expense.

See Town of Silverthorne Excavation Permit Process and Standards for additional requirements.

Street patches shall be warranted for a period of two (2) years from the date of their completion and subsequent acceptance by the Town.

P. Signs

All signs and street marking shall be designed, constructed, and placed in accordance with the "Manual of Uniform Traffic Control Devices" (MUTCD), latest edition, unless otherwise approved by the Town.

Q. Summary

These design criteria as presented are intended to aid the Design Engineer in preparation of plans and specifications for the Town of Silverthorne. As with any design criteria, occasions may arise in which the criteria or minimums are either inappropriate due to environmental or topographical constraints. In these cases, a written variance request to each departure from minimums or maximums shall be submitted to the Town for approval at the designers earliest knowledge of the departure from the standards. The Town Engineer and Public Works Director will evaluate such requests on a case by case basis when making the determination whether or not a variance will be approved. If a variance is approved, the Town will confirm this fact in writing.

III. ROADWAY DESIGN PLAN SUBMITTAL REQUIREMENTS

A. Design Drawing Requirements

All streets designed for construction in the Town of Silverthorne must meet the following criteria:

1. 24 inch by 36 inch blueline prints.

2. 1 inch = 50 feet horizontal and 1 foot = 5 feet vertical or
1 foot = 20 feet horizontal and 1 inch = 2 feet vertical.
(Larger scales will be considered.)

All streets designed for construction in the Town of Silverthorne shall contain the following information.

1. Scale.

2. North arrow.

3. Plan view of all streets.

4. Grades.

5. Profiles or existing ground and proposed street at centerline (existing ground dashed).

6. Length of vertical curves, BVC's EVC's and PIV's.

7. Culverts including locations, size and slope.

8. Crosspans including location size and slope.

9. All other structures.

10. Bench Mark, located within 1,000 feet of the street, tied to U.S.G.S. datum.

11. Horizontal curve data including radii, delta angles, bearing, distances, centerline stations at 100 foot intervals, and BC and EC stationing.

12. Right-of-way widths.

13. Street cross sections for all typical sections.

14. Street Names, including all intersecting streets.

15. Flow arrows showing direction of drainage.

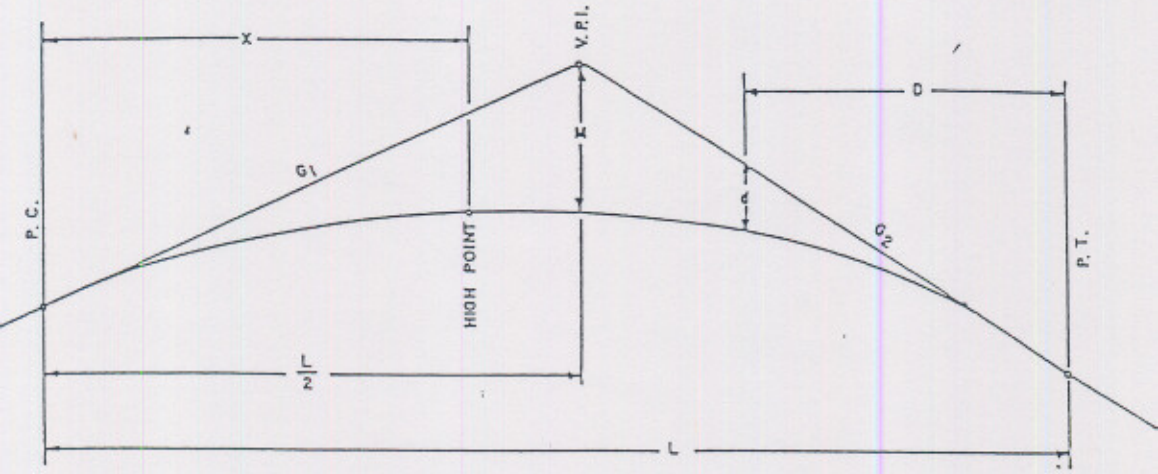
16. Complete design drawings for all structures, such as bridges and box culverts.

17. Stamp and signature of the Registered Professional Engineer under who's direction the plans were prepared.

18. Soils report.

APPENDIX

Figure 1
TYPES OF VERTICAL CURVES



TYPE I

CREST VERTICAL CURVE

L = LENGTH OF CURVE IN STATIONS

G_1 & G_2 = GRADES IN FT. PER 100 FT.

$$M = \frac{L\ (\text{ALGEBRAIC DIFFERENCE IN GRADES})}{8}$$

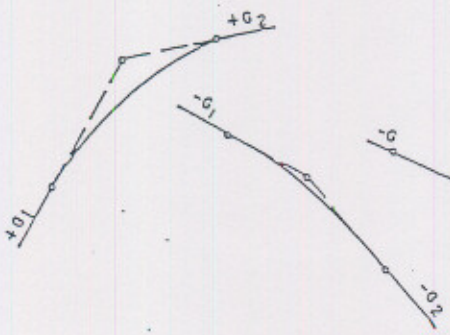
$$d = 4M\left(\frac{D}{L}\right)^2 \quad \text{OR} \quad d = \frac{\text{ALGEBRAIC DIFF.} \times D^2}{2L}$$

TO DETERMINE HIGH POINT (OR LOW POINT ON SAG VERTICAL)

USE THE FOLLOWING:

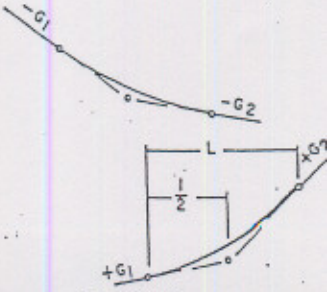
$$X = \frac{G_1 \times L}{\text{ALG. DIFF. IN GRADES}}$$

WHERE X IS THE DISTANCE FROM THE P.C. OF THE CURVE IN STATIONS



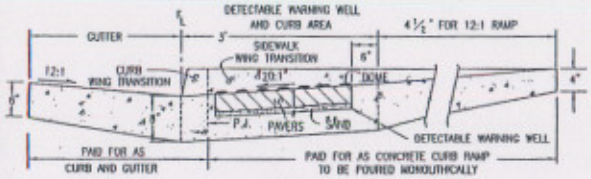
TYPE II
CREST VERTICAL CURVES

TYPE III
SAG VERTICAL CURVES



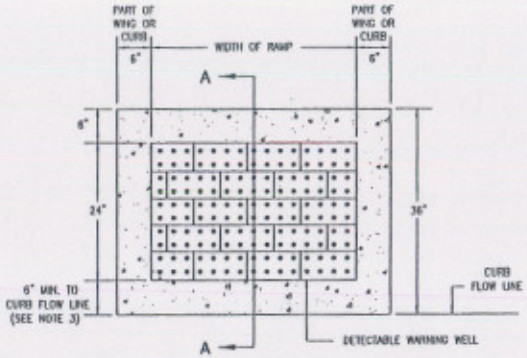
TYPE IV
SAG VERTICAL CURVES

SIDE CROSS SECTION VIEW OF DETECTABLE WARNING, WELL, CURB, AND GUTTER



DETAIL FOR TYPES 1 AND 3 CURB RAMPS

P.J. = PERMISSIBLE JOINT WITH EPOXY-COATED DEFORMED NO. 4 BY 18 IN. BARS CONFORMING TO AASHTO M 284 AT 18 IN. SPACING.

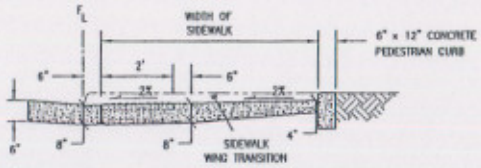


PLAN VIEW OF DETECTABLE WARNING AND WELL

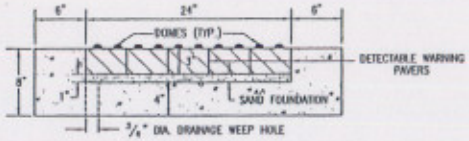
(PAVERS NOT DRAWN TO SCALE)

GENERAL NOTES

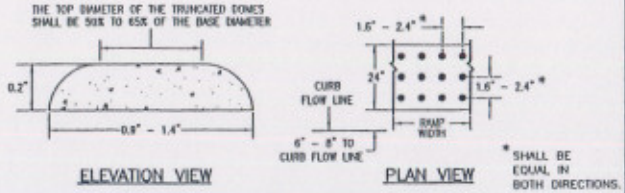
1. THE DETECTABLE WARNINGS SHALL BE INSTALLED AT SIDEWALK/STREET TRANSITIONS. THEY SHALL BE MADE IN PAVER FORM WITH A TRUNCATED DOME SURFACE. THE DOMES SHALL BE PLACED IN A SQUARE GRID.
2. THE TOP OF THE DRAINAGE WEEP HOLE SHALL BE LOCATED AT THE LOWEST POINT OF THE DETECTABLE WARNING WELL.
3. ALL DETECTABLE WARNING AREAS SHALL START A MINIMUM OF 6 INCHES FROM THE FLOW LINE OF THE CURB AND NOT BE MORE THAN A MAXIMUM OF 8 INCHES FROM ANY POINT ON THE FLOW LINE OF THE CURB. ALL DETECTABLE WARNING AREAS SHALL BE 24 INCHES IN LENGTH AND COVER THE COMPLETE WIDTH OF THE RAMP AREA ONLY.
4. THE DETECTABLE WARNING AREA SHALL BE INCLUDED IN THE COST OF THE CONCRETE CURB RAMP.
5. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1. THE DETECTABLE WARNING AND WELL AREA SLOPES SHALL NOT BE STEEPER THAN 20:1.



DETAIL FOR TYPE 2 CURB RAMP



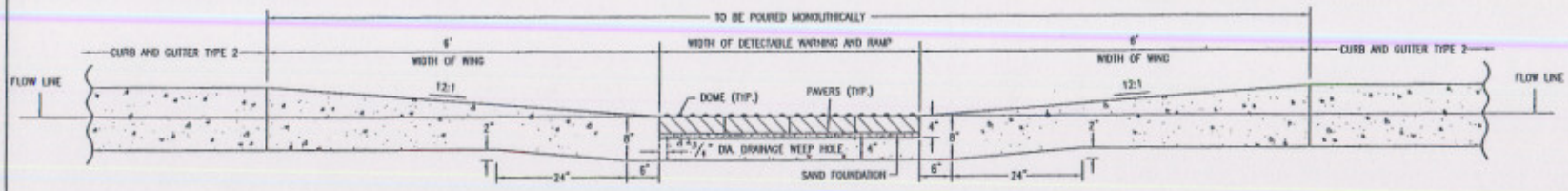
SECTION A–A



ELEVATION VIEW

PLAN VIEW

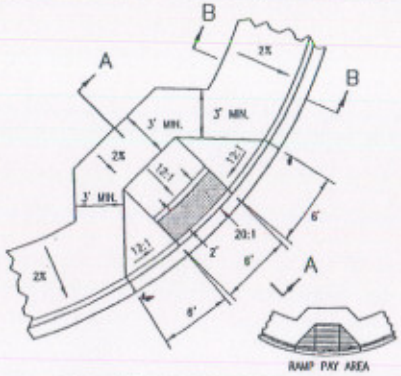
DOME AND DETECTABLE WARNING DETAILS



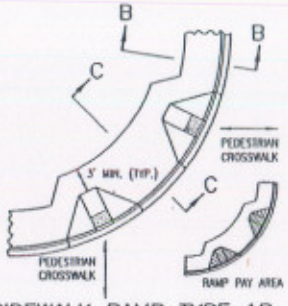
FRONT SECTION VIEW OF DETECTABLE WARNING, WELL, CURB, AND GUTTER

Colorado Department of Transportation	Computer File Information	Standard Plan Revised		CURB RAMPS	STANDARD PLAN NO.
CDOT 4201 East Arkansas Avenue, Denver, Colorado 80222, Phone: (303) 757-9083 FAX: (303) 757-9820	Path: www.dot.state.co.us/DevelopProjects/DesignSupport/MStandards/	Date:	Comments:		M-608-1
	Drawing File Name: 608010104.dwg				
Project Development Branch SRJ	Acad Version: R14 Scale: NA Units: English			Issued By: Project Development Branch October 29, 2003	Sheet No. 1 of 4

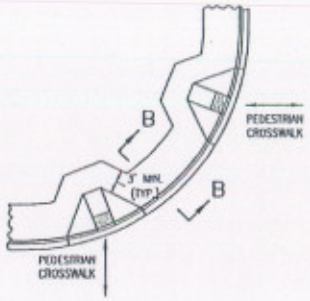
Figure 2a



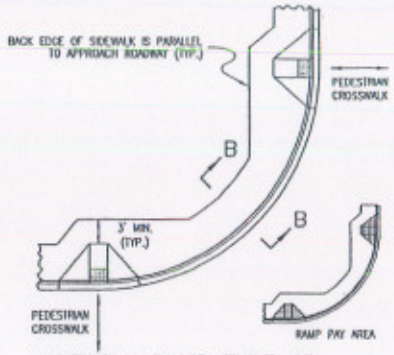
SIDEWALK RAMP TYPE 1A
PLAN



SIDEWALK RAMP TYPE 1B
PLAN

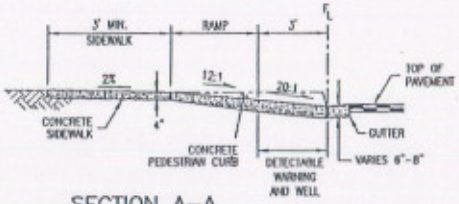


SIDEWALK RAMP TYPE 1C
PLAN



SIDEWALK RAMP TYPE 1D
PLAN

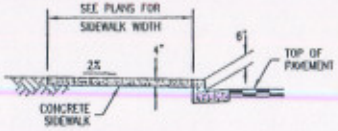
RAMP DETAIL
FOR SIDEWALK RAMP TYPES 1B, 1C, 1D



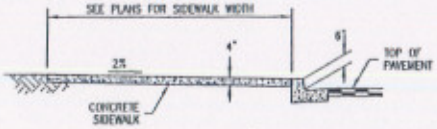
SECTION A–A

GENERAL NOTES

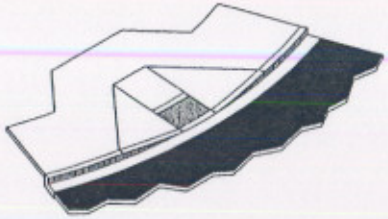
1. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1. THE DETECTABLE WARNING AND WELL AREA SLOPES SHALL NOT BE STEEPER THAN 20:1.



SECTION B–B



SECTION C–C



ISOMETRIC VIEW

Colorado Department of Transportation	Computer File Information	Standard Plan Revised		CURB RAMPS	STANDARD PLAN NO.
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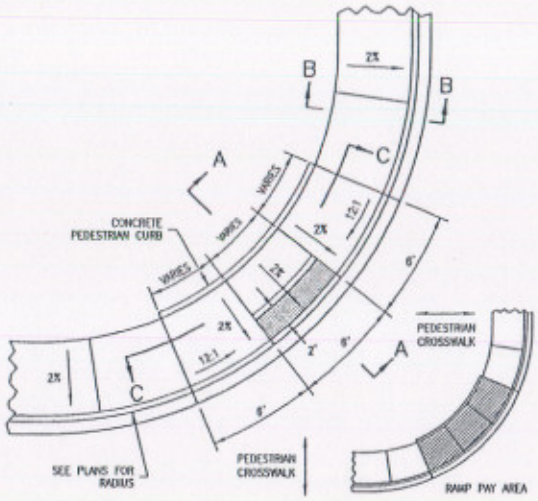
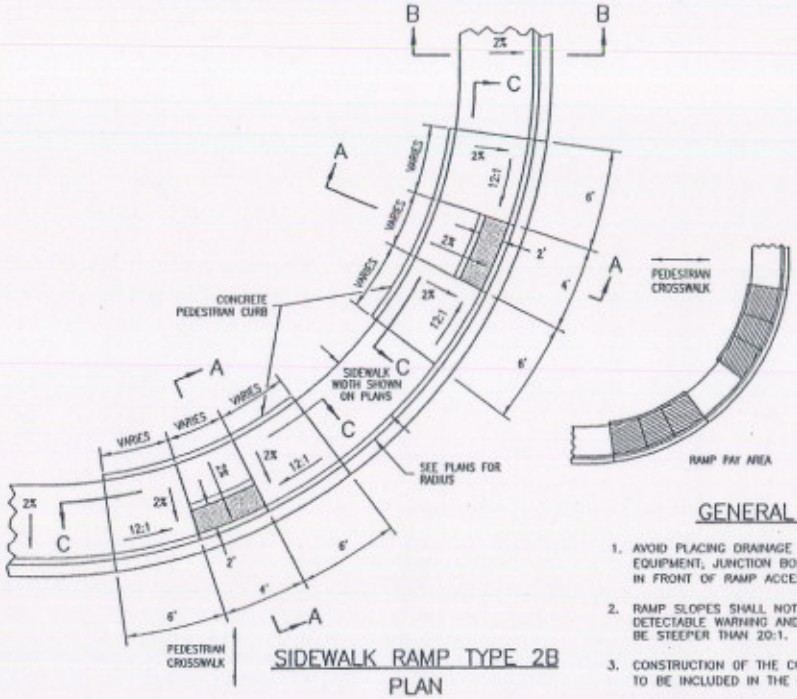
	Drawing File Name: 600010204.dwg				
Project Development Branch SRJ	Acad Version: R14 Scale: NA Units: English			Issued By: Project Development Branch October 29, 2003	Sheet No. 2 of 4

Figure 2b



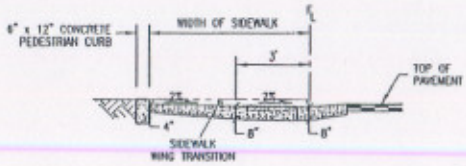
SIDEWALK RAMP TYPE 2A
PLAN



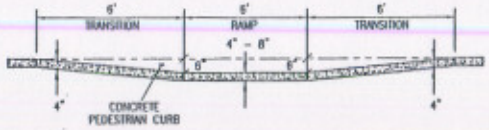
SIDEWALK RAMP TYPE 2B
PLAN

GENERAL NOTES

1. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1. THE DETECTABLE WARNING AND WELL AREA SLOPES SHALL NOT BE STEEPER THAN 20:1.
3. CONSTRUCTION OF THE CONCRETE PEDESTRIAN CURB TO BE INCLUDED IN THE COST OF THE CURB RAMP.
4. SIDEWALK RAMP 2A MAY BE USED IN MID-BLOCK.



SECTION A–A



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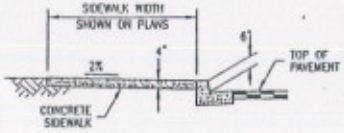
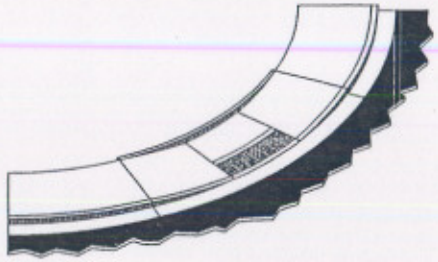


SECTION B–B



ISOMETRIC VIEW

Colorado Department of Transportation	Computer File Information	Standard Plan Revised		CURB RAMPS	STANDARD PLAN NO.
4201 East Arkansas Avenue Denver, Colorado 80222 Phone: (303) 757-9083 FAX: (303) 757-9820	Path: www.dot.state.co.us/DevelopProjects/DesignSupport/MStandards/	Date:	Comments:		M-608-1
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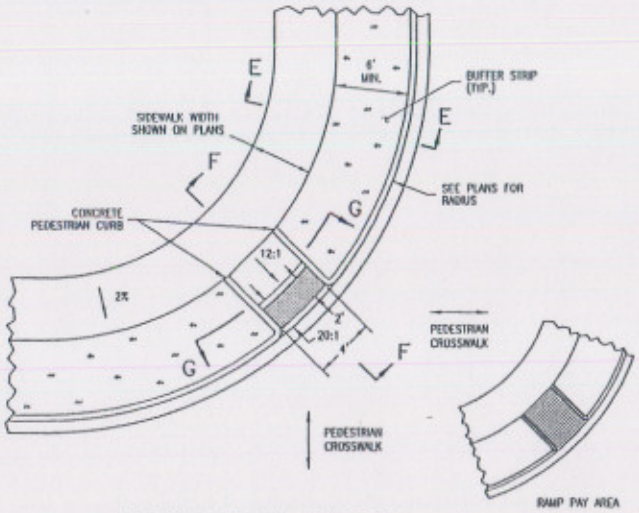
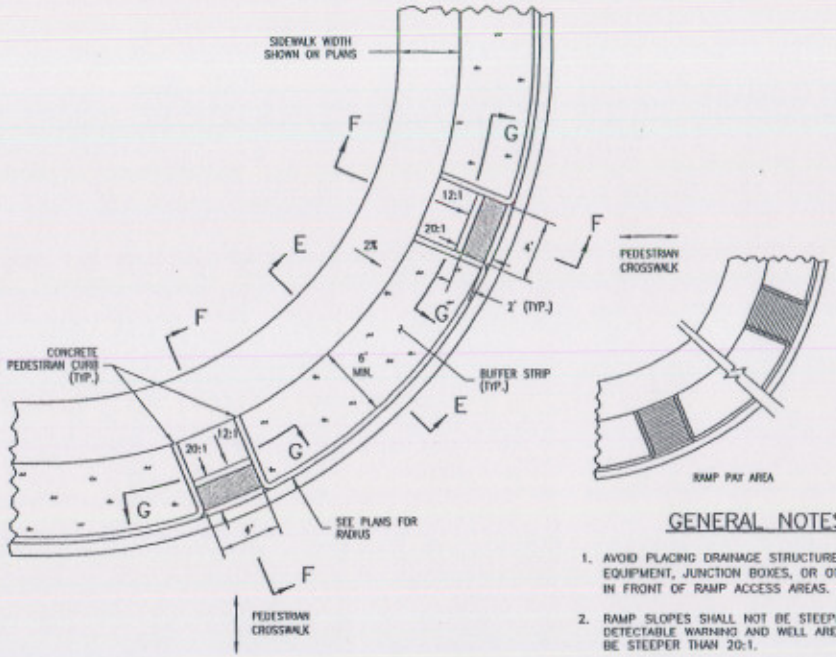
Project Development Branch SRJ	Acad Version: R14 Scale: NA Units: English			Issued By: Project Development Branch October 29, 2003	Sheet No. 3 of 4

Figure 2c



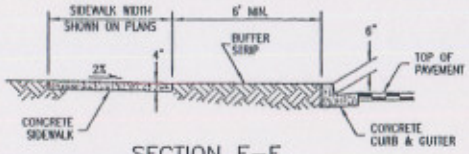
SIDEWALK RAMP TYPE 3A
PLAN



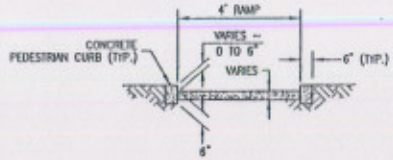
SIDEWALK RAMP TYPE 3B
PLAN

GENERAL NOTES

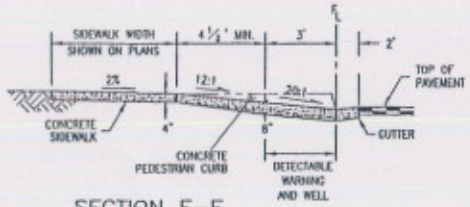
1. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1. THE DETECTABLE WARNING AND WELL AREA SLOPES SHALL NOT BE STEEPER THAN 20:1.
3. CONSTRUCTION OF THE CONCRETE PEDESTRIAN CURB TO BE INCLUDED IN THE COST OF THE CURB RAMP.



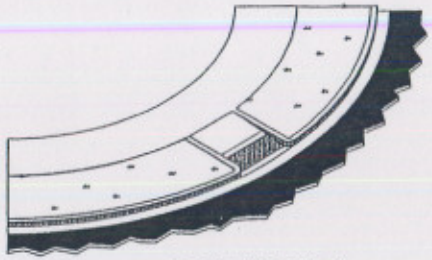
SECTION E-E



SECTION G-G



SECTION F-F



ISOMETRIC VIEW

Colorado Department of Transportation	Computer File Information	Standard Plan Revised	CURB RAMPS	STANDARD PLAN NO.
4201 East Arkansas Avenue, Denver, Colorado 80222, Phone: (303) 757-9083 FAX: (303) 757-9820	Path: www.dot.state.co.us/DevelopProjects/DesignSupport/MStandards/	Date: Comments:		M-608-1
Project Development Branch SRJ	Drawing File Name: 608010404.dwg		Issued By: Project Development Branch October 29, 2003	Sheet No. 4 of 4
	Acad Version: R14 Scale: NA Units: English			

Figure 2d

Residential Driveway Construction Detail
NOT TO SCALE

NOTES:
RESIDENTIAL DRIVEWAYS ONLY:
An Asphalt OR Concrete pan/swale may be constructed where ditchlines are too shallow to allow for the installation of a culvert. The pan/swale shall meet at the minimum, the dimensions of the detail shown.

Where ditchlines are of sufficient depth to allow a culvert, a minimum 18" diameter culvert is required. A pan/swale at the edge of the road conforming to the detail shown shall still be formed.

All site drainage must either drain into an approved ditch OR must drain according to an approved site drainage plan.
Private drives must not drain onto Town roadways.

Any proposed changes by the contractor must be approved by the Town Engineer PRIOR to construction.

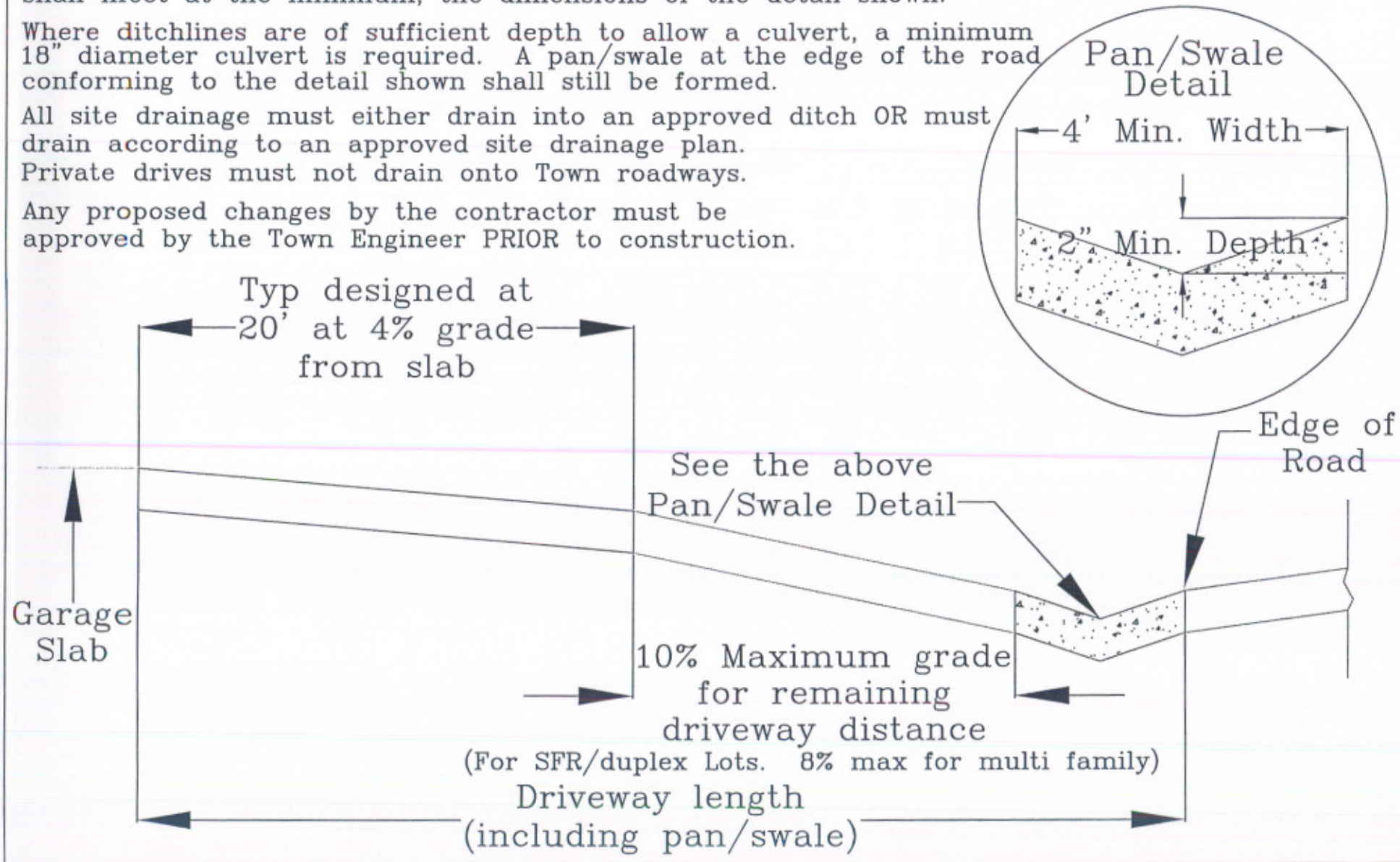


Figure 3

Table 1
Roadway Criteria
(Abbreviated – Remaining criteria described in document text)

		Street Type	
Design Topic	**Local**	**Collector**	**Arterial**
Clear Sight Distance (length along through road leg, feet)	250	350	350
Minimum Angle of Intersection (90 degree preferred at all roads)	70 degrees	70 degrees	70 degrees
Minimum curb or edge of asphalt radius (feet)			
a. Local	25	25	30
b. Collector			
Minimum dedicated right-of-way	60 feet	75 feet	as determined by CDOT
Minimum paved width	24' w/ 2' shoulders	26' w/ 2' shoulders	as determined by CDOT
Minimum tangent between curves	50 feet	150 feet	as determined by CDOT
Minimum corner sight distance[1]	250 feet	350 feet	350 feet
Minimum stopping sight distance[2]	150 feet	250 feet	250 feet

[1]Corner sight distance measured from a point on the minor road, 15 feet from the edge of the major road pavement, and from an eye height of 3.75 feet on the minor road to a height of 4.5 feet on the major road.

[2]Stopping sight distance measured from the drivers eye, 3.75 feet above the pavement to the top of an object six inches high on the pavement anywhere on the road.