



**JEFFERSON**  
COUNTY COLORADO

# **Jefferson County Transportation Design & Construction Manual**



# Jefferson County

# Transportation Design & Construction

# Manual

JEFFERSON COUNTY, COLORADO PLANNING AND ZONING DIVISION

## *Revision Dates*

*The Transportation Design & Construction Manual, formerly known as Roadway Design & Construction Manual, adopted by the Board of County Commissioners of Jefferson County, Colorado on March 21, 1995, has since been amended on the following dates:*

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# Table of Contents

## ***Chapter 1 General Provisions***

- 1.1. Short Title
- 1.2. Jurisdiction
- 1.3. Purpose and Effect
- 1.4. Enactment Authority
- 1.5. Amendment and Revisions
- 1.6. Enforcement Responsibility
- 1.7. Review and Approval
- 1.8. Interpretation
- 1.9. Relationship to Other Standards

## ***Chapter 2 Construction Drawing Requirements***

- 2.1. General Requirements
- 2.2. Cover Sheet
- 2.3. Plan
- 2.4. Profile
- 2.5. Cross Sections
- 2.6. Details
- 2.7. Standard Notes

## ***Chapter 3 Design and Technical Criteria***

- 3.1. General
- 3.2. Street/Road Types
- 3.3. Functional Classification
- 3.4. Standard Templates
- 3.5. Horizontal Alignment
- 3.6. Vertical Alignment
- 3.7. Intersection Spacing, Vision Clearance Triangle and Sight Distance
- 3.8. Drainage
- 3.9. Traffic Control
- 3.10 Miscellaneous

## ***Chapter 4 Pavement Design and Technical Criteria***

- 4.1. General Requirements
- 4.2. Pavement Design Report Submittal
- 4.3. Subgrade Investigation
- 4.4. Pavement Design Criteria
- 4.5. Pavement Design Procedure
- 4.6. Material Specifications

## ***Chapter 5 Construction Specifications and Standards***

- 5.1. Construction Specifications
- 5.2. Construction Standards

*Definitions*

*Examples: Standard Templates*

*Examples: Construction Standards*

*Design Nomographs for Pavements*

*Transportation Studies*

*Resolution*

## *Chapter 1*

# **General Provisions**

### **1.1. Short Title**

These regulations together with all future amendments shall be known as the “Jefferson County Transportation Design and Construction Manual” (hereafter called MANUAL) as referenced in the Jefferson County Land Development Regulation (hereafter called LDR) and the Jefferson County Zoning Resolution (hereafter called ZR).

### **1.2. Jurisdiction**

The requirements of this MANUAL shall apply to all subdividers, developers or other landowners, their employees, agents or contractors designing and constructing public and/or private streets/roads within unincorporated areas of Jefferson County (hereafter called County), except where superseded by State and/or the Federal regulations. The foregoing design and construction of transportation systems are subject to review and approval by the County pursuant to any County regulation or requirement.

### **1.3. Purpose and Effect**

Presented in this MANUAL are the minimum design and technical criteria for the design and construction of streets/roads. All land development or any other proposed construction submitted for approval under the provisions of the LDR and/or ZR as applicable, shall include adequate transportation system analysis and appropriate transportation system design. Such analysis and design shall conform to the criteria set forth herein. Technical criteria not specifically addressed in this MANUAL shall follow the provisions of the American Association of State Highway and Transportation Officials (AASHTO) “A Policy of Geometric Design of Highways and Streets”, as amended; the Colorado Department of Transportation (CDOT) Design Standards, as amended; and the Manual on Uniform Traffic Control Devices (MUTCD), as amended.

### **1.4. Enactment Authority**

The LDR has been adopted pursuant to the authority conferred within: Article 28 of Title 30 (County Planning); Article 2 of Title 43 (State, County, and City Highway Systems); Article 20 of Title 29 (Land Use Control and Conservation); and other applicable sections of the Colorado Revised Statutes, as amended.

This MANUAL is adopted by resolution of the Board of County Commissioners, as the authority provided by which the County promulgates the LDR.

### **1.5. Amendment and Revisions**

These criteria may be amended as new technology is developed and/or if experience gained in the use of this MANUAL indicates a need for revision. Amendments and revisions will be made by resolution of the Board of County Commissioners.

## **1.6. Enforcement Responsibility**

It shall be the obligation of the Board of County Commissioners acting through the Department of Development and Transportation to enforce the provisions of this MANUAL.

## **1.7. Review and Approval**

The County will review all submittals for compliance with this MANUAL. An approval by the County does not relieve the owner, engineer, or designer from responsibility of ensuring that the calculations, plans, specifications and construction are in compliance with the MANUAL and accepted engineering practices.

## **1.8. Interpretation**

In interpretation and application of the provisions of the MANUAL, the following shall govern:

1.8.1. The provisions shall be regarded as the minimum requirements for the protection of public health, safety, comfort, convenience, prosperity, and welfare of the residents of the County.

1.8.2. Whenever a provision of this MANUAL and any other provision of the LDR or any provision in any law, ordinance, resolution, rule, or regulation of any kind, contains any restriction covering any of the same subject matter, whichever restrictions are more restrictive or impose higher standards of requirements shall govern.

1.8.3. This Jefferson County Transportation Design and Construction Manual was adopted by the Board of County Commissioners on March 21, 1995. Any amendments to this MANUAL shall be immediately effective upon its adoption by the Board of County Commissioners. All applications shall be subject to the provisions of this MANUAL that are in effect at the time of the formal application submittal, unless otherwise specified by the Board of County Commissioners resolution.

## **1.9. Relationship to Other Standards**

If the State or Federal Government imposes stricter criteria, standards, or requirements, these shall be incorporated into the County's requirement after due process and public hearings needed to modify the County's regulations and standards.

## ***Chapter 2***

# **Construction Drawing Requirements**

## **2.1. General Requirements**

Construction drawings must be submitted in Portable Document Format (PDF) unless otherwise approved for hard copy submittal, to scale, shall be a complete package, which includes all details and documentation necessary for the construction of the proposed improvements. The plans shall be prepared by, or under the direction of a professional engineer, registered in the State of Colorado, and qualified in the field of civil engineering.

The final set of plans (hard copy) for each drawing shall be 24" x 36", unless otherwise approved by the County, and shall contain a title block, sheet number, scale, north arrow, and date.

The developer's engineer shall comply with Colorado Revised Statute 9-1.5-101 through 9-1.5-108 "Excavation Requirements" when the nature of work proposed (1) will involve a contract with Jefferson County (this shall include, but not be limited to binding agreements such as permits and Subdivision Improvement Agreements); (2) will involve primarily Horizontal Construction and not the construction of buildings; (3) will involve excavation that exceeds two (2) feet in depth and that is a contiguous 1,000 square feet, or involve Utility Boring; and (4) requires the design services of a licensed professional engineer. Existing and Proposed Subsurface Utilities shall be identified on the design plans in accordance with ASCE 38 Standards. For more information please reference the Colorado Revised Statutes and Federal Highway Administration websites.

## **2.2. Cover Sheet**

A cover sheet should be provided with each submittal which contains the following:

1. A vicinity map at a minimum scale of 1" - 2000' which shows the location and name of all arterial streets/roads within one mile of the proposed development and all streets/roads within the proposed development.
2. A legend, scale, and north arrow.
3. General notes.
4. Index of sheets.
5. Seal, signature, and date of the professional engineer responsible for plan preparation.
6. A permanent benchmark description and location based on USGS datum. At least one permanent benchmark must be established within each subdivision or filing thereof, located on public property.

If a cover sheet is not provided, the above information shall be included on the first sheet of the submittal.

## **2.3. Plan**

The plan view shall include but not be limited to, the following:

1. The scale shall be a minimum of one (1) inch to fifty (50) feet and shown on the plan.
2. Locations and dimensions of existing and proposed improvements, property lines, easements, and Right-of-Way. Plan view limits shall extend 100 linear feet before the Point of Beginning, and 100 linear feet after the Construction End. Each Point of Beginning and Construction End shall be clearly labeled and identified with stationing.
3. Names of streets/roads.
4. Survey line ties to section or quarter corners.
5. Survey lines and centerline stationing. Stationing shall be equated to flowline stationing at horizontal radius curves, cul-de-sacs, and other departures from normal roadway cross sections.
6. Centerline stations for all intersecting roadways and commercial driveways.
7. Existing and proposed street/road improvements (sidewalk, curb, gutter, pavement limits, bridges, culverts, inlets, manholes, asphalt core sample locations, guardrails, curb ramps, etc.). Existing improvements shall be clearly depicted by a dashed line; proposed improvements shall be depicted by a solid line and or greyscale or hatching. Plans shall include existing and proposed limits for asphalt pavement, including areas of milling and overlaying, as well as new asphalt placement. All items shall have a corresponding legend.
8. Curve layout including radius, degree of curve, deflection angle, length of curve, point of curvature, and point of tangency.
9. Elevations and station shall be noted for all curb returns, points of curvature, points of tangency, and high or low points of all vertical curves. The existing and proposed percent cross slope shall be repeated on the plan sheets at select points. Include elevations and cross slopes, existing and proposed, for all lanes of intersection improvements, regardless if construction is planned for opposing streets.
10. Rate of super elevation.
11. Typical template(s) for streets/roads.
12. Match lines and consecutive sheet numbers.
13. Key map.
14. A minimum of one (1) permanent bench mark, based on United States Geological Survey's datum, fully described, within each subdivision or filing thereof.

15. Existing and proposed utilities and structures, including but not limited to: water, fire hydrants, sanitary sewer, storm sewer, telephone, gas, electric, cable television, fiber optic. Existing utility pothole information shall be organized on a separate plan sheet to identify location, depth, utility type, pipe size and material, conflicts with proposed improvements, and other information obtained during subsurface investigation. Subsurface investigation shall include new laterals or service connections to existing main lines and be clearly shown on separate plan sheets. \*
16. Stations and critical elevations of all utility and drainage appurtenances. \*
17. Construction phasing. \*
18. Major Collector and/or Arterial intersection design at a scale of one (1) inch to twenty (20) feet. \*
19. Traffic signal design at a scale of one (1) inch to twenty (20) feet. \*
20. Signing and Striping Plan.
20. Noise attenuation measures/details. \*
21. Trails. \*
22. Sediment and erosion control measures/details. \*
23. Landscaping. \*

\*May be included on separate plan sheets.

## **2.4. Profile**

The profile shall include, but not be limited to the following:

1. The scale shall be a minimum of one (1) inch to five (5) feet for street profiles and a minimum of one (1) inch to ten (10) feet for road profiles, and be shown on the plan.
2. Existing (dashed line) and proposed (solid line) grades.
3. Continuous centerline stationing for the entire portion of the existing and proposed roadway shown in the plan. Clearly label centerline stationing for all intersecting roadways and commercial driveways.
4. All design elevations shall be centerline, flowline, back of curb, or lip of gutter.
5. Vertical curve data including length of curve, P.V.C., P.V.T., P.V.I., beginning and end grades. All vertical curves shall be symmetrical.
6. Curb return profiles at a horizontal scale of 1" = 10' and vertical scale of 1" = 1'.
7. All existing curbs, gutters, sidewalks, culverts or storm sewers, ditches and irrigation structures and asphalt adjacent to the proposed design, as well as the same such features that are 100 linear feet before the Point of Beginning and continue for 100 linear feet beyond the Construction End. Basis for existing grades shall be as-built elevations at intervals not to exceed fifty (50) feet. All existing grades, locations and alignments shall be field surveyed by a licensed Professional Land Surveyor for design of the proposed improvements. Previously approved designs are not an acceptable means of establishing existing grades.
8. Separate flowline or top of curb profiles shall be provided for all proposed curb and gutter, including for design of cul-de-sacs and any other departure from a 2% street/road cross slope. In addition, cross-sections at intervals not to exceed 50 feet are required if a departure from a normal cross-slope is proposed.
9. Existing and proposed utilities. \*

\*May be included on separate plan sheets.

## **2.5. Cross Sections**

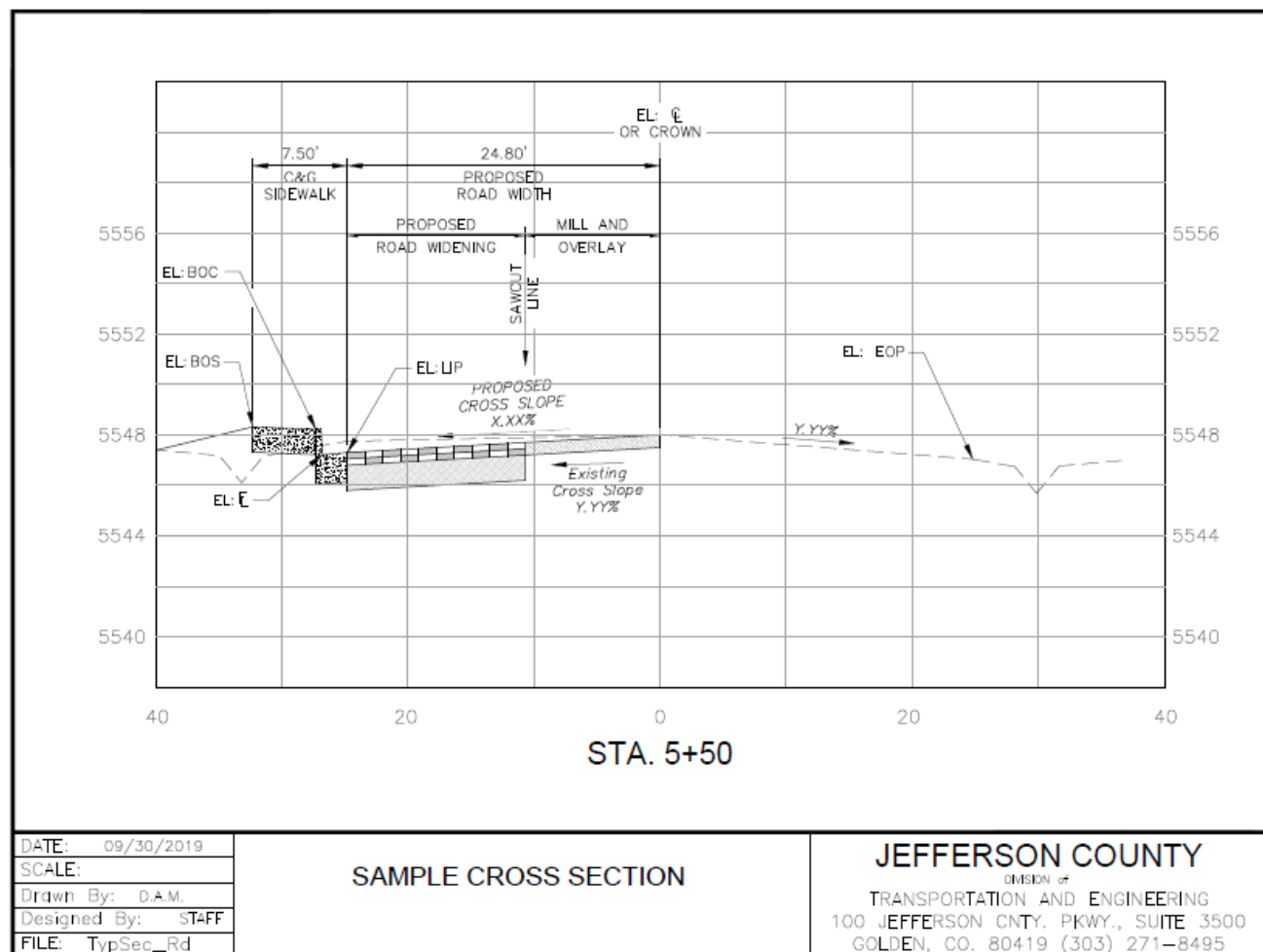
1. On widening or matching projects, or as required by the Jefferson County Planning & Zoning, cross sections of the proposed new Transportation Design and Construction Manual – Amended 12-17-19

construction and existing improvements within the Right-of-Way shall be provided at survey stationing at a maximum of fifty foot intervals and at locations of cross culverts. The scale shall correspond to that used on the plan and profile.

2. Cross sections shall identify both the existing or matching percent cross slope of the roadway, as well as percent proposed cross slope.
3. Cross sections shall identify the elevation at the point of match for widening projects for each station interval.
4. Cross sections shall identify the proposed new road segment in gray scale or other hatching.
5. Cross sections shall identify the proposed pavement treatment or alterations, such as mill and overlay of the match point; as well as the proposed new pavement section and respective lifts asphalt.
6. Core samples shall be collected from the existing roadway prior to construction to determine the existing asphalt depth and condition. Such cores shall not exceed 4-inches in diameter and shall be collected at the centerline of the existing road, as well as edge of existing asphalt. The existing depth of asphalt shall be represented on the cross sections.
7. Proposed widening shall avoid cross sections with gross inverts or peaks at the match point. Normal roadway cross sections shall follow AASHTO design criteria that limit the minimum cross slope to 1.5% and maximum cross slope to 3.0%. Cross slope grade change shall not exceed  $\pm 0.5\%$  as measured every 50 linear feet along the station intervals. There shall be no change in existing cross slope greater than  $\pm 1.0\%$  from the match point to the proposed edge of asphalt, or the flow line or the lip of the gutter pan.

Refer to Figure 2-1 "Sample Cross Section" below:

**Figure 2-1 - Sample Cross Section**





## **2.6. Details**

Jefferson County or CDOT standard details may be referenced as applicable. Where these standards cannot be used, a separate detail sheet shall be provided with an explanation detailing why these standard details are not being used.

## **2.7. Standard Notes**

The following general notes shall appear on the cover sheet or the first sheet of the plans for all street/road construction plan packages.

1. A Construction Permit from Transportation and Engineering is required prior to commencing work within County Right-of-Way.
2. Any work within State Right-of-Way will require a State Construction Permit.
3. The contractor shall notify Transportation and Engineering at least 24 hours prior to starting construction within the Right-of-Way.
4. The contractor shall provide all signs, barricades, flagmen, lights, or other devices necessary for safe construction traffic control in accordance with the current edition of the MUTCD and as modified by the Colorado Supplement to the MUTCD. A construction traffic control plan shall be submitted to and approved by Transportation and Engineering prior to the issuance of any construction permit for work within County Right-of-Way.
5. The contractor shall contact the Utility Notification Center of Colorado at least 48 hours prior to construction.
6. Construction specification: Current edition of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, special provisions and revisions thereto, and as amended by Chapter 5 of this MANUAL.
7. The subgrade material shall be scarified or removed to a depth required by Jefferson County per information obtained from laboratory tests and/or as required in the Pavement Design Report. Additives or approved material may be required if the native material is unsatisfactory. The subgrade shall be compacted to a minimum density and moisture content range of 2 percent below optimum to 2 percent above as determined in accordance with AASHTO designation T180 or T99 and in accordance with the Standard Specifications Section 203.07.
8. Class 6 aggregate base course for shoulders shall be placed and compacted 95 percent modified Proctor Test (AASHTO T180) after placement of asphalt.
9. Existing asphalt pavement shall be straight sawcut or blade-cut when adjoining with new asphalt pavement. SS-1 tack coat shall be applied to all surfaces.
10. Structural section, including subbase and asphalt, shall be constructed according to the Final Pavement design that has been prepared by the developer's engineer, and approved by Transportation and Engineering according to Chapter 4 of this MANUAL. Existing structural section at the match point shall comply with the minimum Full Depth Asphalt thickness identified in Table 4.3 "Minimum Pavement Sections" of this MANUAL for the respective road classification, regardless of the original thickness of asphalt and / or sub-base.

The following notes shall appear in addition to the above for all street construction, as applicable:

1. Concrete may be placed by machine methods if all finish lines are within 1/8" + tolerance of the lines shown on the plans. The flowline must be free draining and comply with this MANUAL.
2. One half (1/2) inch expansion joint material shall be installed when abutting any existing concrete or a fixed structure.
3. The contractor is advised to first obtain inspection of forms by Transportation and Engineering before placing concrete curb, gutter, sidewalk, inlets, and/or other concrete drainage structures.

## **Design and Technical Criteria**

### **3.1. General**

This section sets forth the minimum design and technical criteria to be used in the preparation of all street/road construction plans. All street/road design shall be in accordance with the current edition of AASHTO Geometric Design of Highways and Streets, unless modified herein.

For this regulation, streets shall be used in the Plains and roads shall be used in the Mountains, except as indicated below:

3.1.1 Roads may be allowed in the Plains in locations with slopes greater than 15%, subject to approval by Planning and Zoning.

3.1.2 Streets may be required in the following Mountains locations as directed by Planning and Zoning: 1) Areas where urban development is projected based on Community Plans designations, 2) Areas where curb and gutter would be needed to mitigate drainage impacts.

### **3.2. Street/Road Types**

3.2.1 Public Streets/Roads: Streets or roads that are owned and maintained by the City, County or State for public use.

3.2.2 Private Streets/Roads: Streets or roads that are owned, maintained, or restricted for the use by a person, group of people, or non-governmental entity.

3.2.3 Non-Maintained Streets/Roads in County ROW: Streets or roads that are owned by the County for public use, but are not constructed to a County public standard and are not County maintained.

### **3.3. Functional Classification**

Jefferson County has adopted a Major Thoroughfare Plan based on traffic volumes, existing and/or zoned land use, and anticipated growth. The Major Thoroughfare Plan designates streets/roads as freeway, parkway, principal arterial, minor arterial, major collector, or collector.

3.3.1. Freeway: A freeway serves major regional traffic movements and carries the highest traffic volume of all classifications. A freeway is planned to have four to six through lanes and may have frontage roads. The movement of traffic takes precedence over access. Access is fully controlled and is allowed only to other freeways or to arterials by grade separated interchanges. Opposing movements on a freeway are separated by a raised or depressed median. Pedestrians and bicycle traffic are physically separated from the travel lanes. A freeway may be developed as a parkway with at-grade intersections as a first phase. Freeways are typically in State jurisdiction.

Design Speed: Special Design Required

3.3.2. Parkway: A parkway serves major regional traffic movements and carries high traffic volumes. A parkway is planned to have four to six through lanes. The movement of traffic takes precedence over access. Access is fully controlled and allowed only to major collector classifications or higher. Grade separation at major intersections is preferred over traffic signals. Opposing movements on a parkway are separated by a raised or depressed median. Pedestrians and bicycle traffic are physically separated from the travel lanes unless a bicycle lane or paved shoulder is designated per the Jefferson County Bicycle Plan as amended.

Design Speed: 40 - 50 MPH

3.3.3. Arterial.

3.3.3.1. Principal Arterial: A principal arterial serves major regional traffic movements and carries high traffic volumes. A principal arterial is planned to have four to six through lanes in the Plains and four through lanes in the Mountains. The movement of traffic takes precedence over access. Access is controlled and allowed to collectors and higher class facilities is preferred, but some restricted access

to major developments may be allowed. Opposing movements are usually separated by a raised, depressed, or painted median. Pedestrians and bicycle traffic may be carried on detached walks and trails unless a bicycle lane or paved shoulder is designated per the Jefferson County Bicycle Plan as amended.

Design Speed: 35 - 45 MPH

3.3.3.2. Minor Arterial: A minor arterial serves intracommunity traffic and carries moderate traffic volumes. Minor arterials are planned to have four lanes in the Plains. In the Mountains, minor arterials are planned to have two lanes, plus turn lanes and passing or climbing lanes where warranted. Neither the movement of traffic nor access takes precedence. Reasonable access is allowed except for private residential driveways. Opposing movements are generally separated by a raised, depressed, or painted median in the Plains. Pedestrians and bicycle traffic are usually carried on a detached walk or an adjacent trail unless a bicycle lane or paved shoulder is designated per the Jefferson County Bicycle and Pedestrian Plan, as amended.

Design Speed: 30 - 40 MPH

3.3.4. Major Collector: A major collector serves intracommunity traffic and carries moderate traffic volumes. Major collectors are planned to have two lanes, plus turn lanes where warranted, in the Plains and the Mountains. Neither the movement of traffic nor access takes precedence. Reasonable access is allowed except for private residential driveways. Opposing movements are generally separated by a median/turn lane. Pedestrians and bicycle traffic are usually carried on a detached walk or an adjacent trail unless a bicycle lane or paved shoulder is designated per the Jefferson County Bicycle and Pedestrian Plan, as amended.

Design Speed: 30 - 40MPH

3.3.5. Collector: A collector serves neighborhood traffic movements over short distances, generally accessing arterials and major collectors. A collector has two lanes, plus turn lanes where warranted, in the Plains and two lanes in the Mountains. Access takes precedence over the movement of traffic. Reasonable access is allowed except for private residential driveways. Opposing movements are not physically separated. Pedestrian traffic is handled on attached or detached sidewalks in the Plains. No special accommodation is made for bicycle traffic.

Design Speed: 25 - 30 MPH

3.3.5. Local: A local street or road serves neighborhood traffic over very short distances to higher class roadways. A local street or road has two travel lanes. It is always paved in the Plains and usually paved in the Mountains. Access to adjacent land is its primary purpose. All types of access are allowed. Opposing movements are not physically separated. Pedestrian traffic is handled on attached or detached sidewalks in the Plains. No special accommodation is made for bicycle traffic.

Design Speed: 15 - 25 MPH

### 3.4. Standard Templates

The following templates reflect the minimum section for each street/road classification and for cul-de-sacs. Any additional requirements including, but not limited to, acceleration/deceleration lanes and left turn lanes are not shown.

Template Number	Description	Typical Volume Range in Average Daily Traffic (ADT)	Right-of-Way Width (Feet)
Public Street/Road Templates			
1	Principal Arterial Street	Greater than 25,000	130'
2	Minor Arterial Street	15,000 to 25,000	100'
3	Major Collector Street	8,000 to 15,000	78'

4	Collector Street (36' FL to FL) with Attached Sidewalks	1,000 to 8,000	50'
5	Collector Street (36' FL to FL) with Detached Sidewalks	1,000 to 8,000	37' + 20' easement for sidewalks, maintenance and traffic signs
6	Local Street (34' FL to FL) with Attached Sidewalks	Less than 1,000	50'
7	Local Street (34' FL to FL) with Detached Sidewalks	Less than 1,000	35' + 20' easement for sidewalks, maintenance and traffic signs
8	Local Street (28' FL to FL) with Attached Sidewalks	Less than 350	45'
9	Local Street (28' FL to FL) with Detached Sidewalks	Less than 350	30' + 18' easement for sidewalks, maintenance and traffic signs
Template Number	Description	Typical Volume Range in Average Daily Traffic (ADT)	Right-of-Way Width (Feet)
Public Street/Road Templates			
10	Minor Arterial Road	Greater than 8,000	70'
11	Major Collector Road	2,000 to 8,000	50', 60' for turn lanes
12	Collector Road	1,000 to 2,000	50'
13	Local Road	Less than 1,000	50'
14	Street Cul-de-sac – Option 1 Street Cul-de-sac – Option 2 Street Cul-de-sac – Option 3	See LDR, Section 15	90' 100' 112'
15	Partial Cul-de-sac for Local Streets	See LDR, Section 15	45'R
16	Offset Cul-de-sac for Local Streets	See LDR, Section 15	90'
17	Cul-de-sac for Local Roads	See LDR, Section 15	90'
Private street/road templates and Non-maintained streets/roads in County ROW templates *			
18	Driveway/Private Street/Road & Non-maintained Street/Road in County ROW (No Parking)	See LDR, Section 15	20' minimum
19	Pull Out for Private Road	N/A	n/a
20	Hammerhead Turnaround for Driveway/Private Road	See LDR, Section 15	varies
21	Hammerhead Turnaround for Private Street	See LDR, Section 15	varies

\*The "non-maintained streets/roads in County ROW" templates can only be used if the following provisions apply:

1. The County is not holding a guarantee a previous development process that would require the construction of a County public standard street/road in the ROW.
2. The County does not wish to have the street/road constructed to a County public standard.
3. The street/road is not identified on the Jefferson County Major Thoroughfare Plan.



### 3.5. Horizontal Alignment

3.5.1. Horizontal Curves: Minimum curve radii for a normal crown section based on design speed are summarized in the table below.

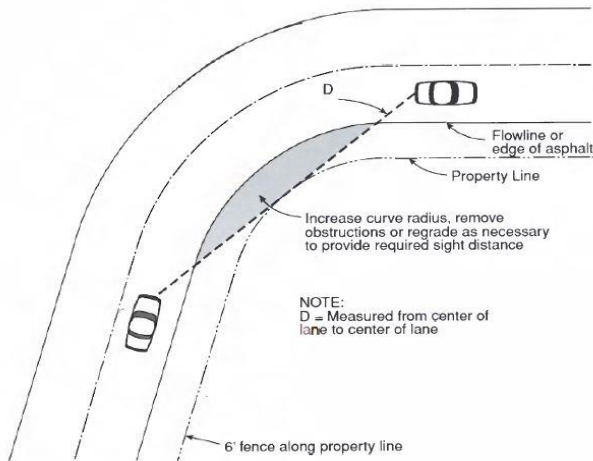
Design Speed (mph)	Minimum Curve Radius (feet)
15	50
20	107
25	198
30	333
35	510
40	762
45	1039
50	Special Design

3.5.1.1. For collector roads, the centerline line radius may be reduced to a minimum of one hundred (100) feet, provided, however, that on a curve with a centerline radius less than four hundred (400) feet, the maximum grade shall be reduced by one (1) percent for each one hundred (100) feet or fraction thereof the radius is reduced.

3.5.2. Super Elevation: Super elevation is required for curves on all principal and minor arterial streets/roads and selected collector streets/roads. Minimum horizontal curve radius, rate of super elevation, and lengths of tangent runout and super elevation runoff shall be in accordance with the recommendations of the current edition of AASHTO Geometric Design of Highways and Streets.

Super elevation shall not be used on local streets, but may be used on local roads.

3.5.3. Sight Distance: Horizontal alignment must provide at least the minimum stopping sight distance for the design speed at all points. This includes visibility at intersections, as well as around curves and roadside encroachments. Where an object off the traveled surface restricts sight distance, the minimum radius of curvature is determined by the stopping sight distance. A likely obstruction may be a bridge abutment, retaining wall, cut slope, landscaping, or side or corner of a building. In considering sight distance, it shall be assumed a 6'-0" fence (as measured from finished grade) exists along all property lines except in the sight distance triangles required at all intersections. Minimum stopping sight distance (measured from the centerline of the inside lane) shall be as follows for centerline grades equal or less than 3%:



Design Speed (mph)	Stopping Sight Distance (d) (feet)
15	80
20	115
25	150
30	200
35	250
40	325
45	400
50	475

For grades greater than 3%, stopping distance shall be in accordance with the recommendations of the current edition of AASHTO Geometric Design of Highways and Streets.

### 3.6. Vertical Alignment

3.6.1. Grades: The minimum grade for all new streets and roads is 2%, except within a sag. A minimum flowline grade of 1.5% shall be maintained around all full and partial cul-de-sac bulbs, except within a sag. Planning and Zoning may approve grades as low as 1% if existing conditions make it infeasible to construct a minimum of 1.5%. The maximum grade for all public streets is 6.0% and for public roads is 8.0%. The maximum grade for public roads may be increased to 10% where the dip of the natural terrain bears between South 60° East and South 45° West.

3.6.2. Intersection Grades: The maximum grade at intersections shall be in accordance with the following figure and table. Grades and lengths apply to the street/road controlled by a stop sign. At signalized and uncontrolled intersections, grades and lengths apply to all legs of the intersection.

	Through Street / Road		
Intersection Street/Road	Local	Collector	Major Collector/Arterial
Local	50' @ 4%	100' @ 4%	100' @ 4%
Collector	-	100' @ 3%	200' @ 2%
Major Collector/Arterial	-	-	200' @ 2%

3.6.3. Changing Grades. Continuous grade changes shall not be permitted. The use of grade breaks in lieu of vertical curves is discouraged; however, if a grade break is necessary and the algebraic difference in grade (A) does not exceed four-tenths (0.40) of a percent along the street/road, the grade break will be permitted.

The maximum grade break allowed at the point of tangency at a curb return for local and collector streets shall be two (2) percent and a maximum of one (1) percent for arterial streets.

3.6.4. Vertical Curves. All vertical curves shall be symmetrical. A vertical curve shall be used when the algebraic difference in grade (A) Transportation Design and Construction Manual – Amended 12-17-19

equals or is greater than four-tenths (0.40) of a percent. The minimum grade within a sag (sump) vertical curve is five-tenths (0.50) of a percent. All vertical curves shall be labeled, in the profile with curve length (L) and K value ( $= L/A$ ). The minimum K values for crest and sag vertical curves shall be in accordance with the following table:

Design Speed (mph)	Minimum K Value	
	Crest	Sag
30	30	40
35	50	50
40	80	70
45	120	90
50	160	110

### 3.6.5. Connection with Existing Streets/Roads

3.6.5.1. Connection with existing roadways shall be smooth transitions conforming to normal vertical curve criteria (see Section 3.6.4. of these standards) if the algebraic difference in grade (A) between the existing and proposed grade exceeds four-tenths (0.40) of a percent. When a vertical curve is used to make this transition, it shall be fully accomplished prior to the connection with the existing improvement, and comply with the grade requirements at intersection approaches.

3.6.5.2. Existing grade shall be shown for at least three hundred (300) feet with field verified as-builts showing stations and elevations at twenty-five (25) foot intervals. In the case of connection with an existing intersection, these as-builts are to be shown within a three hundred (300) foot radius of the intersection. This information will be included in the plan and profile that show the proposed roadway.

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

3.6.5.4. The basis of the as-built elevations shall be the same as the design elevations (both flowline or top of curb, etc.) unless otherwise approved by Planning and Zoning.

## 3.7. Intersection Spacing, Vision Clearance Triangle and Sight Distance

3.7.1. Intersection Spacing: Spacing of intersections (measured centerline to centerline) shall be in accordance with the following table:

Proposed Street/Road: Existing Street/Road	Minimum Separation (feet)
Local: Local or Collector	175
Local: Arterial or Major Collector	500
Collector: Collector	230
Collector: Major Collector or higher	1000
Major Collector: Major Collector	660
Major Collector: Arterial or higher	1320
Arterial: Arterial or higher	5,280'

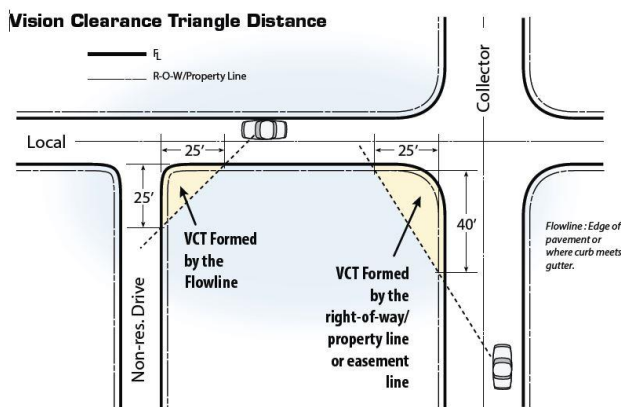
3.7.2. Vision Clearance Triangle: The table below shows where a vision clearance triangle must be provided.

Required	Not Required
Street/Road Intersections	Intersection of internal drive isles in non-residential*
Intersections of non-residential driveways with streets/roads	Multi-family and townhome developments*
Intersections of multifamily and/or townhome residential drive isles with streets/roads	
Intersections of street/roads and railroad Right-of-Way	

\*Layout of these types of developments should not impede a driver's ability to see on-coming vehicles and pedestrians at intersections

As illustrated below, the vision clearance triangle must provide an unobstructed view across the triangle formed by the Right-of-Way/property line or easement line adjacent to a street or road as illustrated. The vision clearance triangle may also be formed by the flowline adjacent to a street or road as illustrated below subject to approval by Planning and Zoning. The approval of the vision clearance triangle formed by a flowline is predicated on a fully built-out street or road and existing Right-of-Way that exceeds the Right-of-Way requirements in the Land Development Regulation. Within the area of the triangle, there shall be no fence, wall, landscaping, structure or other obstruction to view more than forty-two (42) inches in height, or trees with foliage or signs lower than eight (8) feet in height (measured from the flowline or edge of pavement on the street/road surface). The allowable height of forty-two (42) inches is determined by measuring from the flowline or edge of pavement, as applicable. For example, the grade on a lot within the triangle is 12" higher than the flow line of a gutter, the allowable height of landscaping would be 30" on the property.

Note that if there is any conflict between this provision (3.7.2) and the Sight Distance provision (3.7.2.1) of this MANUAL, the Sight Distance provision shall take precedence. Note that if a physical median exists or is proposed at an access point restricting or eliminating a conflict point, the Vision Clearance Triangle requirements will not apply where no conflict points exist.



Street/Road Classification	Required Distance from Intersection
Non-residential drive	25'
Local	25'
Collector	40'
Major Collector/Arterial/Parkway	55'
Railroad Right-of-Way	55'

3.7.2.1. Sight Distance: At any street/road intersections or multifamily residential, commercial and industrial site driveways, an unobstructed view as defined above must be provided across the area formed by the flowline or edge of pavement on one street/road and the flowline or edge of pavement of the intersecting street/road (or edge of driveway) and lines (labeled d1 or d2 on the Sight Distance figure) connecting them at ten (10) feet from their point of intersection. This area will be used to ensure that drivers of vehicles exiting from the stopped approach have the minimum required sight distance available. The minimum required sight distance shall be in accordance with the Minimum Sight Distance Requirements table for two lane streets/roads.



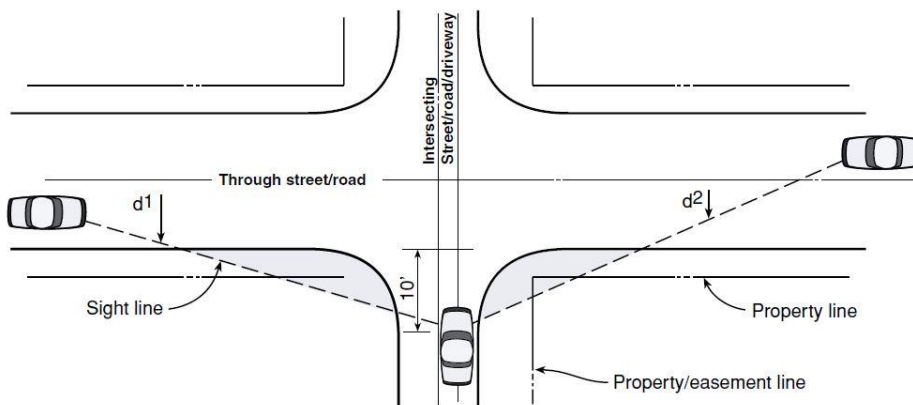
## Minimum Sight Distance Requirements

(in feet) for vehicles entering onto two-lane streets/roads:

Operating Speed (mph)	Left Sight Distance d1 *	Right Sight Distance d2 **
20	220	130
25	260	170
30	350	260
35	430	350
40	530	440
45	610	570
50	740	700

\* Measured from the driver's eye ten feet back of the flowline or pavement edge to the vehicle approaching in the outside lane.

\*\* Measured from the driver's eye ten feet back of the flowline or pavement edge to the vehicle approaching in the median lane.



1. Requirements assume that the vehicle is stopped on the proposed public or private street/road or driveway.
2. Requirements are based on a 3.5-foot driver eye height in the stopped vehicle and a 4.25-foot height of the approaching vehicle.
3. The operating speed of the approaching vehicle is assumed to be the posted speed limit.
4. Sight distance requirements as shown in the Minimum Sight Distance Requirements table are designed to enable vehicles entering the street/road to accelerate to the operating speed of approaching vehicles without causing the approaching vehicles to reduce speed by more than 10 mph.
5. Truck traffic (WB30 or larger) entering onto streets/roads requires longer sight distances than shown in Table. Any proposed public or private street/road or driveway regularly used by truck traffic may require an individual analysis.
6. When the criteria for sight distances cannot be met, the County may deny the access, prohibit left turns by vehicles entering the street/road or require speed change lanes.

### 3.7.3. Right Turn Lanes

3.7.3.1. Right Turn Acceleration Lanes: Right turn acceleration lanes may be required based on an approved transportation study. Right turn acceleration lanes may also be required where necessary for public safety and traffic operations based upon site specific conditions,

as determined by Planning and Zoning.

3.7.3.2. Right Turn Deceleration Lanes: Right turn deceleration lanes are required at arterial and major collector street/road intersections and at driveways on arterial streets/ roads as needed based on required transportation study/analysis. Transportation study/analysis shall address storage, as applicable. Right turn deceleration lanes may also be required where necessary for public safety and traffic operations based upon site specific conditions, as determined by Planning and Zoning.

3.7.3.3. If the proposed street/road intersection or driveway is within two different speed zones, the criteria for the higher speed zone apply.

3.7.3.4. Where there are three or more through lanes in the direction of travel, right turn acceleration and deceleration lanes will be required only when determined necessary by Planning and Zoning due to high traffic volume or other site specific safety considerations.

3.7.3.5. Taper and lane lengths shall be in accordance with the following criteria.

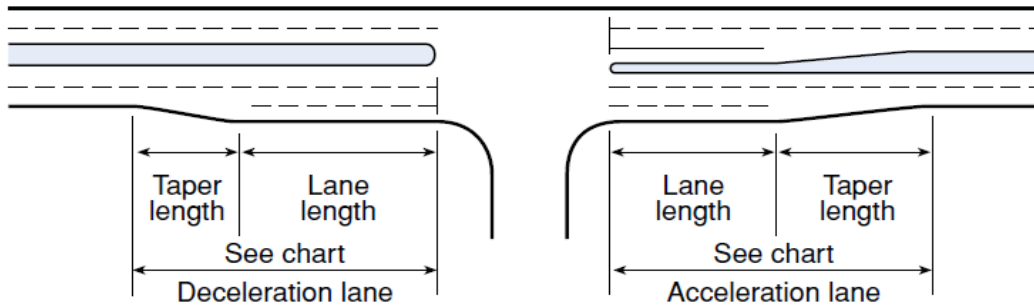
#### Deceleration Right Turn Lanes

Design Speed (M.P.H.)	Taper Length (For 11' Lane Width)	Lane Length	Total Length* (Taper Length + Lane Length)
25	80'	120'	200'
30	100'	150'	250'
35	120'	190'	310'
40	140'	230'	370'
45	160'	280'	440'
50	180'	320'	500'

*\*At signalized intersections, where storage is needed for right-turning vehicles, additional length shall be provided to accommodate the average number of vehicles anticipated.*

#### Acceleration Right turn Lanes

Design Speed (M.P.H.)	Taper Length (For 11' Lane Width)	Lane Length	Total Length (Taper Length + Lane Length)
30	120'	190'	310'
35	120'	270'	390'
40	180'	380'	560'
45	180'	550'	730'
50	240'	760'	1000'

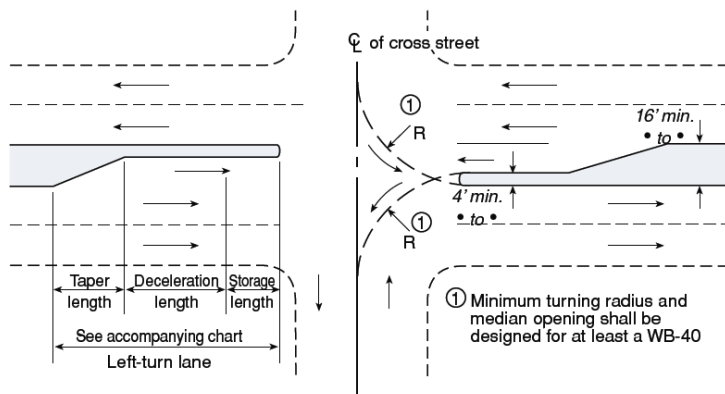


3.7.3.6. A continuous accel/decel lane may be required if the acceleration lane for one access and the deceleration lane for another access overlap or are in close proximity to each other.

3.7.3.7. The minimum pavement width for acceleration and deceleration lanes shall be eleven (11) feet, excluding gutter pan or shoulder.

3.7.3.8. Grade correction factors are required where street/road grades are steeper than three (3) percent.

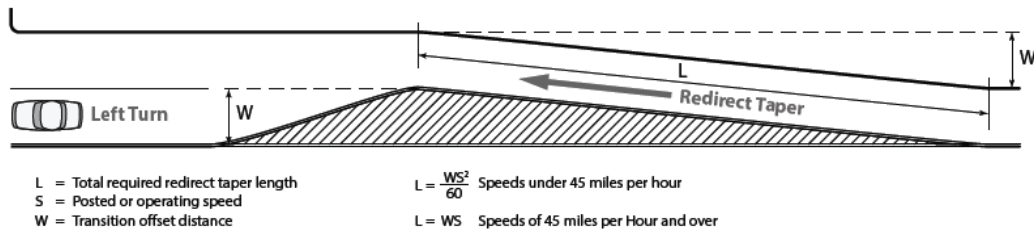
3.7.4. Left-Turn Lanes: Left-turn lanes are required at all arterial and major collector street/road intersections and at driveways on major collector/arterial streets/roads. Design of left-turn lanes shall be in accordance with the following criteria.



**Left-Turn Lanes**

Design Speed (M.P.H.)	Taper Length (For 11' Lane Width)	Decel Length	Total Length
30	100'	150'	*250'
40	140'	230'	*370'
45	160'	280'	*440'
50	180'	320'	*500'

*\*Plus storage length*



3.7.4.1. Storage Lengths: Storage lengths for signalized and unsignalized intersections shall be determined by an approved transportation analysis or transportation study, as applicable.

3.7.4.2. Median Design: Other left-turn median designs such as reverse curve taper, offset approach nose and double left-turn lanes must be approved by Planning and Zoning and shall conform to AASHTO standards.

3.7.5. Curb Returns

3.7.5.1. The table below provides the minimum street/road intersection radii measured to flowline or edge of pavement where no curb and gutter is required.

### Curb Return Radii (R) To Flowline

Intersecting Street	Principal Arterial	Minor Arterial	Major Collector	Collector	Local
Principal Arterial	Special Design*	Special Design*	40'	40'	30'
Minor Arterial	Special Design*	Special Design*	30'	30'	25'
Major Collector	40'	30'	30'	30'	25'
Collector	40'	30'	30'	25'	20'
Local	30'	25'	25'	20'	20'/15'

*\*Special Design should provide consideration for right turn channelization.*

3.7.5.1.1. At driveway locations where curb returns are used, the minimum radii allowed on arterials and major collectors shall be twenty-five (25) feet.

3.7.5.1.2. At driveway or private access locations where there is no curb and gutter, the minimum radii (measured to edge of pavement) allowed on arterials and major collectors shall be twenty-five (25).

3.7.5.2. The minimum elevation difference (fall) around curb returns (PCR to PCR) for flow along the curb line shall be as follows:

Radius	Minimum Fall
15'	0.3'
20'	0.4'
25'	0.5'
All Others	1.27% of length from PCR to PCR

3.7.5.3. The maximum fall around curb returns shall be equal to the steepest grade coming into or out of the return multiplied by the return length, + 0.2 feet.

3.7.5.4. Curb Return Profiles: Curb return profiles are required for radii equal to or greater than thirty (30) feet within the public Right-of-Way. A midpoint elevation along the arc length of the curb return shall be shown in plan view for radii equal to or greater than twenty-five (25) feet. Curb return design shall be set in accordance with the following design procedure. General standards for flowline control and profiles within the curb returns shall be as follows:

3.7.5.4.1. The point of tangency at each curb return shall be determined by the projected tangent grade beginning at the point of intersection (P.I.) of the flowlines.

3.7.5.4.2. The arc length and external distance of the curb return shall be computed and indicated on the drawing.

3.7.5.4.3. Show the corresponding flowline (or top of curb) grade for each roadway beyond the P.C.R.

3.7.5.4.4. Design of the curb return flowline shall be such that the maximum cross slope between the midpoint of the curve and the PICR (external distance) does not exceed +5 percent. Grade breaks at the PCR's will not exceed two (2) percent for local and collector streets and one (1) percent for arterials. The flowline design of the curb return will be accomplished within the return without affecting street grades beyond the PCR. Maximum vertical curves will equal the arc length of the curb return. The elevation and location of the



high or low point within the return, if applicable, is to be called out in the profile.

3.7.5.4.5. Scale for the curb return profile is 1" = 10' horizontally and 1" = 1' vertically. See Section 2.4.6.

### 3.7.6. Driveway Spacing

Opposing and adjacent driveway locations shall be in accordance with the following figure and table. The minimum spacing shall be increased as necessary to accommodate left turn storage bays. Offset of opposing driveway locations is not required if driveways are physically constrained to right-in, right-out.

NOTE: Flowline of curb/gutter or edge of asphalt if curb/gutter does not exist or edge of shoulder if asphalt does not exist.

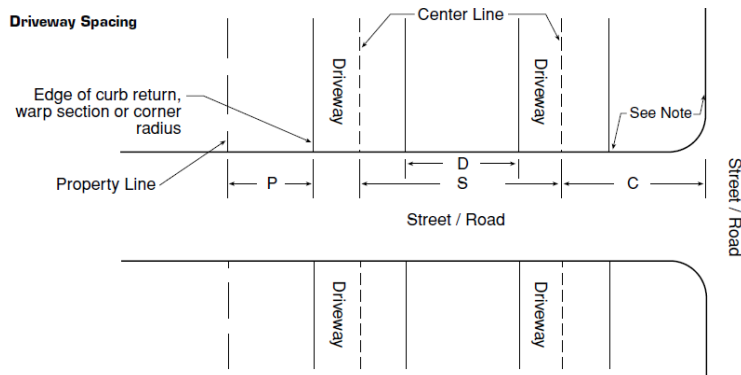


	Figure Reference	Distance
<b>Residential Driveways</b>		
From property lines	P	0'
From streets/roads	C	30'
Between driveways	N/A	0'
On local streets/roads	D	10'
On collector streets/roads	S	80'***
On major collector/arterial streets/roads	S	325'
<b>Non-Residential Driveways on Locals/Collectors</b>		
From property lines	P	0'
From major collectors/arterial streets/roads	C	300' *
From collector streets/roads	C	200' *
From local streets/roads	C	125'
<b>Between driveways</b>		
30 MPH design speed	S	180'
35 MPH design speed	S	200'

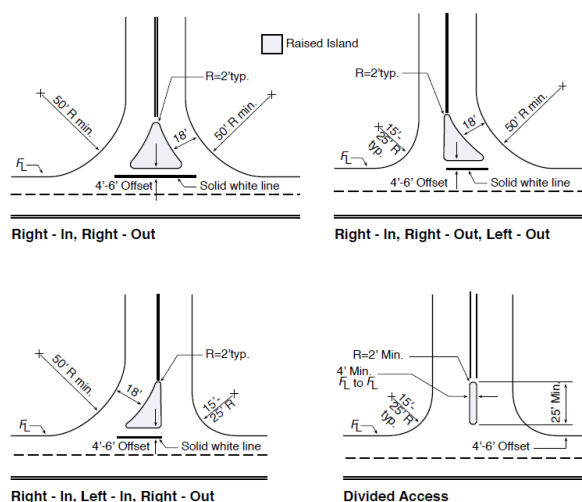
Non-Residential Driveways on Major Collectors/Arterials/Parkways		
From property lines	P	0'
From streets/roads	C	500' **
Between driveways		
40 MPH design speed	S	275'
45 MPH design speed	S	325'

\*The C dimension may be reduced if approved by Planning & Zoning Division due to the existence of limiting factors. The minimum distance shall be no less than 150 feet.

\*\* If the proposed driveway is restricted to right turn movements or if it is not aligned with an existing or planned left turn lane, the C dimension may be reduced if approved by Planning & Zoning Division due to the existence of limiting factors. If signalization is proposed, the minimum C distance shall be increased to 660 feet.

\*\*\*May be reduced for circular driveways or driveways with a standard hammerhead turnaround If approved by Planning and Zoning.

3.7.7. Channelizing Islands The following figures illustrate the minimum design for channelizing islands for site accesses with various turn movement restrictions.



3.7.7.1. Non-rigid post mounted delineators are required on raised islands.

3.7.7.2. Curb ramps four (4) feet wide, with a maximum slope of 12:1, are required and shall be shown on the plans.

3.7.8. Driveways, Private Roads, and Non-Maintained Roads in County Right-of-Way Standards.

3.7.8.1. Driveways serving one dwelling unit shall meet the following standards:

3.7.8.1.1. Minimum horizontal curve radius of 30 feet at centerline.

3.7.8.1.2. A total width of 14 feet, including a 10-foot all-weather travel surface and two-foot shoulders on either side or if the driveway exceeds 150 feet in length, a 12-foot all-weather travel surface and two-foot shoulders on either side is required in accordance with Template 18.

3.7.8.1.3. Maximum grade of ten percent on straight sections and 12 percent grade where the dip of the natural terrain bears between South 60° East and South 45° West. Maximum grade of eight percent for curves with radius of less than or equal to 50 feet at centerline.

3.7.8.1.4. If the length of the driveway in the Plains is less than or equal to 50 feet, Sections 3.7.8.1.1. through 3.7.8.1.3. do not apply.

3.7.8.1.5. If the length exceeds 150 feet, a turnaround shall be provided in accordance with Template 20 and the location of the turnaround shall be approved by the appropriate fire protection district.

3.7.8.2. Private roads serving more than one dwelling unit and non-maintained roads in county Right of Way shall meet the following standards:

3.7.8.2.1. Minimum horizontal curve radius of 30 feet at centerline.

3.7.8.2.2. A total width of 20 feet, including a 16-foot all-weather travel surface and two-foot shoulders on either side in accordance with Template 18 for roads serving up to 15 dwelling units. Alternatively, for a private road a total width of 14 feet, including a 10-foot traveled surface, two-foot shoulders on either side, and pullouts at 150 foot intervals in accordance with Template 19.

3.7.8.2.3. A total width of 24 feet, including an 18-foot paved surface and three-foot shoulders on either side in accordance with Template 18 for roads serving 16 or more dwelling units or one or more non-residential units.

3.7.8.2.4. Maximum grade of ten percent on straight sections: Maximum 12 percent grade where the dip of the natural terrain bears between South 60° East and South 45° West. Maximum grade of eight percent for curves with radius of less than or equal to 50 feet at centerline.

3.7.8.3. The appropriate fire protection district may approve alternative standards for driveways and private roads. Plans shall be submitted that bear the written approval of the appropriate fire protection district.

3.7.8.4. Driveway approaches and private road intersections with public roads must comply with Standard 8 - Driveway and Private Road Approaches onto Roads.

3.7.8.5. Cattle guards shall conform to the current edition of the CDOT M&S Standard Plans and approved by the appropriate fire protection district.

3.7.8.6. All gates and entry-way structures shall be approved by the appropriate fire protection district.

### **3.8. Drainage**

All storm drainage systems shall be designed in accordance with Jefferson County Storm Drainage Design and Technical Criteria (JCSDDTC). Safe and efficient conveyance of traffic is the primary function of streets/roads; therefore, design of the storm drainage function shall not exceed the limits (such as gutter capacity and street overtopping) set forth in the JCSDDTC. All new or repaired storm sewer pipe and associated structures within County Right-of-Way and/or easements shall be constructed with trace wire and test locations. Installation shall be tested for operation and documented with Form Letter "T", in accordance with Jefferson County Land Development Regulation Section 33.

3.8.1. Crosspans: Crosspans are not permitted across collector or arterial streets, nor are they allowed on streets with existing storm sewer systems. Crosspans may be used parallel to collector or arterial streets to convey storm runoff across local streets.

3.8.2. Inlets: Inlets shall be located to intercept gutter flow at the point gutter capacity is exceeded by the storm runoff (see Chapter 9 of the JCSDDTC for gutter capacity). Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation. Due to the presence of curb ramps at intersections, inlets are not allowed within the curb return, but shall be located at the tangent points of the curb return.

3.8.3. Cross Slope: Except at intersections, or where superelevation is required, streets/roads shall be level from top of curb to top of curb (or flowline to flowline) and shall have a two (2) percent crown. At or within 150' of an intersection, the maximum elevation difference between flowlines is that dictated by the intersection grade (Section 3.5.2.) and the actual distance between flowlines.

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

3.8.3.2. Carrying the crown at a side street into the through street is permitted only when drainage considerations warrant such a Transportation Design and Construction Manual – Amended 12-17-19

design.

3.8.3.3. 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.

3.8.4. Temporary Erosion Control: Temporary erosion control is required along and at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with the Jefferson County Zoning Resolution, Section 15.

3.8.5. Cross Culverts: Cross culverts shall be installed at locations where roads cross natural drainageways and/or where changes in road grade are greater than two (2) percent. The culvert slope shall match as nearly as possible that of the existing topography, but shall in no case be less than one (1.0) percent. Cross culverts for roads shall be spaced a maximum of five hundred (500) feet apart.

### **3.9. Traffic Control**

3.9.1. Construction Traffic Control: Traffic safety in construction zones should be an integral element of every project from planning through design and construction. Pedestrian, as well as vehicular traffic, should be considered in the design of a traffic control plan. A traffic control plan shall be submitted to and approved by Transportation and Engineering prior to issuance of a construction permit.

Design of all traffic control plans shall be in accordance with Part VI of the Manual on Uniform Traffic Control Devices, Standards for Work Zone Traffic Control. All necessary signs, pavement markings, barricades, etc. shall be shown on the plan.

3.9.2. Traffic Signals: Traffic signals shall be installed at street/road intersections or site accesses identified as meeting warrants in the traffic study submitted for a proposed development. If the proposed signal location is within twelve hundred (1,200) feet of any adjacent signal, a two-way progression analysis shall be included in the traffic study.

Design of all traffic signals shall be in accordance with the Manual on Uniform Traffic Control Devices and the Colorado Department of Transportation Standards and Specifications. Traffic signal plans shall be submitted to and approved by Planning and Zoning.

Traffic signal poles shall not be installed within sidewalks or curb ramps.

3.9.3. Signing and Striping: Plans are required for signing/ striping of new streets/roads and re-signing/stripping of existing streets/roads necessitated by development. All signing/stripping plans shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and shall be submitted as part of the construction plans.

3.9.3.1. The signing plan shall:

1. Show the general longitudinal location of each existing and proposed sign (by side of street/road and station).
2. Specify the sign legend and sign type (from the MUTCD).
3. Specify the sign size.
4. Include a typical detail of installation dimensions (height, distance from curb or edge of pavement).
5. Include a detail of post and base dimensions and installation plan (showing any wedges or sleeves, depth below surface, any materials used).
6. Specify the blank gauge and material of the sign(s).
7. Note the reflectorization provided.

3.9.3.2. The striping plan shall show:

1. Striping material (paint, thermoplastic, preformed tape, etc.).
2. Color designation and line width.
3. Lane width.



4. Proposed and existing lane striping including skip interval.

5. Typical treatments for accel/decel lanes, turning lanes, bike lanes and crosswalks.

3.9.3.1. Stop signs shall be placed at intersections in accordance with the MUTCD, unless otherwise approved by the Director of Planning and Zoning.

3.9.3.2. All street/road name signs shall be in accordance with the current edition of DRCOG “Guidelines for the Design and Placement of Street Signs in the Denver Region”.

### **3.10. Miscellaneous**

3.10.1. Guardrail: In locations where guardrail is required, as determined by Planning and Zoning, design shall be in accordance with the Colorado Department of Transportation Standards and Specifications. Determination of guardrail requirements shall be based on Colorado Department of Transportation Roadway Design Manual, Section 702. Guardrail locations shall be shown on the construction plans.

3.10.2. Noise Attenuation: In locations where arterial streets/roads are adjacent to existing or planned residential areas, fencing and/or other noise attenuation measures are required. These measures may include, but are not limited to, earth beams, landscaping, walls, or a combination.

3.10.3. Street Lighting: Street lights shall be provided at all parkway/arterial/major collector street/road intersections. In addition, street lights shall be provided at all locations where multifamily residential, commercial or industrial site driveways intersect parkway/arterial/major collector streets/roads. Street lights shall be designed in accordance with the most recent ANTI/ICES Roadway Lighting Standards and installed in accordance with Public Service Company of Colorado standards. Light poles shall not be installed within sidewalks or curb ramps.

3.10.4. Roundabouts: Roundabouts may be constructed subject to an approved traffic study. Roundabouts shall be designed in accordance with the current edition of the Federal Highways Administration Publication, Roundabouts: An Informational Guide, and approved by Transportation and Engineering and the appropriate fire protection district.

3.10.5. Bridges: Bridges shall be designed in accordance with CDOT Bridge Manuals and approved by Transportation and Engineering and the appropriate fire protection district.

3.10.6. Curb Extensions (mid-block and corner) and Pedestrian Refuge Islands: Curb extensions and pedestrian refuge islands shall be designed in accordance with the current version of the Federal Highway Administration Bicycle and Pedestrian Report and approved by Transportation and Engineering and the appropriate fire protection district.

## ***Chapter 4***

# **Pavement Design and Technical Criteria**

### **4.1. General**

This section sets forth the minimum criteria and design procedures for public and private roadway pavements. Recommended design methodologies for asphalt are addressed and essentially follow the Colorado Department of Transportation (CDOT) and the Asphalt Institute methodology. Some standardization of criteria has been made in design procedures. Other design methodologies may be presented for comparison to the current County design method.

## **4.2. Pavement Design Report Submittal**

4.2.1 Preliminary Pavement Design: A Preliminary Pavement Design shall be used for estimating purposes only to determine the financial security "Exhibit A" associated with development projects. Three standardized Preliminary Pavement Designs corresponding to three zones of unique geotechnical characteristics within Jefferson County are presented in Construction Standards 16-18. Construction Standard 19 shows each of the three zones. Zone 1 corresponds with materials associated with decomposing granite in the higher elevation foothills and mountains. Zone 2 addresses highly expansive clay and claystone material within the Designated Dipping Bedrock Area with edge drains. Zone 3 involves non-cohesive soil and weathered bedrock along the Front Range. The Preliminary Pavement Design shall be replaced with the Final Pavement Design, and the associated "Exhibit A" financial security costs recalculated, after County approval of the Final Pavement Design Report.

### **4.2.2 Final Pavement Design:**

The final pavement design shall be completed and submitted after or in conjunction with County approval of the associated construction plans. All soil samples must be taken after overlot grading, or represent the "as-constructed" soil conditions after construction has been completed. Pavement design approval is required prior to placement of any concrete flatwork and/or paving within County Right-of-Way.

The report shall be prepared by or under the supervision of and signed by a Professional Engineer registered in the State of Colorado and shall include the following information:

- A. Vicinity map to locate the investigated area.
- B. Scaled drawings showing the location of borings, and required information stated in 4.3.2.
- C. Scaled drawings showing the estimated extent of subgrade soil types and Equivalent Daily Load Application (EDLA) for each street.
- D. Pavement design alternatives for each street on a scaled drawing.
- E. Tabular listing of Sample Designation, Sample Depth, Composite Group Number, Liquid Limit, Plasticity Index, Percent Passing the No. 200 sieve, American Association of State Highway and Transportation Officials (AASHTO) Classification, Group Index, Percent Swell from Swell Consolidation tests, and Soil Description.
- F. California Bearing Ratio (CBR) or R-value test results and calculations for each soil type used in the design. Include natural moisture content and natural density.
- G. Pavement design nomographs supplied by Jefferson County properly drawn to show Soil Support, EDLA and Structural Number (SN).
- H. Design calculations for pavement thickness.
- I. Percentage water soluble sulfates, sampled at a minimum of every other boring.
- J. A discussion regarding potential subgrade soil problems including, but not limited to:
  - 1. heave or settlement prone soils
  - 2. frost susceptible soils
  - 3. ground water
  - 4. drainage considerations (surface and subsurface)
  - 5. cold weather construction (if appropriate)
  - 6. other factors or properties which could affect the design or performance of the pavement system
- K. Recommendations to alleviate or mitigate the impact of problems discussed in Item J above.

## **4.3. Subgrade Investigation**

4.3.1 Field Investigation: The field investigation shall consist of boring soils to a depth of at least five feet below the bottom of the Transportation Design and Construction Manual – Amended 12-17-19

proposed asphalt pavement layer elevation for roads classified as Local or Collector. Borings shall extend 10 feet below the bottom of the proposed asphalt pavement layer elevation on Major Collector / Minor Arterial and Major Arterial roadways. In all cases borings shall be spaced no more than 250 feet apart, or a minimum of one boring for each section of street, unless otherwise required by Transportation and Engineering. The borings shall be checked for ground water at the time of drilling, and then 24-hours after the borings are completed. Samples shall be taken after overlot grading is completed and the subgrade is "rough cut" (1 to 2 feet of proposed elevation). Soil classifications shall be verified after installation of utilities.

Geological features within five feet of the existing ground surface, and all new roadways proposed in the Dipping Bedrock Area, require more detailed investigation including drilling and/or trenching. Every third bore hole shall be a minimum of 10 feet deep, regardless of the road classification.

California Drive samples shall be obtained from each boring within 12-18 inches of the final subgrade elevation.

4.3.2. Boring Profiles: Boring logs shall include the following:

- a. Date, Strata Elevations, Depth of Boring.
- b. Natural moisture content, Blow Count and Dry Density of each undisturbed sample.
- c. Water table elevation.

4.3.3. Classification Testing: Each soil sample shall be tested according to AASHTO and/or the American Society for Testing Materials (ASTM) criteria to determine: Liquid Limit, Plastic Limit, Plasticity Index, and Percentage passing the U.S. Standard No. 200 sieve. Samples of sands and gravels shall require gradation analysis for classification determination.

These data shall be determined using the following methods:

- a. Liquid Limit - AASHTO T 89 (ASTM D 4318)
- b. Plastic Limit - AASHTO T 90 (ASTM D 4318)
- c. Passing No. 200 - AASHTO T 11 (ASTM C 117)
- d. Gradation - AASHTO T 27 (ASTM D 422)

The results of these tests shall be used to calculate the AASHTO Classification and Group Index using AASHTO M 145.

4.3.4. Soil Grouping: Soil samples collected in the field investigation can be combined to form soil groups. These groups shall be based upon the AASHTO Classification, Group Index and location within the area investigated. Groupings shall not consist of samples with different AASHTO Classifications (Note: There may be more than one group index within a given classification). Composite samples can be manufactured by combining representative, equal portions of each sample contained within the group and mixing to provide a uniform composite sample of the soil group. This shall be limited to group indices within the range of 7. Composite samples shall be subjected to Classification Testing as outlined in Section 4.3.3. Moisture-Density curves must be included for groups used in the design.

4.3.5. Subbase Support Testing: Individual subbase or composite samples shall be tested to determine the support value using either CBR (California Bearing Ratio) or Hveem Stabilometer (R-value) testing. These values shall be used in the design of pavement sections in accordance with the procedures outlined in Section 4.5. Tests shall be conducted in accordance with the following procedures:

4.3.5.1. CBR Tests: California Bearing Ratio tests shall be conducted in accordance with AASHTO T 193 with the following modifications:

- a. Note 4 of AASHTO T 193 shall not apply. A 3- point CBR evaluation is required.
- b. The compaction method used for the CBR test shall be determined by the soil classification.
- c. Surcharge shall be calculated using a unit weight of 140 pcf for bituminous pavement and 135 pcf for untreated aggregate base course.
- d. The design CBR value shall be determined from the CBR - Dry Density Curve and shall be the CBR value at 95 percent compaction.
- e. In addition to the values requested in AASHTO T 193, Stress-Penetration curves for each sample, a CBR - Dry Density curve and

Proctor Compaction test results shall be reported.

4.3.5.2. R-Value Tests: Hveem Stabilometer tests shall be conducted in accordance with AASHTO T 190. The design R-value shall be at 300 psi exudation pressure. The reported data shall consist of:

- a. Dry density and moisture content for each sample.
- b. Expansion pressure for each sample.
- c. Exudation Pressure - corrected R-value curve showing the 300 psi design R-value.

#### 4.4. Pavement Design Criteria

This section sets forth the parametric input data to be used for the design of pavements of various roadway classifications. If cohesive soil mitigation is required, the soil treatment shall extend from back of sidewalk to back of sidewalk.

4.4.1. Equivalent (18 Kip) Daily Load Applications (EDLA): The pavement design procedure in this chapter is intended to provide for a 20-year service life of pavement, given that normal maintenance is provided to keep roadway surface in an acceptable condition. EDLA and Design Traffic Number (DTN) are considered equivalent units based on 20-year design criteria and an 18 kip axle loading. All data and design nomographs in this chapter use EDLA units for pavement loading repetitions. Calculations shall be included, where applicable.

EDLA criteria for each Jefferson County roadway classification are given in Table 4.1.

**Table 4.1 Recommended Equivalent (18 Kip) - Daily Load Applications (EDLA)**

Classification	Class Modifier	EDLA Values
Local	Serving <50 D.U.	8
	Serving >50 D.U.	10
Collector	Residential	30
	Other	100
Major Collector/Minor Arterial	All	200
Principal Arterial	All	200

*NOTE: Alternative EDLA values may be considered with justification provided by the Transportation Study, proposed land uses, and traffic analysis that defines proportion of truck vehicles, including construction truck traffic.*

4.4.2. Design Serviceability: The following criteria shall be used for all Jefferson County roadways to be dedicated for public use:

**Table 4.2 Serviceability Index**

Roadway Classification	SI
Arterials	2.5
Collectors	2.5
Local	2.0

4.4.3. Minimum Pavement Layers: This paragraph provides the minimum acceptable pavement layers for public roadways in Jefferson County. These pavement layer thicknesses may be used for preliminary planning purposes. Final pavement designs must be based on actual subbase support test results. Table 4.3 lists these minimum thicknesses for each roadway classification.

**Table 4.3 Minimum Pavement Sections**

Road Classification	EDLA	Composite Section (inches)			Full Depth Asphalt (inches)
		Asphalt	Subbase		
			Base Course	Stabilized	
<50 D.U.	8	4	6	12	5
=>50 D.U.	10	4	6	12	5
Residential	30	4	6	12	5
Other	100	5	6	12	6
Major Collec- tor	200	5	6	12	7
Minor Arterial	200	5	6	12	7
Major Arterial	200	5	6	12	8

Regardless of the pavement layer design, all soils with an R-value less than 10, or PI greater than 15, shall be stabilized to a minimum of 12 inches below the bottom of the asphalt pavement layer, and shall be included in the depth of treatment.

Cohesive soil subbases shall be overexcavated and replaced with moisture conditioned fill. Minimum requirements for overexcavation are listed below in Table 4.3a.

**Table 4.3a Minimum Overexcavation Requirement for Cohesive Soils**

Plasticity Index	Depth of Overburden/Fill Treatment	
	Locals/Collectors	Major Collectors/Arterials
15-20	1 foot	2 feet
21-30	2 feet	3 feet
31-40	3 feet	4 feet

**NOTES:**

1. Road segments with isolated soil types may be designed separately for that individual segment.
2. Soil with (PI) over 40 shall be removed and wasted to a depth of five feet for any type of street.
3. In the Designated Dipping Bedrock Area, all bedrock shall be overexcavated to a depth of at least five (5) feet below the bottom of the proposed pavement layer. Where the bedrock is claystone, the top of the weathered claystone shall be considered as the top of bedrock. Should soil other than bedrock be found throughout the five (5) foot zone, it shall be overexcavated as shown in Table 4.3a.
4. The overexcavation areas shall be recompact to 95% of maximum Standard Proctor Density (ASTM D-698) at 0 to +4% above optimum moisture content. There shall be a minimum of 12 inches of soil stabilization below the bottom of the asphalt layer that is included in the total depth of overexcavation.
5. Overexcavation of overburden/fill below the stabilization section may be waived by Transportation and Engineering in areas where either previous overexcavation work during overlot grading has been validated or in cases where a thorough geotechnical investigation determines overexcavation is not warranted. Previous overexcavation work must be validated by compaction reports provided by the developer's geotechnical firm and in accordance with the Land Development Regulation (LDR).

4.4.4. Flexible Pavement Strength Coefficients: Table 4.4. contains standard design coefficients for various pavement materials. Non-standard design coefficients may be used only if approved in advance by Transportation and Engineering. In addition, design values must be verified by predesign mix test data and supported by daily construction tests; or, redesign values will be required.

**Table 4.4 Strength Coefficients**

Pavement Structure Component*	Strength Coefficients	(Limiting Test Criteria)
Conventional Materials		

Hot Mix Asphalt	0.40	1800 Lbs. Marshall Or R 90+)
Exist. Asphalt Pavement	0.30	(9-15 Yr)
	0.24	(>15 Yr)
Aggregate Base Course	0.12	(Cbr 80+ Or R 78+)
Exist. Aggregate Base Course	0.10	(Cbr 50+ Or R 69+)
Granular Subbase Course	0.07	(Cbr 15 Or R 50+)
Treated Materials		
Cement Treated Aggregate Base	0.23	(7 day, 650-1000 psi)
Lime Stabilized Subbase	0.14	(PI.<6, net swell <.5%, PH >12.3) Compressive Strength >/200 psi, per ASTM 5102-04, Procedure B
All Stabilized Subbase	0.14	Compressive Strength >/200 psi, per ASTM 5102-04, Procedure B

*\*The combination of one or more of the following courses placed on a subgrade to support the traffic load and distribute it to the roadbed.*

Structural Layers of a conventional flexible pavement design are defined below.

- a) Surface Course: One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called “Wearing Course.”
- b) Base Course: The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a surface course. The use of base course is not accepted in areas that base course does not adequately drain from roadway system.
- c) Subbase: The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course, surface course or both.
- d) Subgrade: Prepared and compacted soil extending to such a depth as to affect the structural design.

## 4.5. Pavement Design Procedure

4.5.1. Flexible Pavements: The following procedure should be used in determining the Structural Number (SN) of the pavement being designed:

4.5.1.1. Using the appropriate roadway classification, determine the corresponding EDLA (Table 4.1).

4.5.1.2. Determine the Serviceability Index (SI) of the roadway classification (Table 4.2).

4.5.1.3. Select the proper nomograph:

Example: Figure 4.1 Flexible Pavements with SI = 2.0

Example: Figure 4.2 Flexible Pavements with SI = 2.5

NOTE: Original nomographs required are available from Transportation and Engineering.

4.5.1.4. Using subgrade CBR or R-Value test results and EDLA, determine the SN from the appropriate design nomograph.

4.5.1.5. Once the Structural Number (SN) has been determined, the design thicknesses of the pavement structure can be determined by the general equation:

$$SN = a_1D_1 + a_2D_2 + a_3D_3 + \dots$$



where

a1 = Hot Mix Asphalt (HMA) strength coefficients

a2, a3, an = strength coefficients of additional pavement components

D1 = thickness of Hot Mix Asphalt (HMA) (inches)

D2, D3, Dn = thickness of additional pavement component sections

The strength coefficients for various components of the pavement structure are given in Table 4.4.

The component thickness selected must meet two conditions:

- a. Total HMA thickness selected cannot be less than the minimum specified in Table 4.3. for the roadway classification.
- b. The base course thickness selected cannot exceed 2.5 times the HMA thickness selected, with a maximum thickness of eight (8) inches.

4.5.1.6. The design must reference any mitigative measures required when the subbase and / or subgrade contains cohesive or expansive soils. Design reports recommending permeable layers such as untreated aggregate base course in the pavement system, must present the measures to be used to ensure adequate drainage of such layers, and to maintain segregation of the layers from the fine-grained soils. If cohesive or expansive soil mitigation is required, the soil stabilization shall extend from back of sidewalk to back of sidewalk. It is required that soils with R-values less than 10 or Plasticity Index greater than 15 be stabilized. Stabilization is for a minimum of the upper twelve (12) inches below the bottom asphalt pavement layer, and shall be included in the depth of treatment.

4.5.2 Rigid Pavements: This procedure has been deleted.

## **4.6. Material Specifications**

The Specifications presented in this section are performance oriented. The County's objective in setting forth these Specifications is to achieve an acceptable quality of roadway structures. All sources for the mined or manufactured materials must be annually approved by Transportation and Engineering as having met the appropriate materials performance specifications. This approval is a condition of using those material sources for public improvement construction. For the purpose of these Standards, public improvements are all roadway improvements, sidewalks, curbs and gutters, appurtenant drainage basins or structures, storm sewer and their access ways, other public works within Jefferson County Right-of-Way, and required stormwater detention structures built on private property and maintained by the property owner(s).

### **4.6.1. Violations of Approval Conditions**

4.6.1.1. Random Testing. Transportation and Engineering may order random tests of materials used in County public improvements to verify compliance with material specifications. These tests are in addition to the requirements of the roadway inspection and testing procedures.

4.6.1.2. Any and all material used to construct public improvements that is not from a certified source, or that is from a certified source and fails one or more random material test, may be subject to complete removal as a condition of County acceptance of that public improvement. Additional tests will be required to confirm the existence and extent of the sub-standard material prior to the initiation of remedial action. The extent of the material to be removed will be at the discretion of Transportation and Engineering.

4.6.2. Use of Materials Not Listed in Section 4.6. Materials in this section and provided with a set of specifications are those deemed to be the primary structural materials commonly or typically used in public improvements. Ancillary public improvement materials such as manufactured paints and coatings, bonding agents, sealers, fabrics or gaskets, insulating materials, etc., should be in compliance with CDOT material specifications for the appropriate material employed. Alternative materials for construction may be proposed for use. Decisions on acceptability of alternative materials will be made by Transportation and Engineering.

#### 4.6.3. Material Specifications

4.6.3.1. Hot Mix Asphalt: This shall comply with material specifications for PG Binders and asphalt mixes in accordance with CDOT's most recent edition of Standard Specifications for Road and Bridge Construction, 702 and 703. This is hereby referred to as "CDOT Standard Specifications".

4.6.3.2. Aggregate Base Course Material. This material shall consist of hard, durable particles or fragments of stone or gravel, crushed to required sizes, containing an appropriate quantity of sand or other finely-divided mineral matter which conforms to the requirements of AASHTO M 147, and to Section 703.03, CDOT Standard Specifications.

Specifications. In addition, the material must have an R-value of 78 or greater, or a CBR of 80+, and must be moisture stabilized. Moisture stability is determined by R-value testing which shows a drop of 12 points or less in R-value between exudation pressures of 300 psi and 100 psi.

Only aggregate from sources approved by the Transportation and Engineering shall be used.

**Table 4.5 Aggregate Base Course Materials**

Sieve Size	Mass Percent Passing Square Mesh Sieves	
	Class 5	Class 6
2"	100	
1"	95 - 100	100
3/4"	—	95
#4	30 - 70	30 - 65**
#8	—	25 - 55
#200*	03 - 15	03 - 12**
Liquid Limit (LL)	30 Max.	30 Max.

\*ASTM (C117)

\*\*For gravel shoulders, No. 200 shall be 9-12 and No. 4 shall be 30-50.

Base course may be used only where the base can daylight in barrow ditches or where the subgrade consists of material classifying as GM, GW, GP, SM, SW, or SP using the Unified Soil Classification System.

4.6.3.3. Cement Treated Aggregate Base Course. This material shall consist of a mixture of aggregate materials, Portland cement and water as outlined in Section 304 of the CDOT Standard Specifications. Acceptable aggregates include CDOT Classes 5 and 6. Other aggregates may be used, if previously approved by Transportation and Engineering.

The materials to be used in construction shall be tested and a mix design submitted to the Transportation and Engineering. As a minimum, the mix design report shall contain a description of material sources, gradations and Atterberg limits of aggregates, cement type, Proctor compaction curves and unconfined compressive strength results for each mix, strength versus cement content curves, a design mix and special construction procedures recommended. Testing shall be in accordance with appropriate AASHTO specifications. Minimum in-place thickness for cement treated aggregate base course shall be twelve (12) inches.

To be approved, the mix shall have a seven-day compressive strength of at least 650 psi and no more than 1,000 psi. The minimum acceptable cement content shall be five percent by weight. Only mix designs approved by Transportation and Engineering shall be used. Approvals are required on a project basis, or an annual basis for suppliers, prior to issuing construction permits.

4.6.3.4. Lime Treated Subgrade: This Material consists of a mixture of native or imported soils, hydrated or quick lime and water as outlined by ASTM Specification C977, CDOT Standard Specification 307.

The materials to be used in construction shall be tested and a mix design submitted to Transportation and Engineering for approval. As a minimum, the mix design report shall contain a description of material sources, gradation and Atterberg limits of native soils, Atterberg limits, pH and five day, 100°F cure unconfined compressive test results for each mix, strength versus lime content curves, a design mix and special construction procedures recommended. Testing shall be in accordance with appropriate AASHTO methods.

To be approved, the mix shall meet the following requirements:

1. Minimum pH of 12.3 after completion of initial mixing.
2. Plasticity Index less than 6, per ASTM D4318.
3. Minimum hydrated lime of 5.0% dry weight, per ASTM D3.
4. Minimum unconfined compressive strength shall be 200 psi, per ASTM D1633.
5. Sulfate concentrations not to exceed .5%

Note: Field validation shall be required after soil blending occurs during construction.

Only mix designs approved by Transportation and Engineering shall be used. Approvals are required on a project basis prior to issuing construction permits. Minimum in-place thickness for this material shall be twelve (12) inches.

4.6.3.5. Lime/Fly-Ash Stabilized: This material consists of a mixture of native or imported soils, hydrated or quick lime, Class “C” Fly-Ash, and water as outlined by ASTM Specification C977, CDOT Section 307.

The materials to be used in construction shall be tested and a mix design submitted to the Transportation and Engineering for approval. As a minimum, the mix design report shall contain a description of material sources, gradation and Atterberg limits of native soils, Atterberg limits, pH and five-day unconfined compressive test results for each mix, strength versus lime/fly-ash content curves, a design mix and special construction procedures recommended. Testing shall be in accordance with appropriate AASHTO methods.

To be approved, the mix shall meet the following requirements:

1. Plasticity Index less than 6, per ASTM D4318.
2. Minimum unconfined compressive strength shall be 200 psi, per ASTM D1633.
3. Sulfate concentrations not to exceed .5%.

NOTE: Field validation may be required after soil blending occurs during construction.

Only mix designs approved by Transportation and Engineering shall be used. Approvals are required on a project basis prior to issuing construction permits. Minimum in-place thickness for this material shall be twelve (12) inches.

4.6.3.6. Cement Stabilized Subgrade. This material consists of a mixture of native or imported soils, Portland cement and water.

The materials to be used on construction shall be tested and a mix design submitted to Transportation and Engineering for approval. As a minimum, the mix design report shall contain a description of material sources, gradation and Atterberg limits of native soils, Atterberg limits, pH and five-day unconfined compressive test results for each mix, strength versus cement content curves, a design mix and special construction procedures recommended. Testing shall be in accordance with appropriate AASHTO methods.

To be approved, the mix shall meet the following requirements:

1. Minimum Portland cement of 3.0% dry weight per ASTM D3.
2. Minimum unconfined compressive strength shall be 200 psi, per ASTM D1633.
3. Sulfate concentrations not to exceed 0.5%.

NOTE: Field validation may be required after soil blending occurs during construction.

Only mix designs approved by Transportation and Engineering shall be used. Approvals are required on a project basis prior to issuing construction permits. Minimum in-place thickness for this material shall be twelve (12) inches.

## *Chapter 5*

# **Construction Specifications and Standards**

## **5.1 Construction Specifications**

The Permittee agrees to adhere to all construction specifications set forth in the latest edition of the Jefferson County Land Development Regulation, the Jefferson County Transportation Design and Construction Manual and the Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction manuals.

5.1.1. Permits: All work performed within County Rights-of-Way and/or easements shall require the issuance of a street/road construction permit. Permits shall be obtained at the Jefferson County Transportation and Engineering office, located at 100 Jefferson County Parkway, Suite 3500, Golden, Colorado.

5.1.1.1. Any permit issued shall pertain only to construction within the County-owned Right-of-Way and is in no way considered a permit to enter on any private property adjacent to such Right-of-Way nor to alter or disturb any facilities or installations existing within the Right-of-Way which may have been installed, and are owned, by others.

5.1.1.2. Permits, when issued, shall be valid for a period of ninety (90) calendar days, and may be renewed for one (1) additional ninety (90) calendar day period, providing the renewal is obtained (renewal may be obtained by telephone) prior to the permit expiration date. Failure to obtain a renewal as stated herein will require obtaining a new permit and payment of applicable fees.

5.1.1.3. Any permit determined to be without an adequate bond as required in Section 5.1.2. below, shall be subject to immediate revocation by Transportation and Engineering.

5.1.2. Bonds: A non-cancellable permit bond shall be required for Right-of-Way Use and Construction Permits and License Agreements Section of the County Policies and Procedures for Streets and Roads.

5.1.3. General Specifications:

5.1.3.1. Any work done to a street/road or other County property under a permit shall result in the street/road or other property being returned to a condition equal to or better than original, within the limits of careful, diligent workmanship, good planning, and quality materials, with said work being accomplished in the least possible time and with the least disturbance to the normal functioning of the street/road or other property.

5.1.3.2. All backfill material, compaction, and resurfacing of any excavation made in the County property shall be done in accordance with specifications and standards approved by and on file with Transportation and Engineering.

5.1.4. Road Closures: Normally, only one side of a public street/road may be blocked at any given time. Should operating conditions require complete closure, advance approval of the closing of a public street/road must be obtained from Transportation and Engineering or advance approval of the closing of a private road must be obtained from Planning and Zoning. The permittee shall notify the appropriate fire protection district, the Jefferson County Sheriff's Department, and the Colorado State Patrol concerning exact location of barricades and dates traffic will be impeded. Barricades shall be maintained by the responsible contractor.

5.1.5. Utility Installations:

5.1.5.1. Underground: All utility lines, including Cable TV, shall be installed a minimum of two (2) feet below ground surface, or proposed roadway elevation, whichever is lower. This requirement is applicable throughout the Right-of-Way, including ditch lines and/or borrow  
Transportation Design and Construction Manual – Amended 12-17-19

pits. Exceptions may be granted by Transportation and Engineering where warranted and upon prior written request and approval.

5.1.5.2. Overhead: A minimum ground clearance of 18 feet 0 inches shall be provided where overhead utility lines cross public roads and streets. The clearance shall be measured at the lowest point where the line crosses the traveled portion of the road and/or street.

5.1.6. Base Course: All aggregate base course shall meet CDOT Class 6 Specifications, or an acceptable base course predicated on specific site conditions as approved by Transportation and Engineering. Native material is unacceptable as base course.

5.1.7. All concrete shall be in conformance with the appropriate class as specified in Section 601 of the CDOT Standard Specifications. A combination cure-sealer shall be used for concrete flatwork. Provide adequate texture by means of a moderately heavy broom finish to surfaces prior to applying the cure-sealer. The product shall be Dayton Superior Cure & Seal LV 25% J20 UV or approved equal. Apply two coats per manufacturer's instructions to all exposed surfaces, with the second coat applied at right angles to the first for complete coverage. The temperature range of application is 35 to 90 degrees F. Concrete shall not be left exposed for more than one hour between the time finishing is completed and commencement of curing treatment.

5.1.7.1. Concrete may be placed by machine methods provided that all finish lines are within 1/8" ± tolerance of the lines shown on the plans. The flowline must be free draining.

5.1.7.2. One-half (1/2) inch expansion joint material shall be installed when abutting any existing concrete or a fixed structure.

5.1.8.1 Storm Sewer Pipe: Within County Right-of-Way and/or easements, all storm sewer pipe shall be minimum Class II Reinforced Concrete Pipe (RCP) in accordance with ASTM C-76, C-506 or C-507. Actual depth of cover, live load, and field conditions may require structurally stronger pipe.

5.1.8.2 All new or repaired storm sewer pipe and associated structures within County Right-of-Way and/or easements shall be constructed with trace wire and test locations. Installation shall be tested for operation and documented with Form Letter "T" in accordance with Jefferson County Land Development Regulation Section 33.

5.1.9. Culverts: Within County Right-of-Way and/or easements, all culverts shall conform to the Storm Drainage Design and Technical Criteria.

#### 5.1.10. Traffic Control Devices

All traffic control devices shall conform to the MUTCD and be approved by Transportation and Engineering prior to installation. Conformance to the following minimum materials specifications or approved equal is required. Traffic signals shall conform to CDOT standards.

5.1.10.1. Signs: Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by Transportation and Engineering. Nonstandard signs will not be maintained by the County.

5.1.10.1.1. Street Name Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick (no polyplate allowed). Facing shall be green Hi-Intensity reflective sheeting with white Hi-Intensity reflective sheeting letters and numerals.

5.1.10.1.2. Regulatory and Warning Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .10 inches thick. Hi-Intensity reflective sheeting shall be used on all regulatory (i.e. stop, speed limit) and warning signs.

5.1.10.1.3. Sign Posts: All sign posts shall be two (2) inch by two (2) inch galvanized telespar tube with .120 inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, all sides over full length, ten (10) feet in length. U-posts are not allowed.

5.1.10.1.4. Sign Post Bases: All sign post bases shall be twist resistant mounting for telespar type post consisting of a steel angle (1/4" x 2 1/2" x 2 1/2" x 24") with a formed and welded steel plate (1/8" x 10" x 15"), used with a compression fit V-lock wedge of 1/8 inch galvanized steel. The wedge must have a one-half (1/2) inch hole drilled in one side for removal.

5.1.10.2. Pavement Marking: Specified pavement marking materials shall be used at locations as identified below.

5.1.10.2.1. 3M Stamark 5730 preformed plastic marking material or an approved equivalent shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes.

5.1.10.2.2. Preformed plastic marking material or reflectorized paint shall be used for all other pavement marking. Use of thermoplastic pavement marking is not permitted.

5.1.10.3. Curb Ramps: All required curb ramps shall conform to current CDOT M&S Standard Plans and be approved by Transportation and Engineering.

5.1.10.4. Bike Racks: All required bike racks shall conform to Association of Pedestrian and Bicycle Professionals “Essentials of Bike Parking: Selecting and Installing Bike Parking that Works”.

## 5.2 Construction Standards

All construction within County Right-of-Way and/or easements shall be in conformance with current CDOT M & S Standards and the following County construction standards.

Standard Number	Description
1	Curb and Gutter
2	Combination Curb, Gutter and Sidewalk
3	6" Vertical Curb, Gutter and Attached Sidewalk
4	6" Vertical Curb, Gutter and Detached Sidewalk
5	Typical Intersection Crossspan
6	Driveway Section for 6" Vertical Curb and Gutter
7	Optional Driveway Section for Combination Curb, Gutter and Sidewalk
8	Driveway Approaches for Roads
9	Typical Median Designs
10	Concrete Joint Details
11	Asphalt Street/Road Patchback
12	Road and Street Name Signs
13	Sign Posts and Bases
14	Typical Arterial Street Lighting
15	Street Name Sign and Bracket on Traffic Signal Pole
16	Zone 1 Foothills / Mountain Area Preliminary Pavement Design
17	Zone 2 Dipping Bedrock Area Preliminary Pavement Design
18	Zone 3 Front Range Area Preliminary Pavement Design
19	Design Zone Preliminary Pavement Sections

# Definitions

## AASHTO

American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, current edition.

## ADT

Average Daily Traffic

## Axle Load

The total load transmitted by all wheels on a single axle extending across the full width of the vehicle. Tandem axles 40 inches or less apart shall be considered as a single axle.

## California Bearing Ratio

A measure of the ability of a soil or aggregate to resist the transmission of a vertical load in a lateral direction.

## CDOT

Colorado Department of Transportation

## Emulsified Asphalt Treated Base

A base consisting of a mixture of mineral aggregate and emulsified asphalt spread on a prepared surface to support a surface course.

## Equivalent Single Axle Loads (ESAL)

A numerical factor that expresses the relationship of a given axle load to another axle load in terms of their effect on a serviceability of a pavement structure. All axle loads are equated in terms of the equivalent number of repetitions of an 18,000 pound single axle.

## 18k EDLA

18,000 pound single axle Equivalent Daily Load Applications (explained in “Axle Load” and “ESAL” above).

## Flexible Pavement

A pavement structure which maintains contact with and distributes loads to the subgrade and depends upon aggregate interlock, particle friction, and cohesion for stability.

## Flowline

The transition point between the gutter and the face of the curb. For a cross or valley pan, it is the center of the pan. Where no curb exists, the flowline will be considered the edge of the outside traveled lane.

## Grade

Rate or percent of change in slope, either ascending or descending from or along the highway. It is measured along the centerline of the highway or access.

## Lime Treated Subgrade

Subgrade consisting of a mixture of soil, hydrated lime and water, usually mixed in place and placed to support a pavement structure.

## MUTCD

The Manual on Uniform Traffic Control Devices and the Colorado Supplement, current editions.

## Mountains

Transportation Design and Construction Manual – Amended 12-17-19



See “Mountains” definition in the Zoning Resolution.

#### Passing Sight Distance

The visibility distance required to allow drivers to execute safe passing maneuvers in the opposing traffic lane of a two-lane, two-way highway.

#### Pavement Structure

The combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

- a. Subbase: The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.
- b. Base Course: The layer or layers of specified or selected material of designed thickness placed on a subbase or subgrade to support a surface course.
- c. Surface Course: The uppermost component of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called “Wearing Course”.

#### Plains

See “Plains” definition in the Zoning Resolution.

#### Plant Mixed Bituminous Base

A base consisting of mineral aggregate and bituminous material, mixed in a central plant, laid and compacted while hot, on a subbase or a subgrade, to support a surface course.

#### Plant Mixed Bituminous Pavement

A combination of mineral aggregate and bituminous material mixed in a central plant, laid and compacted while hot.

#### Regional Factor

A numerical factor expressed as a summation of the values assigned for precipitation, elevation, and drainage. This factor is used to adjust the structural number.

#### Roads

Public or private Rights-of-Way within the Mountain Area or as otherwise designated within this MANUAL.

#### Serviceability Index

A number indicative of the ability of the pavement to serve traffic at any particular time in its design life.

#### Signal Progression

Progressive movement of traffic at a planned rate of speed through adjacent signalized locations within a traffic control system without stopping.

#### Soil Support Value

A number which expresses the relative ability of a soil or aggregate mixture to support traffic loads through the pavement structure.

#### Speed Change Lane

A separate lane for the purpose of enabling a vehicle entering or leaving a roadway to increase (acceleration lane) or decrease (deceleration lane) its speed to a rate at which it can more safely merge or diverge with through traffic.

#### Stabilometer “R” Value

A numerical value expressing the ability of a soil or aggregate to resist the transmission of vertical load in a lateral or horizontal direction.

#### Stopping Sight Distance

The minimum sight distance necessary to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

#### Storage Lane

Additional lane footage added to a deceleration lane to store the maximum number of vehicles likely to accumulate during critical periods without interfering with the through lanes.

#### Streets

Public or private Rights-of-Way within the Plains Area or as otherwise designated within this MANUAL.

#### Strength Coefficient

A factor used for expressing the relative strength of each layer in a pavement structure.

#### Structural Number

A number derived from an analysis of roadbed and traffic conditions. A Weighted Structural Number is a Structural Number which has been adjusted for environmental conditions. A Weighted Structural Number may be converted to pavement structure thickness through the use of suitable factors related to the type of material being used in the pavement structure.

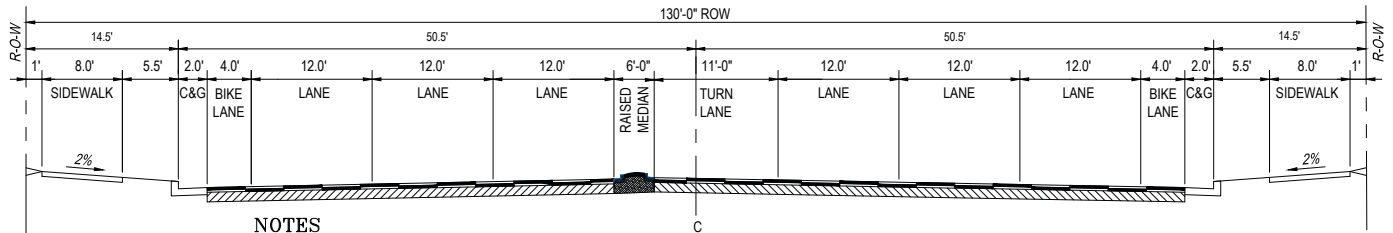
#### Traffic Analysis Period

A common analysis period (usually 20 years) used in geometric design.

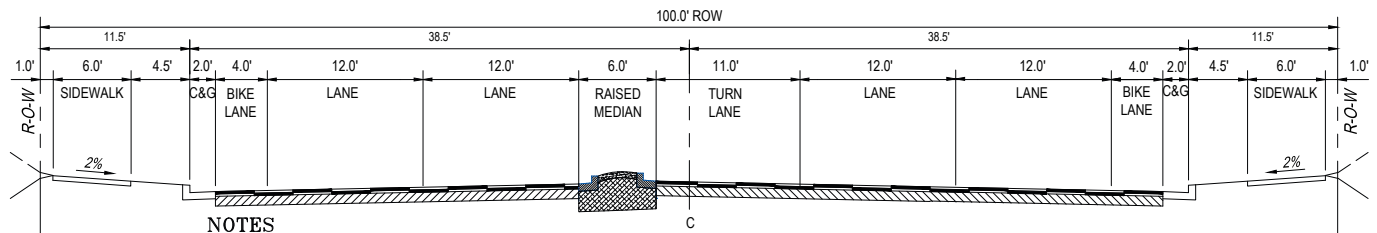
#### Untreated Base Course

A layer or layers of base course without treatment of any kind.

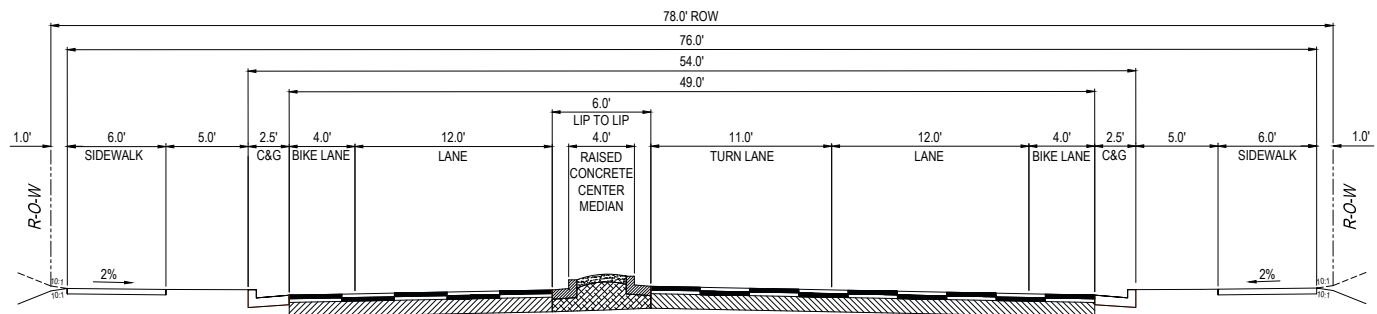
# Examples: Standard Templates



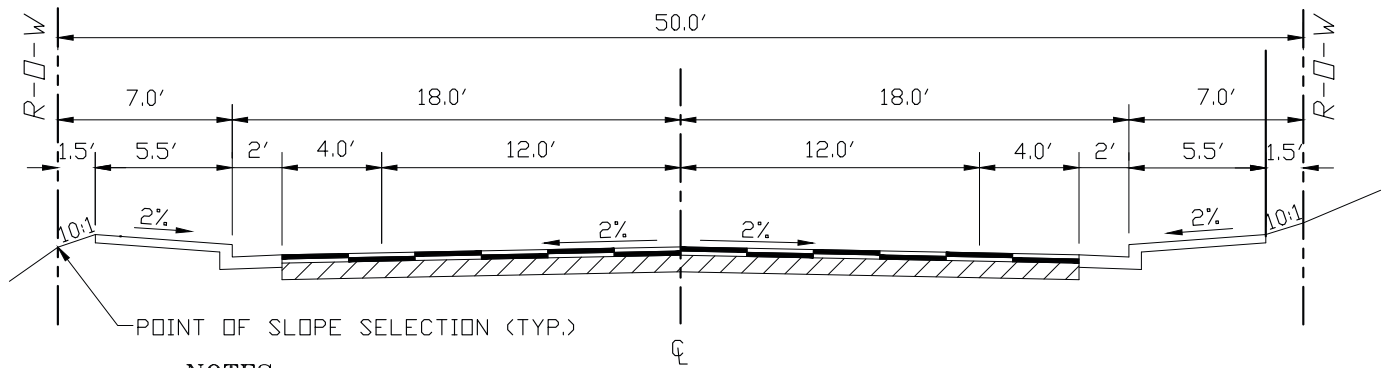
## File: Temp-1 Principal Arterial Street



## File: Temp-2 Minor Arterial Street



## File: Temp-3 Major Collector Street Alternate Controlled Access

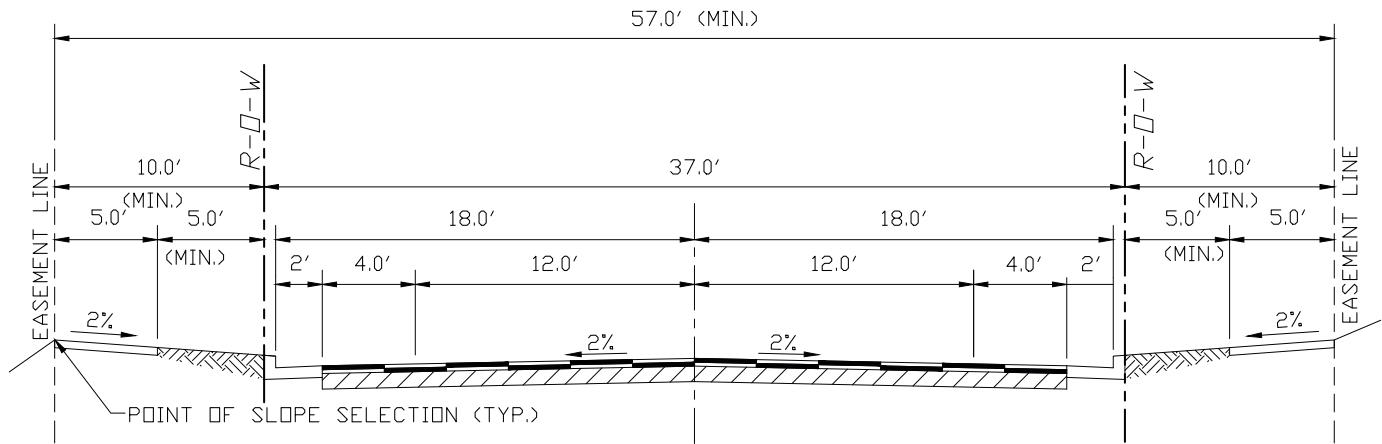


#### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS GREATER THAN 1,000 BUT LESS THAN 8,000.
2. ACCESS POINTS SHALL BE APPROVED BY THE JEFFERSON COUNTY PLANNING & ZONING.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED TO ACCOMMODATE ADDITIONAL PARKING, TURN LANES, CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. VERTICAL CURB REQUIRED.

File: Temp-4

### Collector Street (36' FL to FL) with Attached Sidewalks

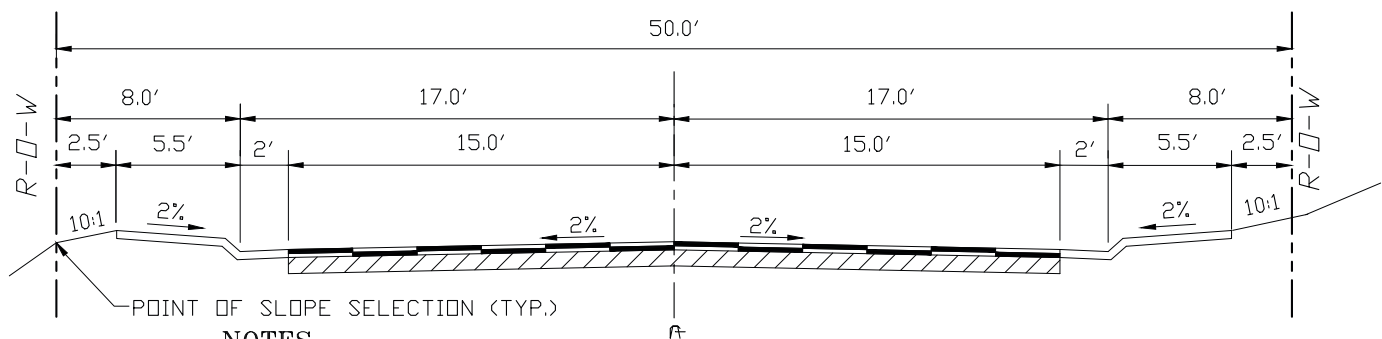


#### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS GREATER THAN 1,000 BUT LESS THAN 8,000.
2. ACCESS POINTS SHALL BE APPROVED BY THE JEFFERSON COUNTY DEPARTMENT OF PLANNING & ZONING.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED TO ACCOMMODATE ADDITIONAL PARKING, TURN LANES, CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. SIDEWALK MAY MEANDER WITHIN EASEMENTS.
5. VERTICAL CURB REQUIRED.

File: Temp-5

### Collector Street (36' FL to FL) with Detached Sidewalks

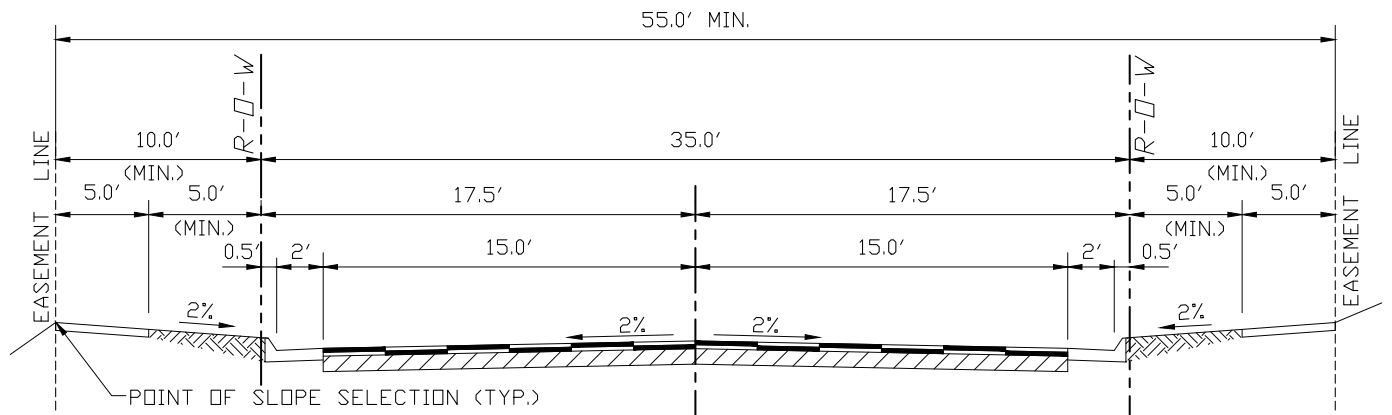


#### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS LESS THAN 1,000.
2. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
3. MOUNTABLE CURB ALLOWED.

File: Temp-6

### Local Street (34' FL to FL) with Attached Sidewalks

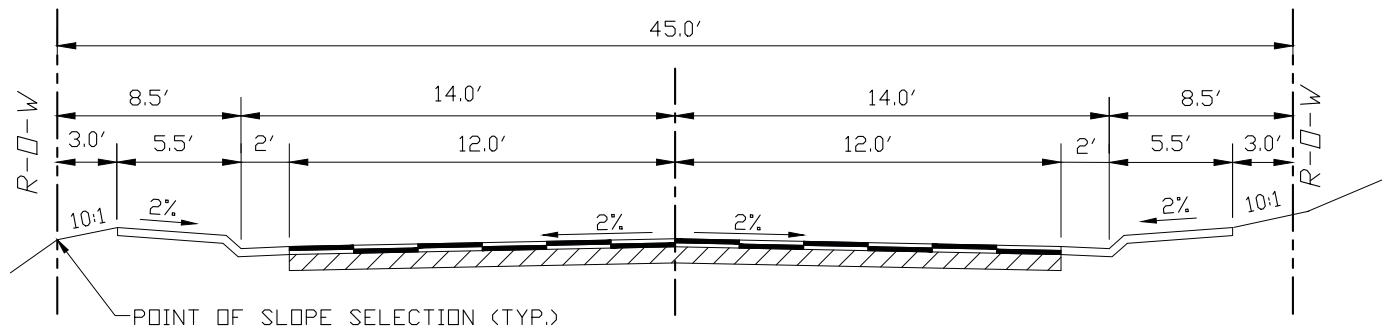


**NOTES**

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS LESS THAN 1,000.
2. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
3. MOUNTABLE CURB ALLOWED.

*File: Temp-7*

**Local Street (34' FL to FL) with Detached Sidewalks**

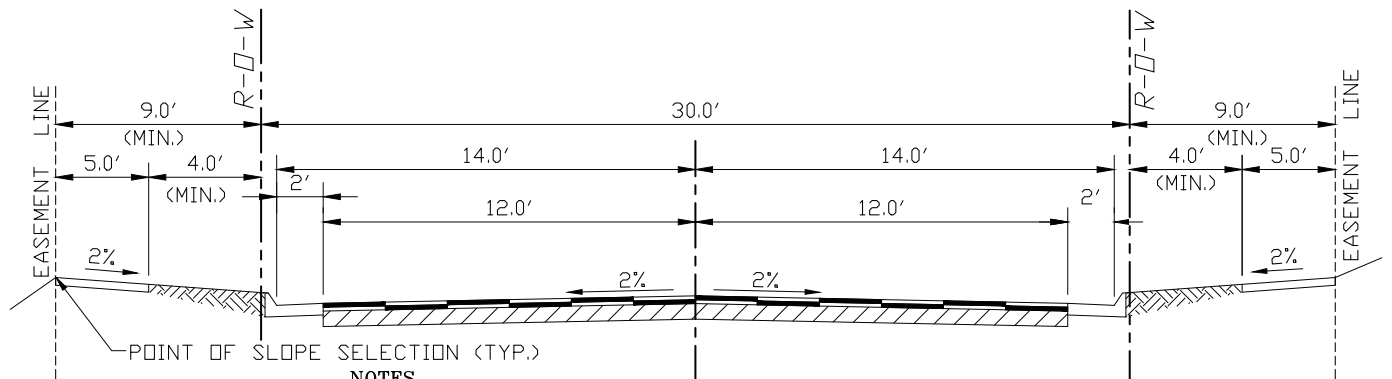


**NOTES**

1. THIS TEMPLATE MAY BE USED WHERE THE DESIGN ADT IS LESS THAN 350 SUBJECT TO APPROVAL BY PLANNING AND ZONING BASED ON SAFETY AND TRAFFIC OPERATIONS AND SPECIFIC SITE CONDITIONS.
2. A MINIMUM OF FOUR OFF-STREET PARKING SPACES PER DWELLING UNIT IS REQUIRED.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. ON STREET PARKING IS NOT PERMITTED.
5. MOUNTABLE CURB ALLOWED.

*File: Temp-8*

**Local Street (28' FL to FL) with Attached Sidewalks**

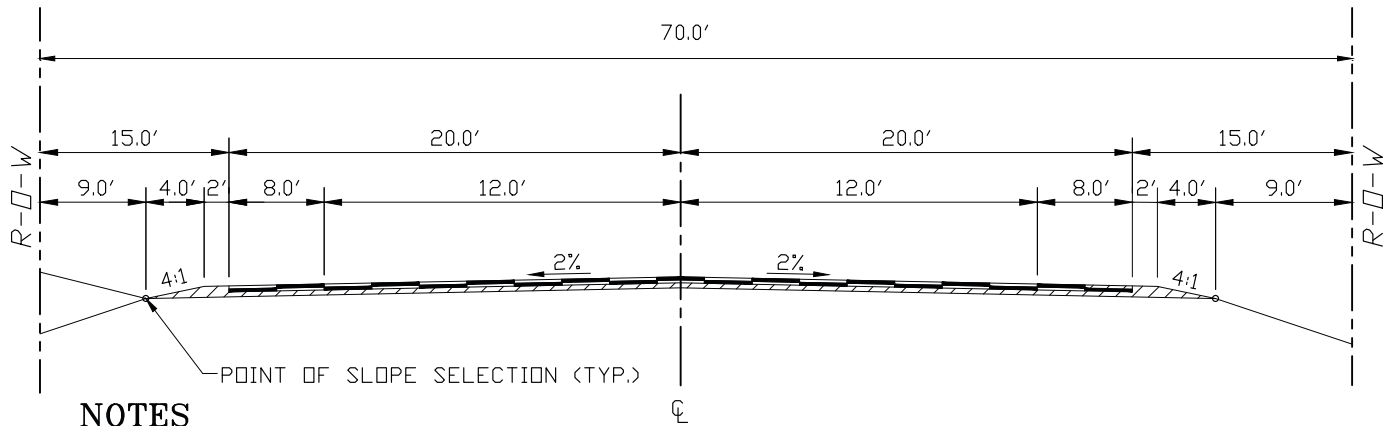


**NOTES**

1. THIS TEMPLATE MAY BE USED WHERE THE DESIGN ADT IS LESS THAN 350 SUBJECT TO APPROVAL BY PLANNING AND ZONING BASED ON SAFETY AND TRAFFIC OPERATIONS AND SPECIFIC SITE CONDITIONS.
2. A MINIMUM OF FOUR OFF-STREET PARKING SPACES PER DWELLING UNIT IS REQUIRED.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. ON STREET PARKING IS NOT PERMITTED.
5. VERTICAL CURB REQUIRED.

*File: Temp-9*

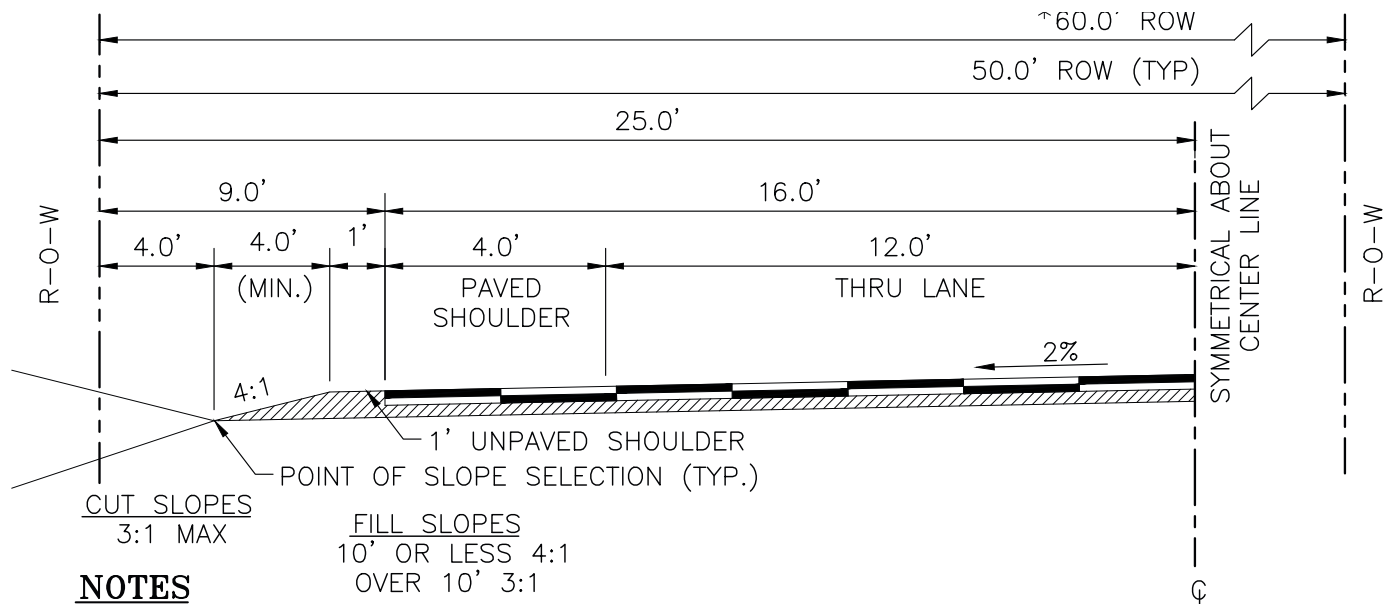
**Local Street (28' FL to FL) with Detached Sidewalks**



### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS GREATER THAN 8,000.
2. INTERSECTION DESIGN AND ACCESS POINTS SHALL BE APPROVED BY JEFFERSON COUNTY PLANNING & ZONING. ACCELERATION/DECELERATION, LEFT TURN AND/OR CLIMBING LANES MAY BE REQUIRED AND WILL NECESSITATE ADDITIONAL RIGHT-OF-WAY.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. GUARDRAIL MAY BE REQUIRED DEPENDING ON FILL SLOPE HEIGHT/SLOPE AND/OR PRESENCE OF OTHER HAZARDS. SEE SECTION 3.10.1.

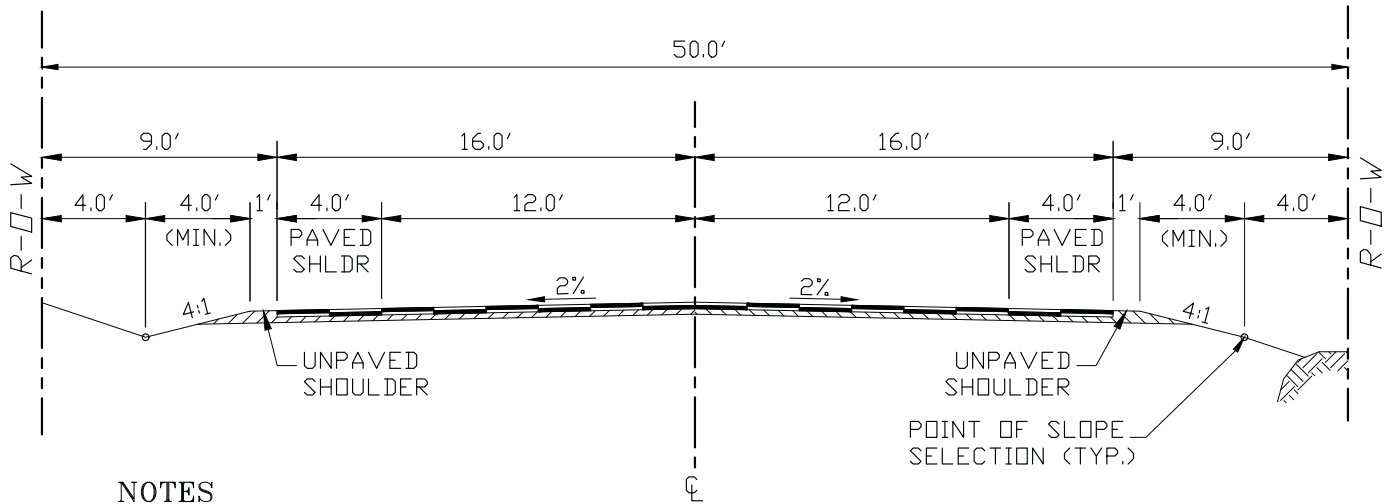
*File: Temp-10*  
**Minor Arterial Road**



### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS GREATER THAN 2,000 BUT LESS THAN 8,000.
- \*2. INTERSECTION DESIGN AND ACCESS POINTS SHALL BE APPROVED BY JEFFERSON COUNTY PLANNING & ZONING. ACCELERATION/DECELERATION, LEFT TURN AND/OR CLIMBING LANES MAY BE REQUIRED AND WILL NECESSITATE ADDITIONAL RIGHT-OF-WAY.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. GUARDRAIL MAY BE REQUIRED DEPENDING ON FILL SLOPE HEIGHT/SLOPE AND/OR PRESENCE OF OTHER HAZARDS. SEE SECTION 3.10.1.

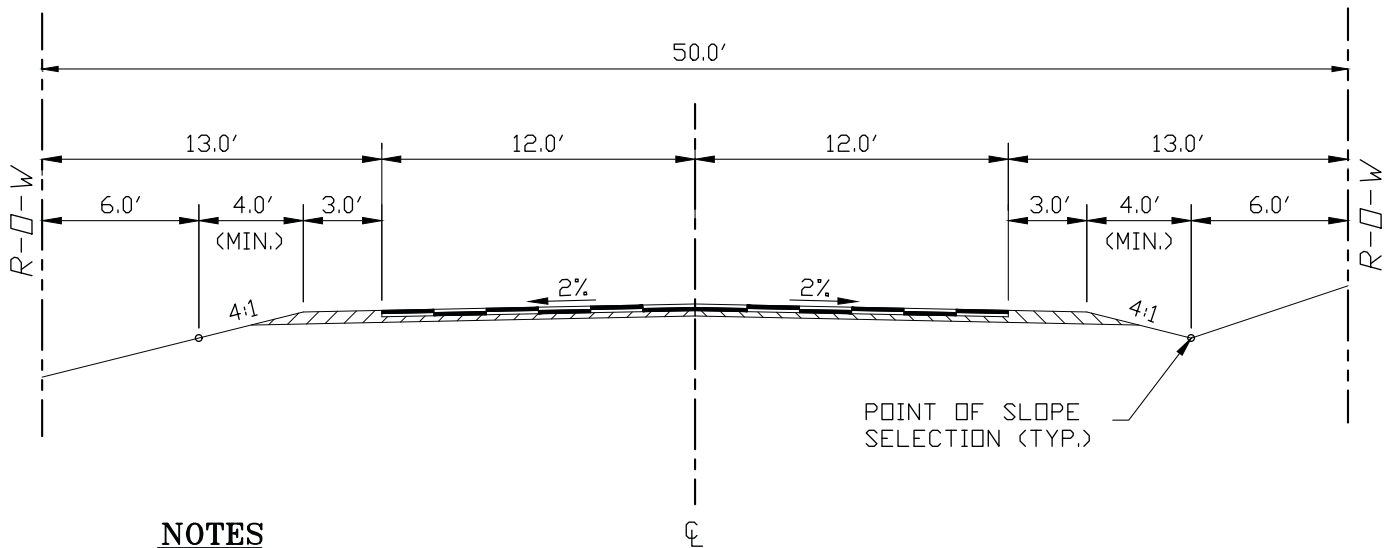
*File: Temp-11*  
**Major Collector Road**



### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS GREATER THAN 1,000 BUT LESS THAN 2,000.
2. ACCESS POINTS SHALL BE APPROVED BY THE JEFFERSON COUNTY PLANNING & ZONING.
3. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. GUARDRAIL MAY BE REQUIRED DEPENDING ON FILL SLOPE HEIGHT/SLOPE AND/OR PRESENCE OF OTHER HAZARDS. SEE SECTION 3.10.1.

### File: Temp-12 Collector Road

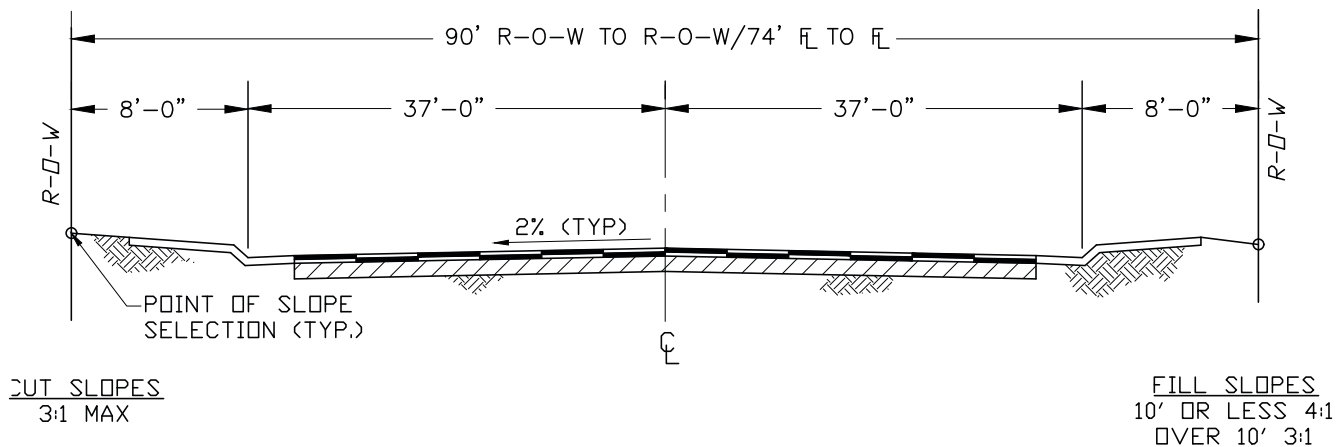
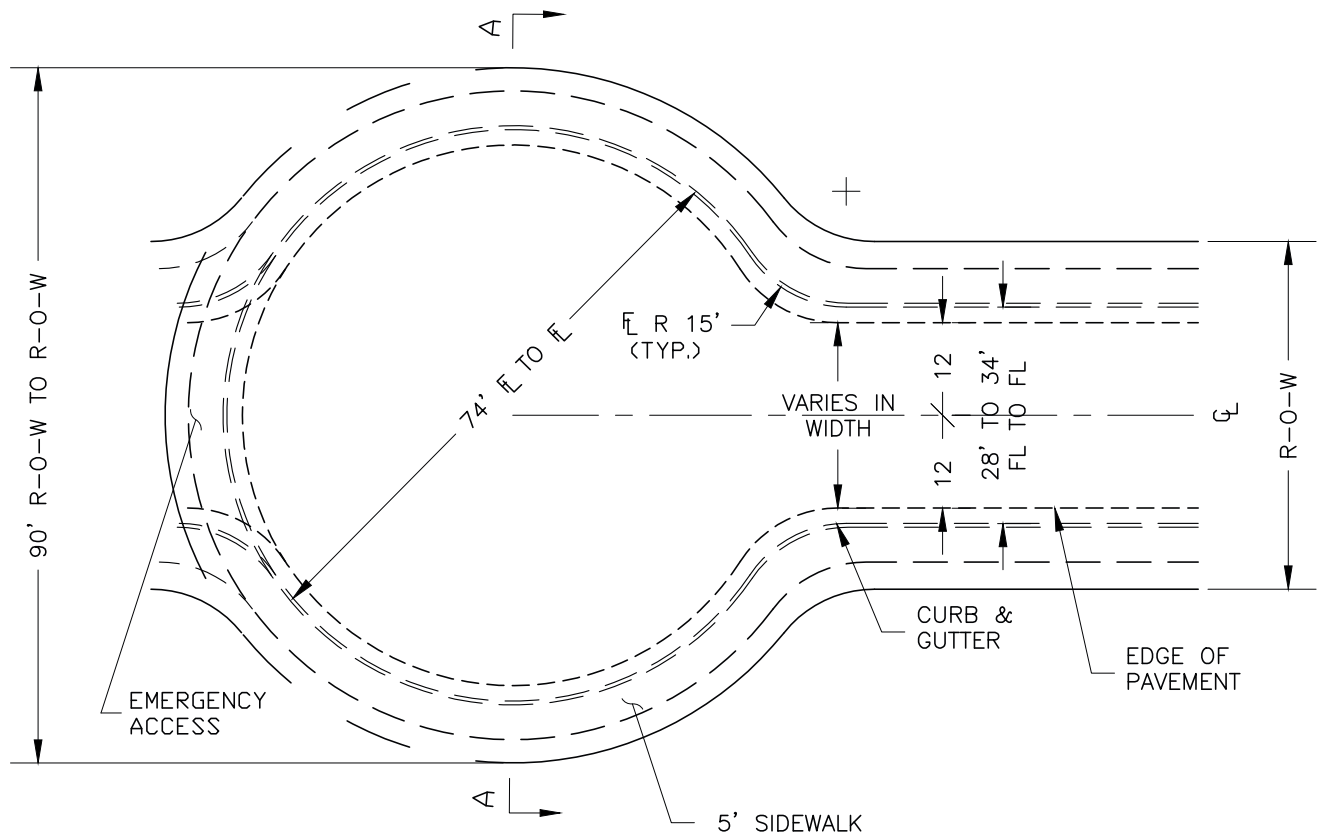


### NOTES

1. THIS TEMPLATE SHALL BE USED WHERE THE DESIGN ADT IS LESS THAN 1,000.
2. ADDITIONAL RIGHTS-OF-WAY/EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
3. GUARDRAIL MAY BE REQUIRED DEPENDING ON FILL SLOPE HEIGHT/SLOPE AND/OR PRESENCE OF OTHER HAZARDS. SEE SECTION 3.10.1.

### File: Temp-13 Local Road





## SECTION A - A 74' FL to FL

### NOTE:

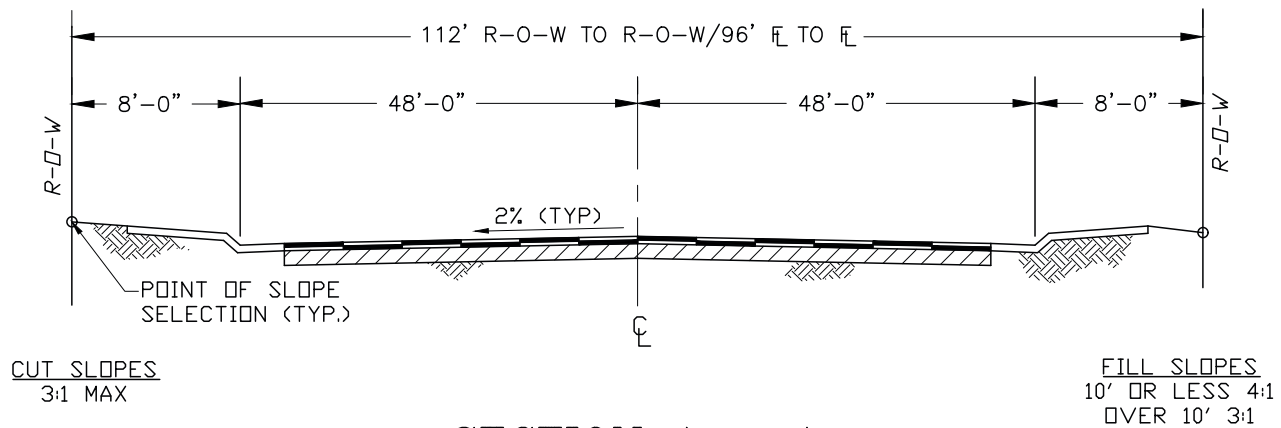
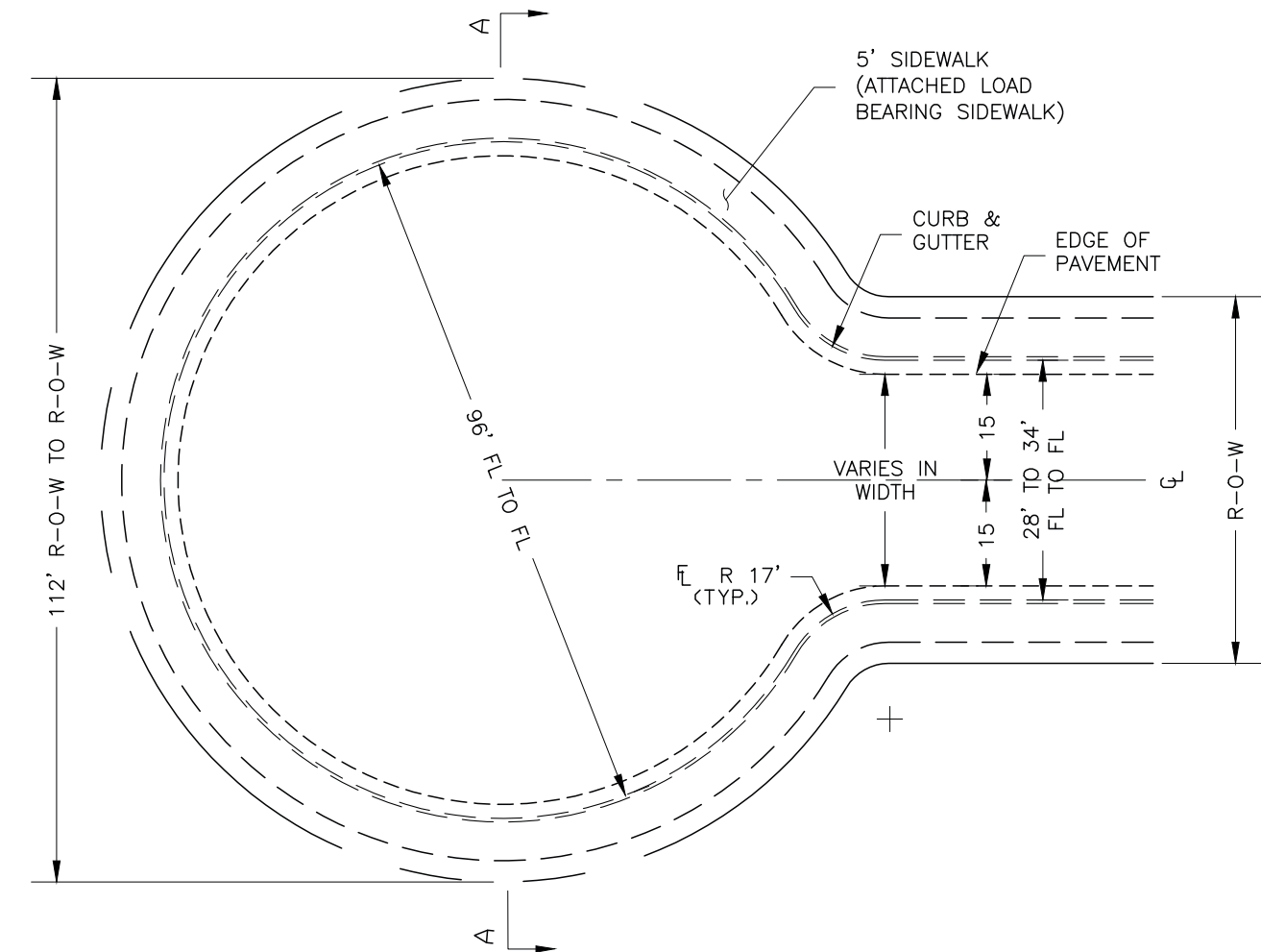
1. SIDEWALK MAY BE DETACHED AS SHOWN ON TEMPLATES 7 AND 9
2. THE FLOWLINE TO FLOWLINE DISTANCE OF 74' AND ON-STREET PARKING IS ALLOWED IF THERE IS EMERGENCY ACCESS CONNECTED TO THE CUL-DE-SAC THAT IS ACCEPTABLE TO THE APPROPRIATE FIRE PROTECTION DISTRICT.

Note: Other than Option 1 shown hereon, alternate standards for cul-de-sacs (Options 2 and 3, File: Temp- 14) shall be appropriate fire protection district.

File: Temp-14

## Street Cul-de-sac - Option 1





## SECTION A - A

### 96' FL to FL

#### NOTE:

1. SIDEWALK MAY BE DETACHED AS SHOWN ON TEMPLATES 7 AND 9
2. A MINIMUM OF FOUR OFF-SITE STREET PARKING SPACES PER DWELLING UNIT IS REQUIRED AND ON-STREET PARKING IS NOT PERMITTED.

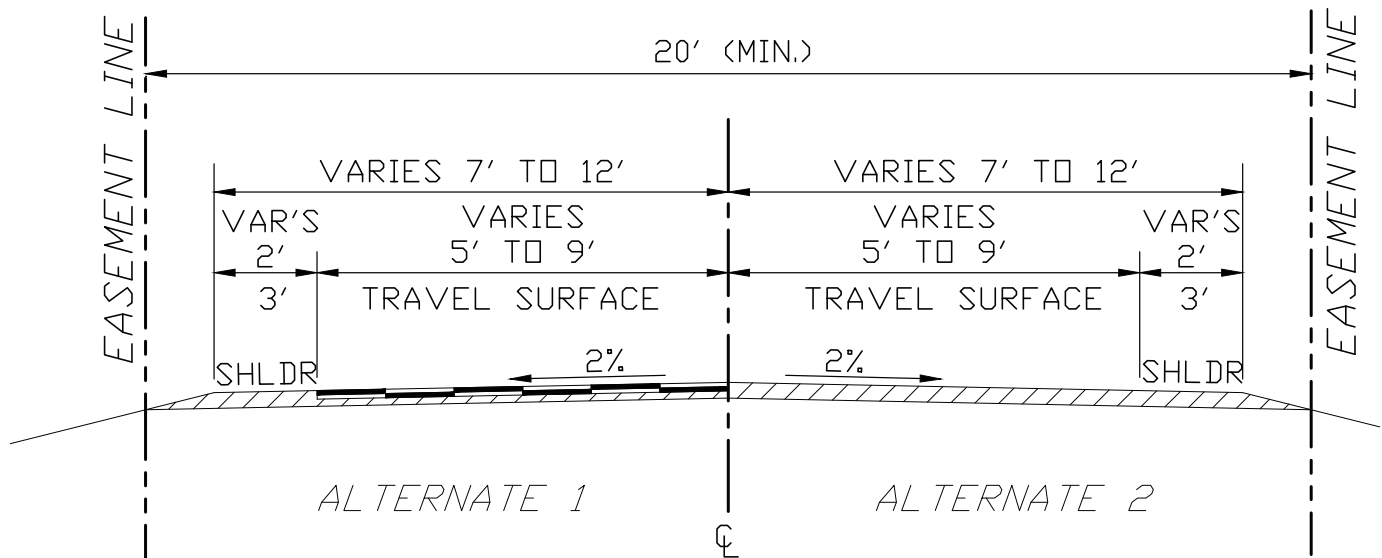
File: Temp-14

### Cul-de-sac for Local Streets - Option 3







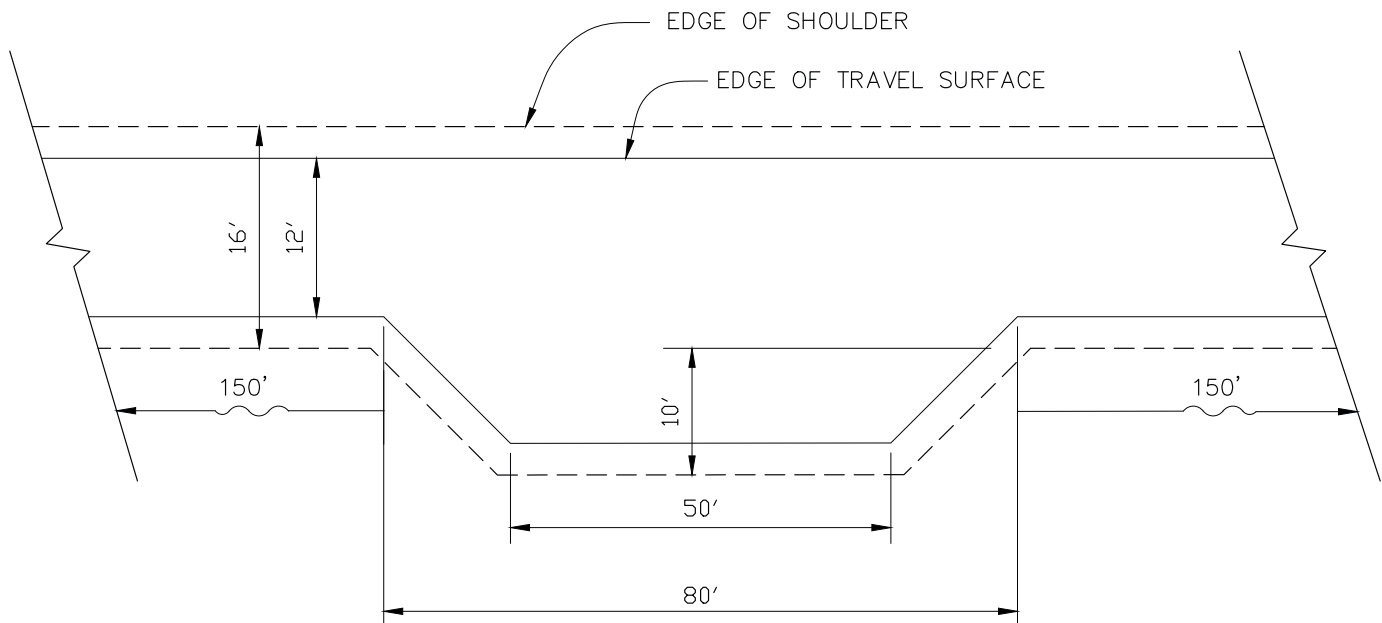


#### NOTES

1. ALTERNATE 1 (PAVED SURFACE) IS REQUIRED FOR PRIVATE STREETS/ROADS SUBJECT TO THE LAND DEVELOPMENT REGULATIONS.
2. ALTERNATE 2 (ALL WEATHER SURFACE) IS PERMITTED FOR DRIVEWAYS AND FOR PRIVATE STREETS/ROADS SUBJECT TO THE LAND DEVELOPMENT REGULATIONS.
3. ADDITIONAL EASEMENTS MAY BE REQUIRED FOR CUT AND FILL SLOPES, DRAINAGE STRUCTURES AND MAINTENANCE.
4. CURB AND GUTTER AND/OR DITCHES ARE REQUIRED FOR PRIVATE STREETS SUBJECT TO THE LAND DEVELOPMENT REGULATION.
5. SEE SECTION 3.7.8 FOR ADDITIONAL DESIGN CRITERIA.
6. DRIVEWAYS LONGER THAN 150 FEET ARE REQUIRED TO HAVE 12 FOOT WIDE TRAVEL SURFACE WITH 2 FOOT WIDE SHOULDERS ON BOTH SIDES.
7. ON STREET/ROAD PARKING IS NOT PERMITTED.

File: Temp-18

### Driveway/Private Street/Road & Non-Maintained Street/Road in County ROW



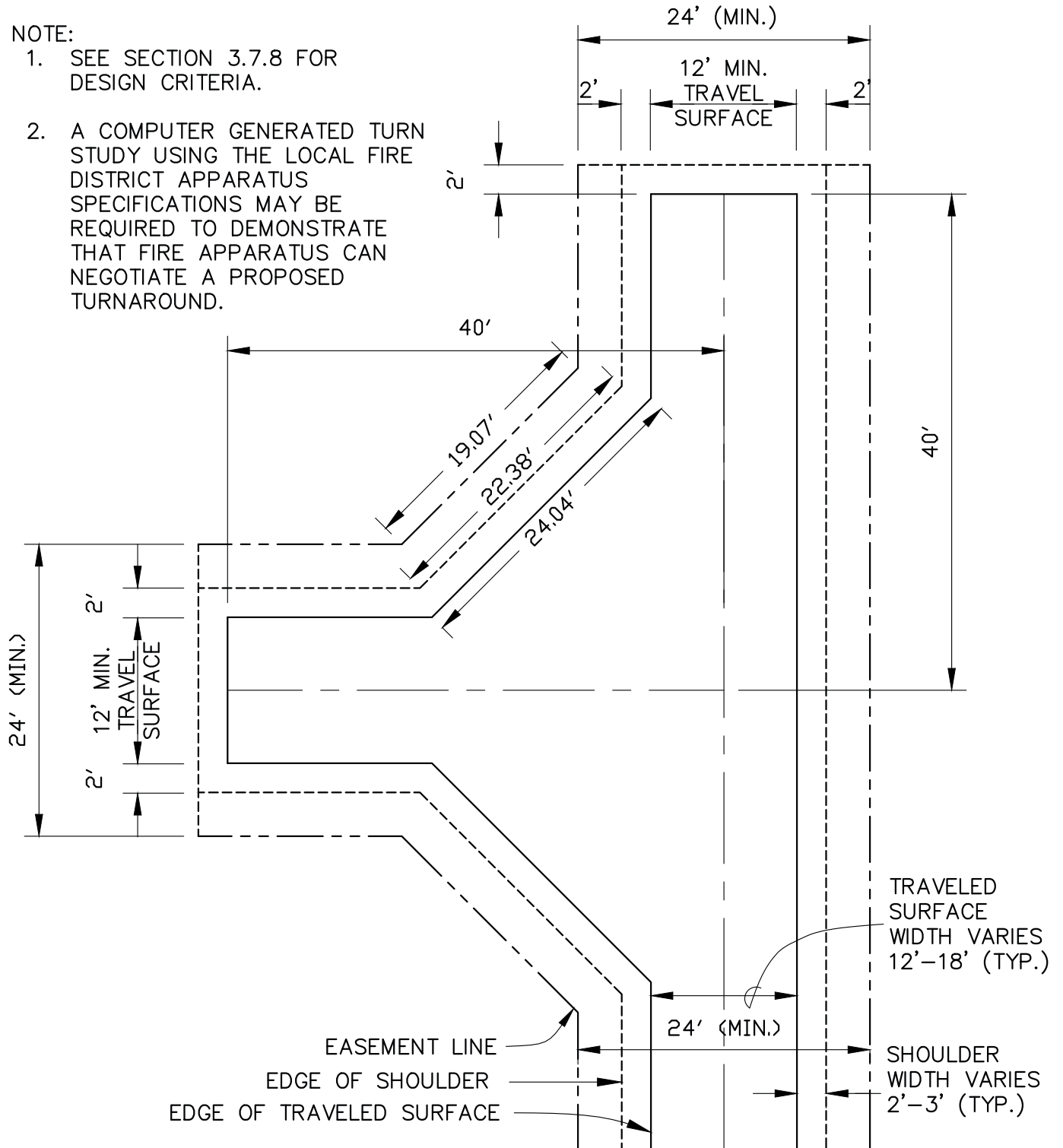
File: Temp-19

### Pull Out for Private Road



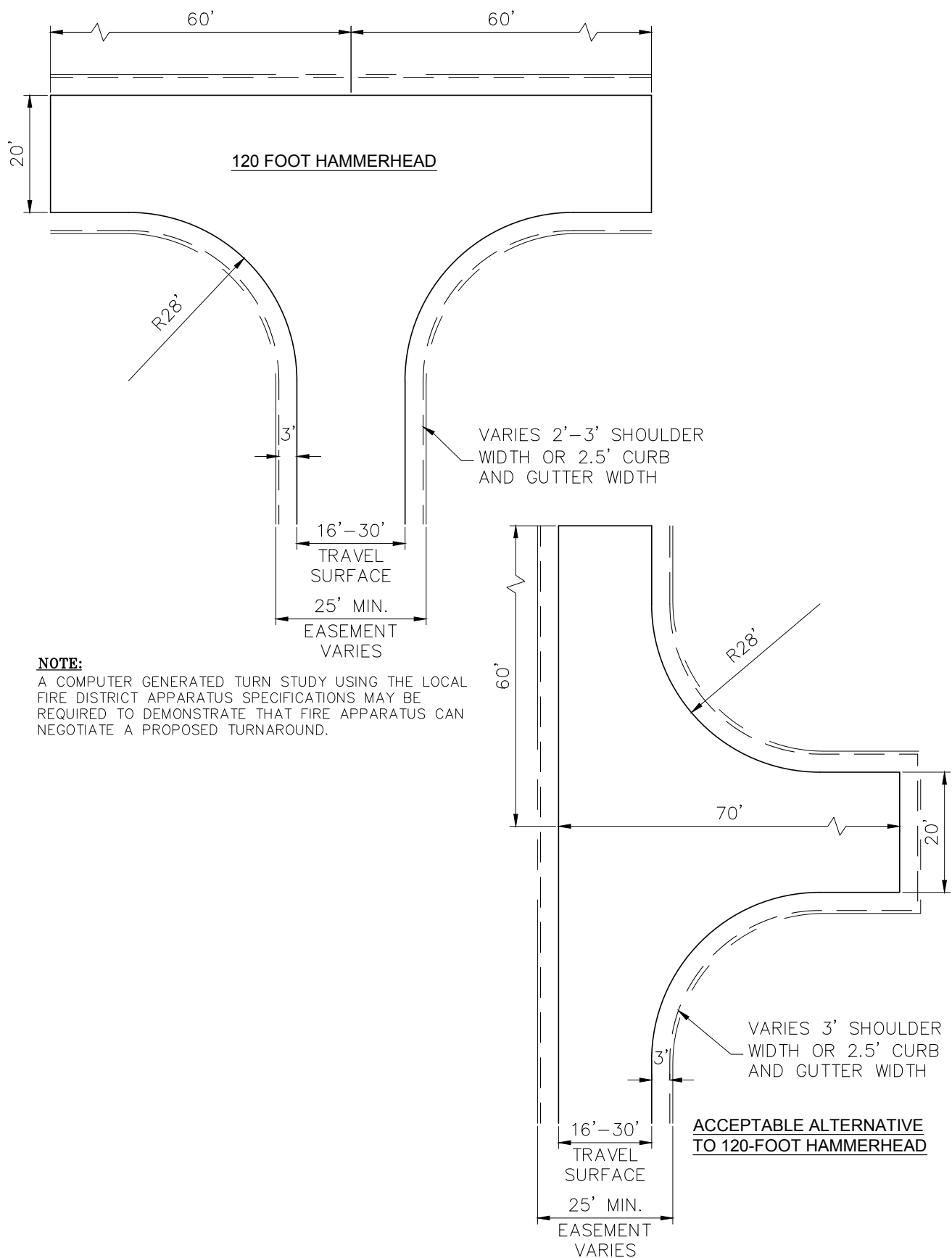
NOTE:

1. SEE SECTION 3.7.8 FOR DESIGN CRITERIA.
2. A COMPUTER GENERATED TURN STUDY USING THE LOCAL FIRE DISTRICT APPARATUS SPECIFICATIONS MAY BE REQUIRED TO DEMONSTRATE THAT FIRE APPARATUS CAN NEGOTIATE A PROPOSED TURNAROUND.



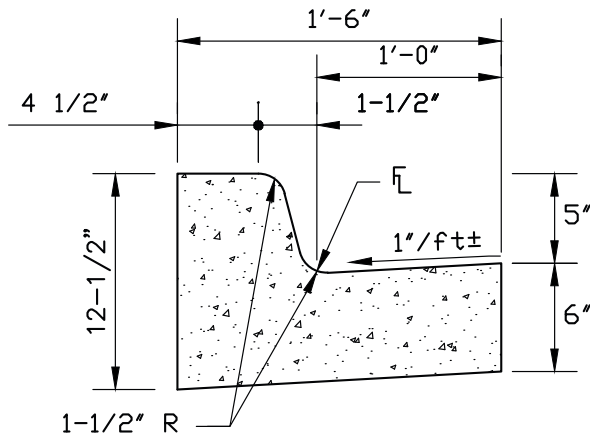
File: Temp-20

## Hammerhead Turnaround for Driveway/Private Road



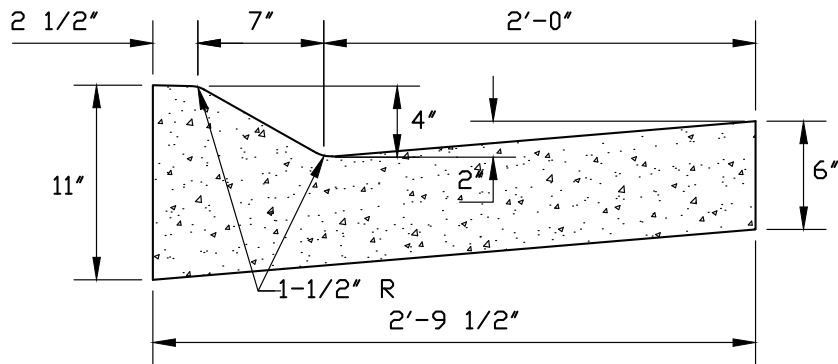
File: Temp-21  
**Hammerhead Turnaround for Private Street**

# Examples: Construction Standards



\* 6" VERTICAL CURB WITH 1' GUTTER IS REQUIRED FOR ALL RAISED MEDIANS.

## 6" VERTICAL CURB WITH 1' GUTTER

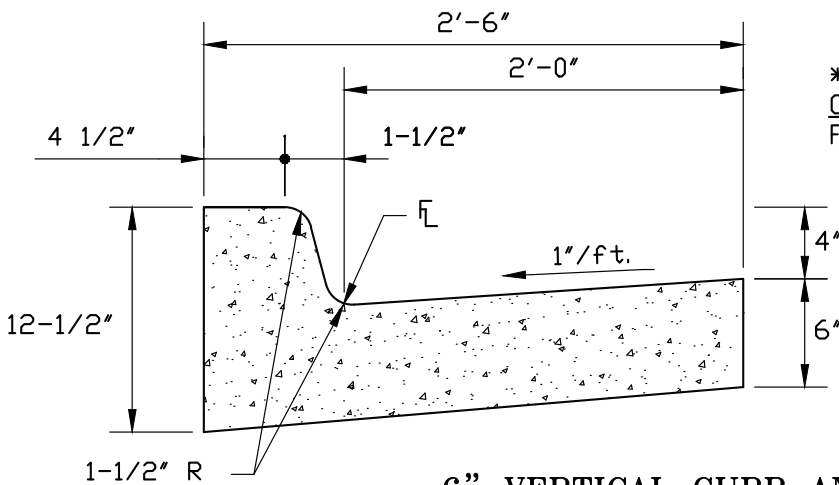


\* SEE STANDARD NO. 10 FOR CONCRETE JOINT DETAILS

\* ANY CURB TRANSITION FROM COMBINATION CURB, GUTTER AND SIDEWALK TO 6" VERTICAL CURB AND GUTTER SHALL TAKE PLACE IN A MINIMUM OF 12 FEET.

\* COMBINATION CURB, GUTTER, AND SIDEWALK IS REQUIRED FOR LOCAL STREETS.

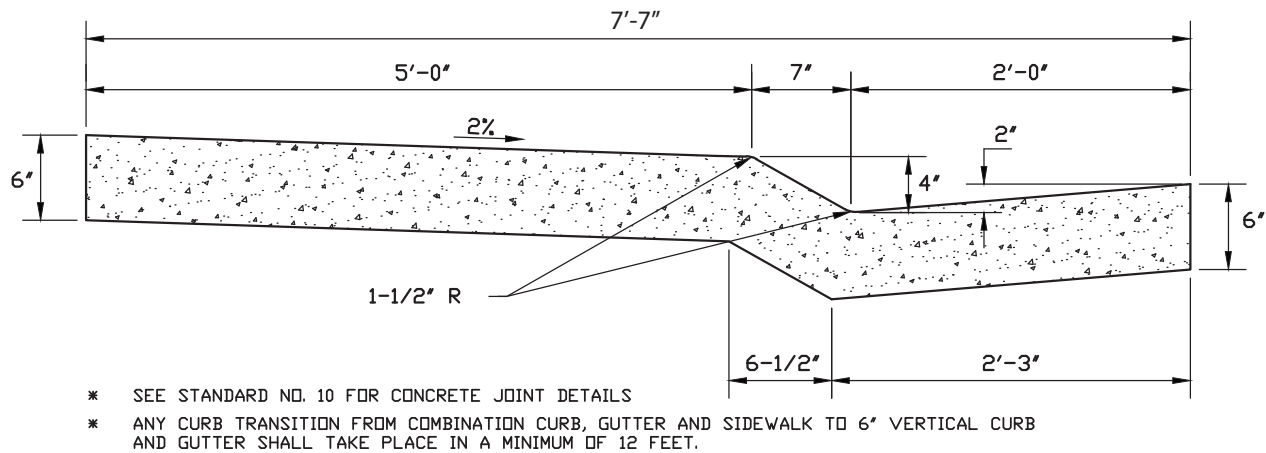
## MOUNTABLE CURB & GUTTER



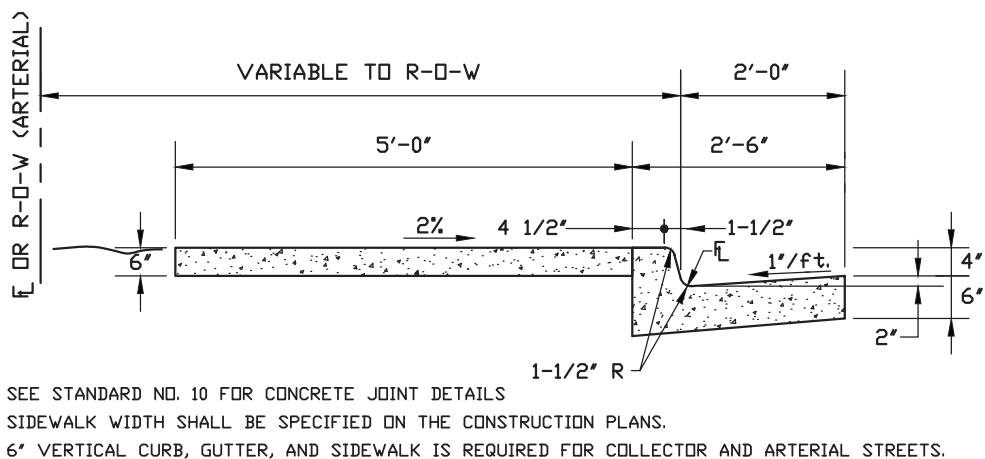
\* SEE STANDARD NO. 10 FOR CONCRETE JOINT DETAILS FOR ALL CURB AND GUTTER.

## 6" VERTICAL CURB AND GUTTER

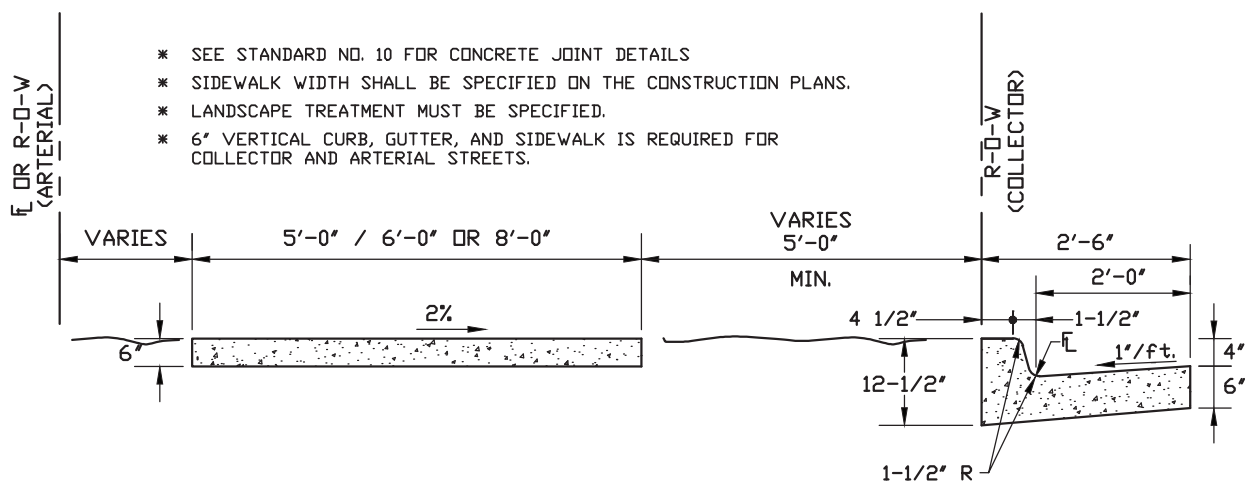
File: Stand-1  
**Curb and Gutter**



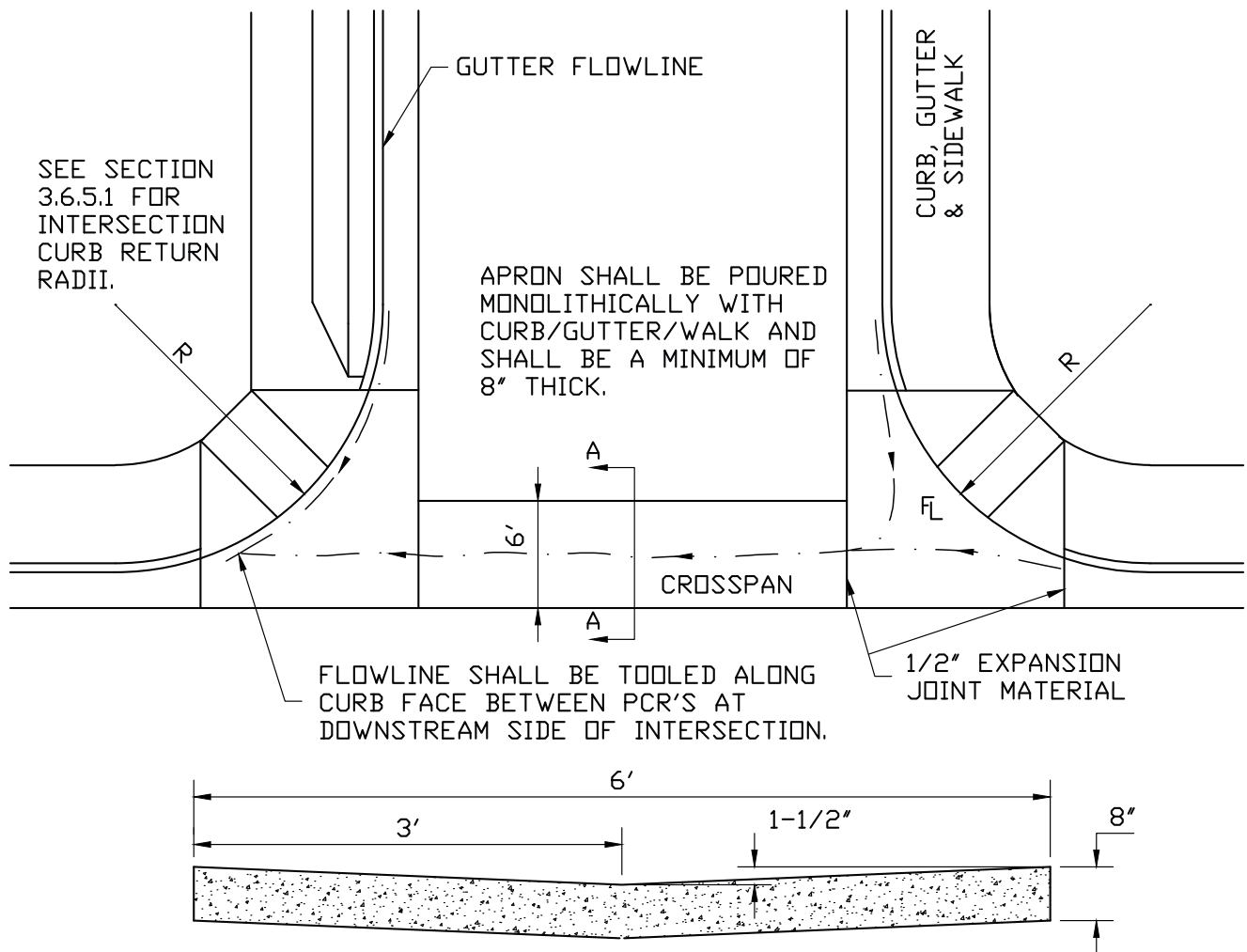
File: Stand-2  
**Combination Curb, Gutter and Sidewalk**



File: Stand-3  
**6" Vertical Curb, Gutter and Attached Sidewalk**



File: Stand-4  
**6" Vertical Curb, Gutter and Detached Sidewalk**



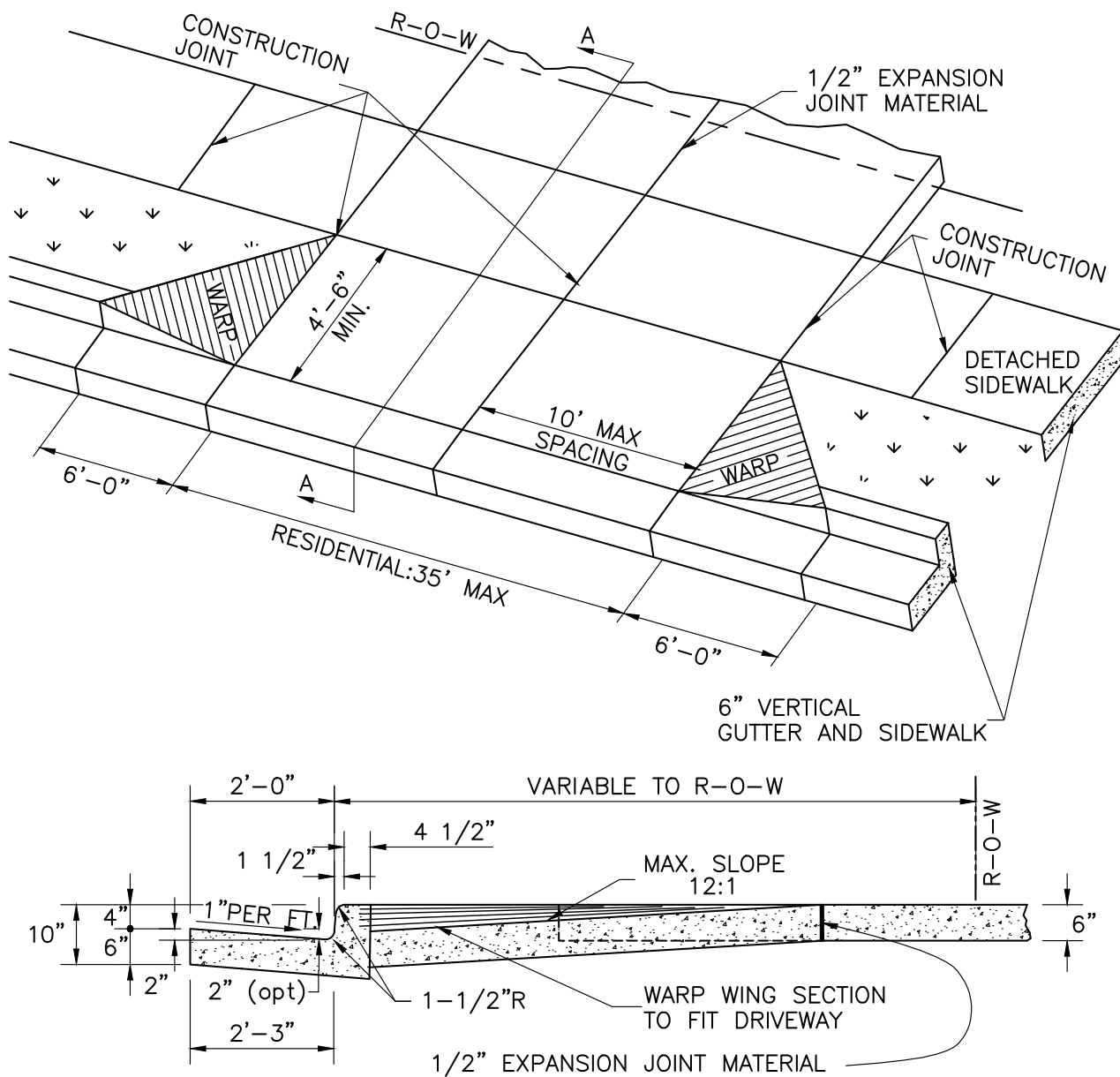
### SECTION A - A 6 FOOT CROSSSPAN

#### NOTE:

- \* SEE STANDARD NO. 10 FOR CONCRETE JOINT DETAILS.
- \* EXPANSION JOINTS ARE REQUIRED AT P.C.R.'S.
- \* CROSSPANS ARE NOT PERMITTED ACROSS ARTERIAL/COLLECTOR STREETS.

*File: Stand-5*

#### **Typical Intersection Crossspan**

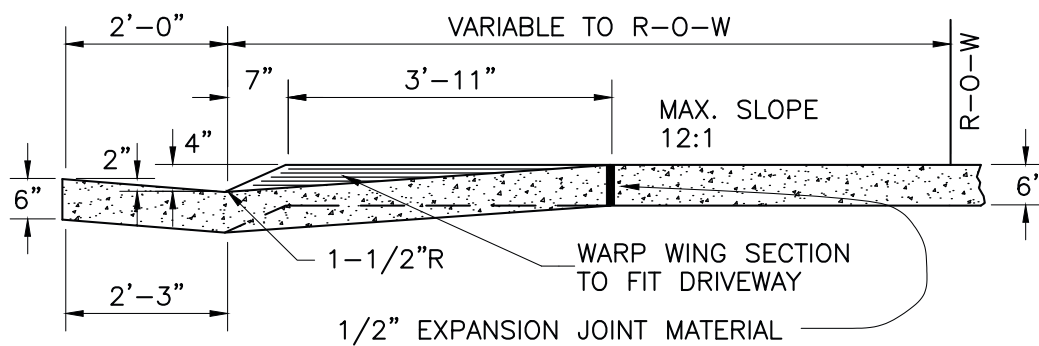
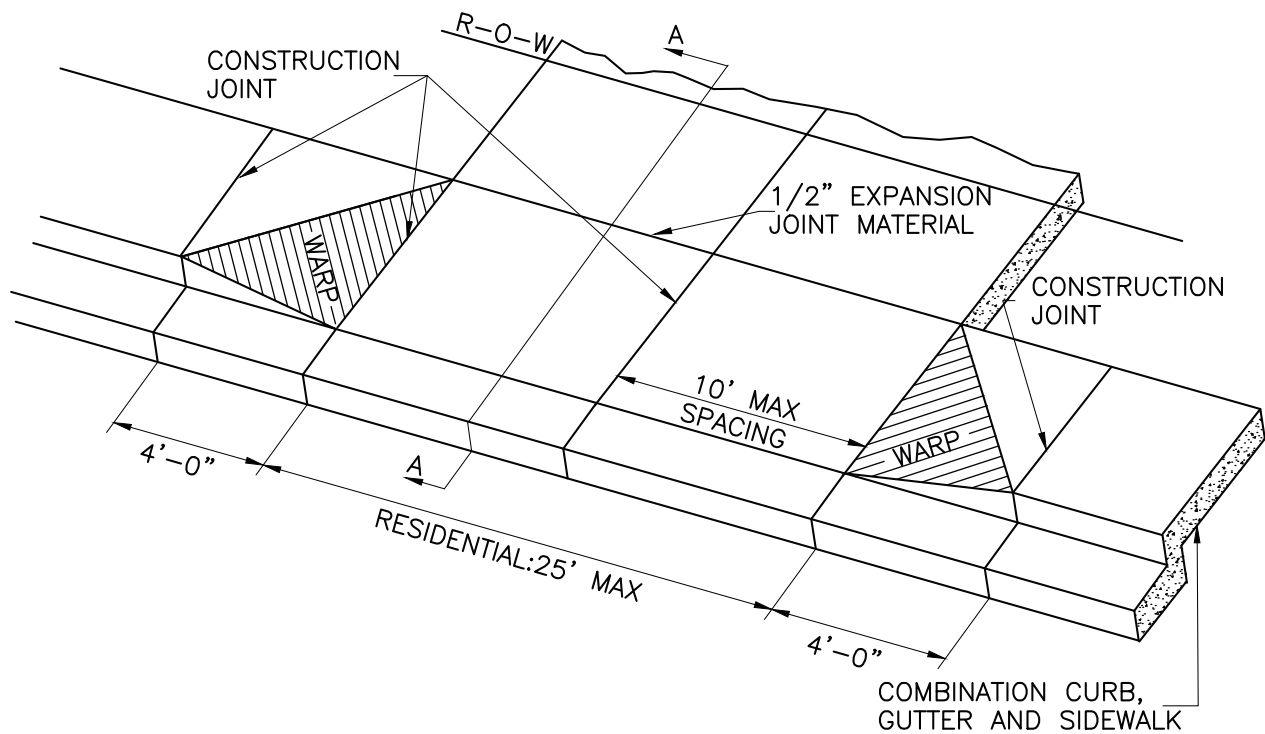


**NOTE:**                      **SECTION A - A**

- \* THIS STANDARD IS NOT ALLOWED ON ARTERIAL STREETS.
- \* REFER TO DRIVEWAY INTERSECTION SPACING REQUIREMENTS IN THIS MANUAL.
- \* SEE STANDARD NO. 10 FOR CONCRETE JOINT DETAILS.

*File: Stand-6*

**Driveway Section for 6" Vertical Curb & Gutter**



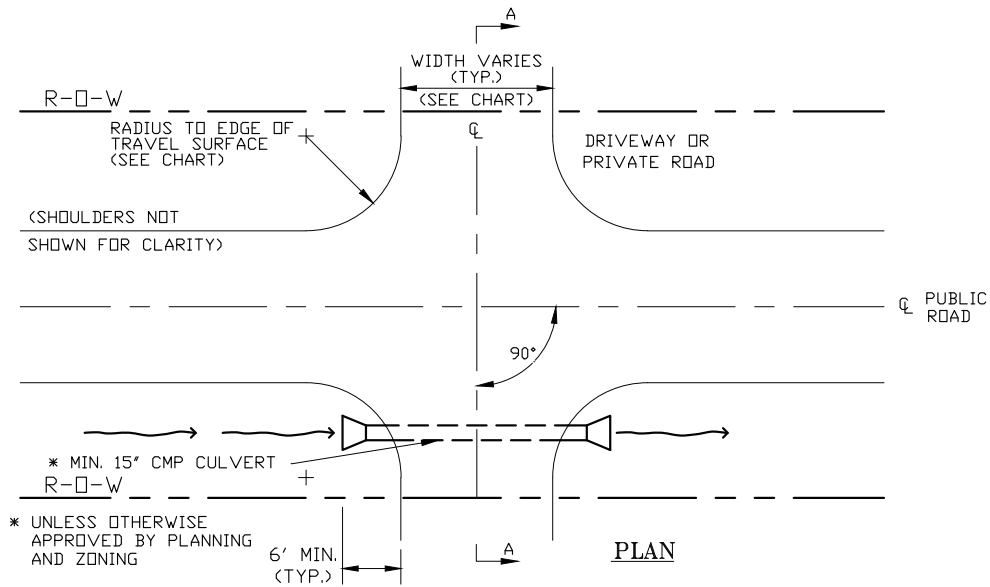
### SECTION A - A

#### NOTE:

- \* REFER TO DRIVEWAY SPACING REQUIREMENTS IN THIS MANUAL.
- \* WARPED WING SECTION SHALL EXTEND FROM FLOWLINE TO THE BACK OF SIDEWALK.
- \* SEE STANDARD NO. 10 FOR CONCRETE JOINT DETAILS.

*File: Stand-7*

### **Optional Driveway Section for Combination Curb, Gutter & Sidewalk**

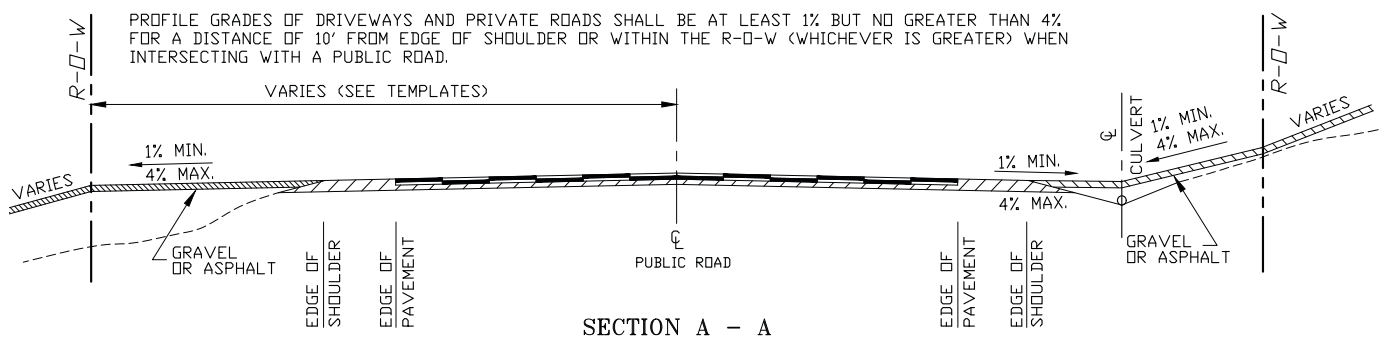


DRIVEWAYS AND PRIVATE ROADS SHALL INTERSECT WITH PUBLIC ROADS AT RIGHT (90°) ANGLES OR AS NEARLY AT RIGHT ANGLES AS POSSIBLE FOR A DISTANCE OF:

- 25' FROM THE TRAVEL SURFACE OR WITHIN THE R-O-W (WHICHEVER IS GREATER) WHEN INTERSECTING WITH A MAJOR COLLECTOR OR ARTERIAL ROAD, OR
- 15' FROM THE TRAVEL SURFACE OR WITHIN THE R-O-W (WHICHEVER IS GREATER) WHEN INTERSECTING WITH A COLLECTOR OR LOCAL ROAD.

	TRAVEL SURFACE	
	WIDTH (FEET)	RADIUS (FEET)
DRIVEWAY	10	10
PRIVATE ROAD	16-18	15

- \* AN ACCESS PERMIT FROM THE JEFFERSON COUNTY PLANNING & ZONING IS REQUIRED FOR A NEW OR MODIFICATION TO AN EXISTING DRIVEWAY OR PRIVATE ROAD ACCESSING A COUNTY ROAD.

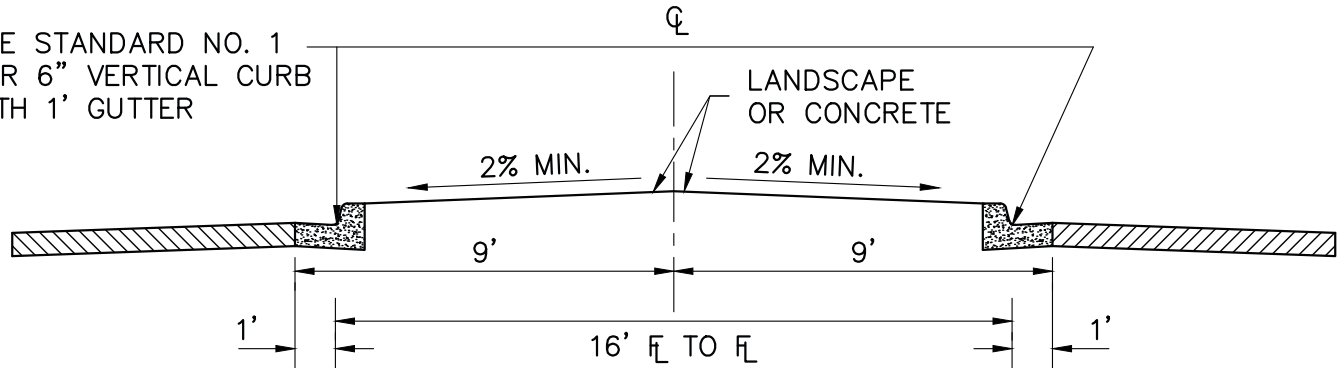


File: Stand-8

## Driveway/Private Road Approaches for Roads

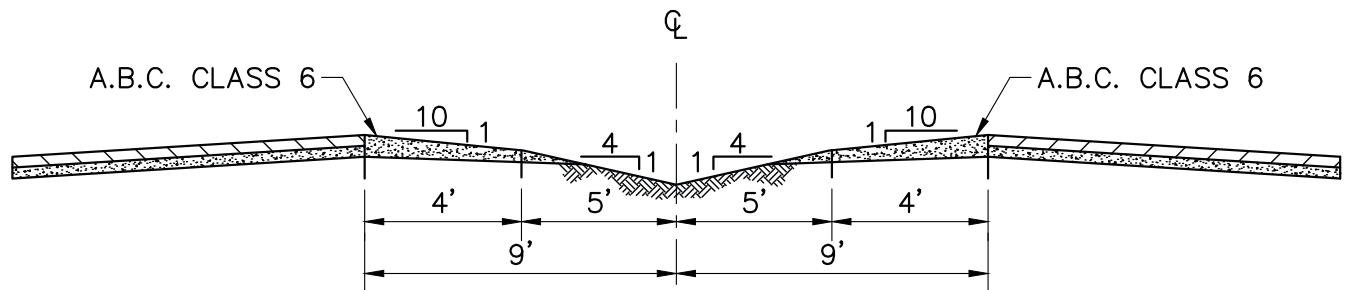


SEE STANDARD NO. 1  
FOR 6" VERTICAL CURB  
WITH 1' GUTTER



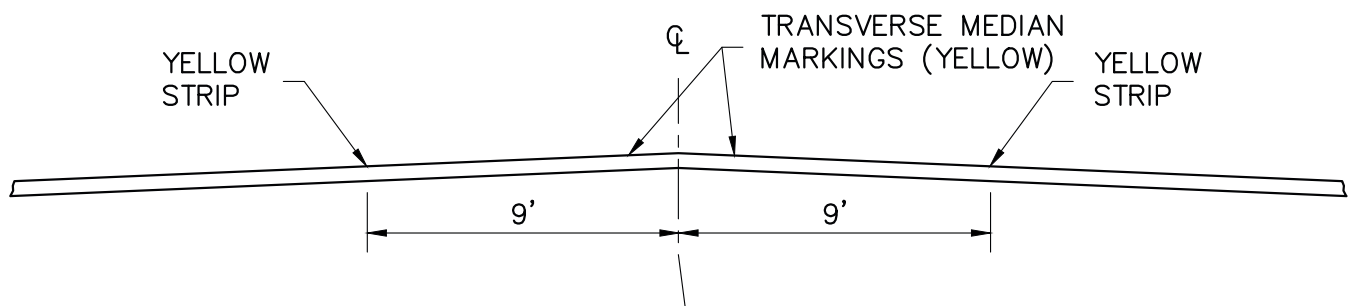
### RAISED MEDIAN

- \* MEDIAN TREATMENT SHALL BE APPROVED BY PLANNING AND ZONING.
- \* SOIL SHALL BE STERILIZED BENEATH RAISED MEDIANS WITH CONCRETE TREATMENTS.
- \* CURB INLETS AND STORM SEWER SHALL BE PROVIDED TO DRAIN ALL RAISED MEDIANS.



### DEPRESSED MEDIAN

- \* MEDIAN TREATMENT SHALL BE APPROVED BY PLANNING AND ZONING.
- \* DRAINAGE SYSTEMS SHALL BE PROVIDED FOR IRRIGATED MEDIANS.

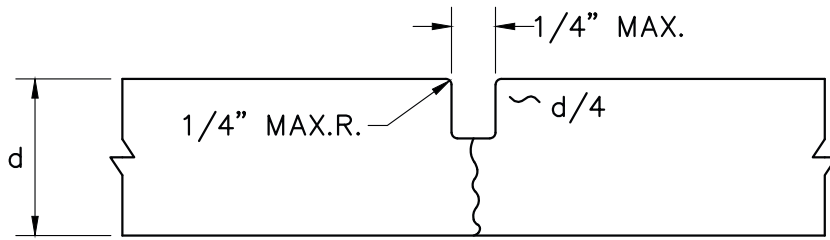


### PAVED, FLUSH MEDIAN

- \* REFER TO CURRENT EDITION OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR ADDITIONAL STRIPING INFORMATION.

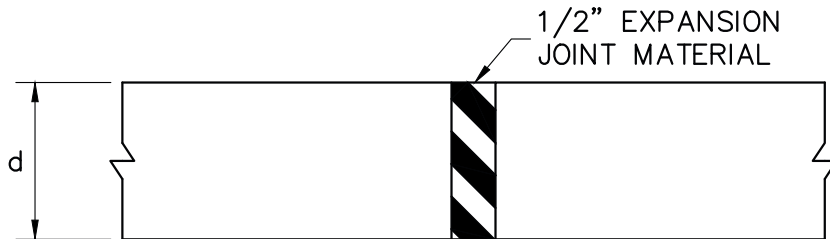
*File: Stand-9*

## **Typical Median Designs**



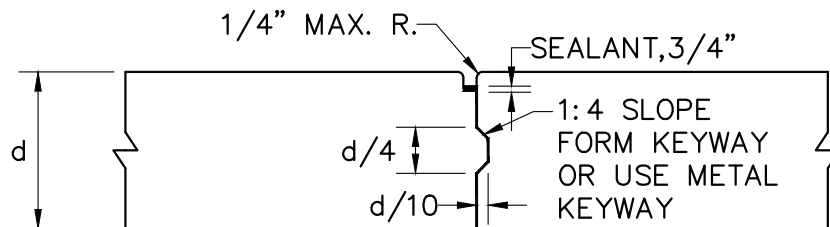
### CONTRACTION JOINT

- \* MAXIMUM CONTRACTION JOINT SPACING FOR CURB, GUTTER AND SIDEWALKS IS 10 FEET.
- \* SAWCUT JOINTS (IF USED) SHALL BE AFTER CONCRETE HAS SUFFICIENTLY HARDENED, BUT BEFORE UNCONTROLLED CRACKING OCCURS.



### DEPRESSED MEDIAN

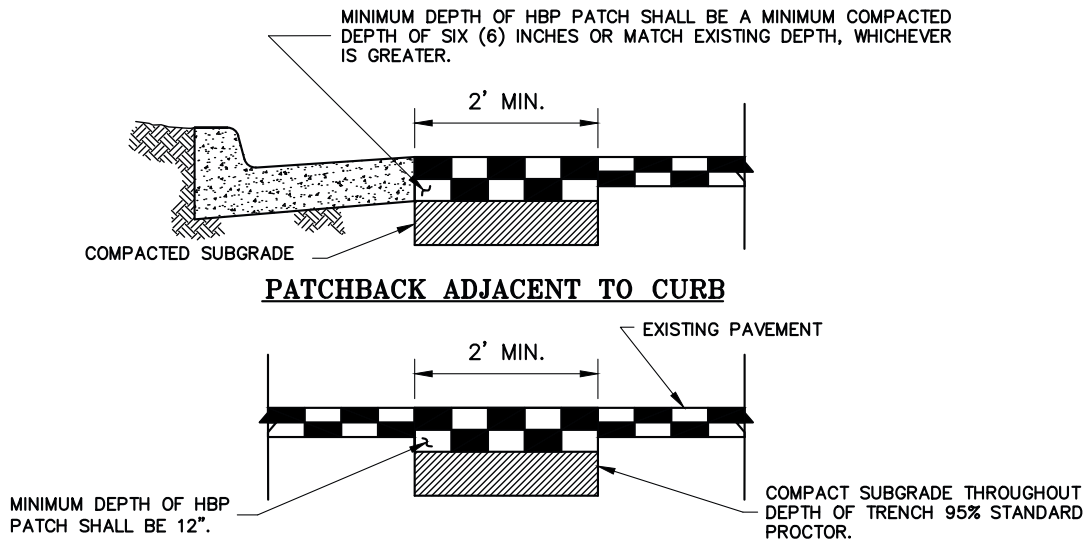
- \* 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED AS REQUIRED AND SHALL EXTEND THE FULL DEPTH OF CONTACT SURFACE
- \* EXPANSION JOINTS SHALL BE INSTALLED WHEN ABUTTING EXISTING CONCRETE OR A FIXED STRUCTURE.



### LONGITUDINAL OR TRANSVERSE CONSTRUCTION JOINT

- \* TRANSVERSE CONSTRUCTION JOINTS REQUIRED AT THE END OF EACH DAY'S POUR AND WHEN THE POUR HAS BEEN SUSPENDED FOR 30 MINUTES OR MORE.
- NOTE: JOINT LAYOUT AND JOINT DETAILS FOR CONCRETE STREETS SHALL BE SUBMITTED TO TRANSPORTATION AND ENGINEERING FOR APPROVAL.

*File: Stand-10*  
**Concrete Joint Details**



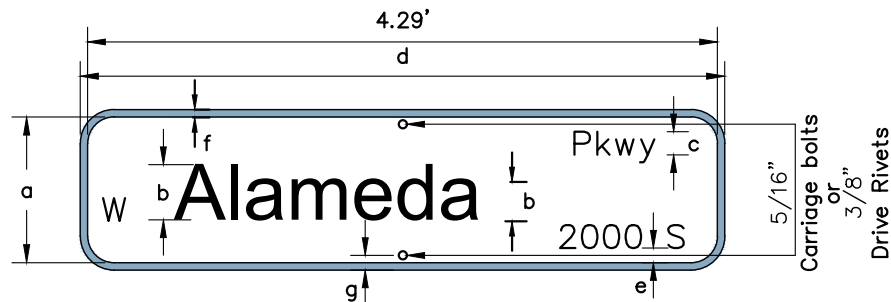
### **PATCHBACK FOR UTILITY AND SERVICE TRENCHES**

#### **NOTE:**

- \* STRAIGHT SAWCUT OR BLADECUT THE EXISTING ASPHALT PAVEMENT WHEN JOINING WITH NEW ASPHALT PAVEMENT.
- \* PATCH SHALL BE PLACED AND COMPACTED IN LIFTS A MAXIMUM OF 3' IN DEPTH.
- \* APPLY SS-I TACK COAT TO EXISTING ASPHALT AND/OR CONCRETE SURFACES.
- \* TRENCHES LESS THAN 2' IN WIDTH MUST RECEIVE PRIOR APPROVAL FROM THE DEPARTMENT OF HIGHWAYS & TRANSPORTATION AND SHALL BE FLOW-FILLED

*File: Stand-11*

### **Asphalt Street/Road Patchback**



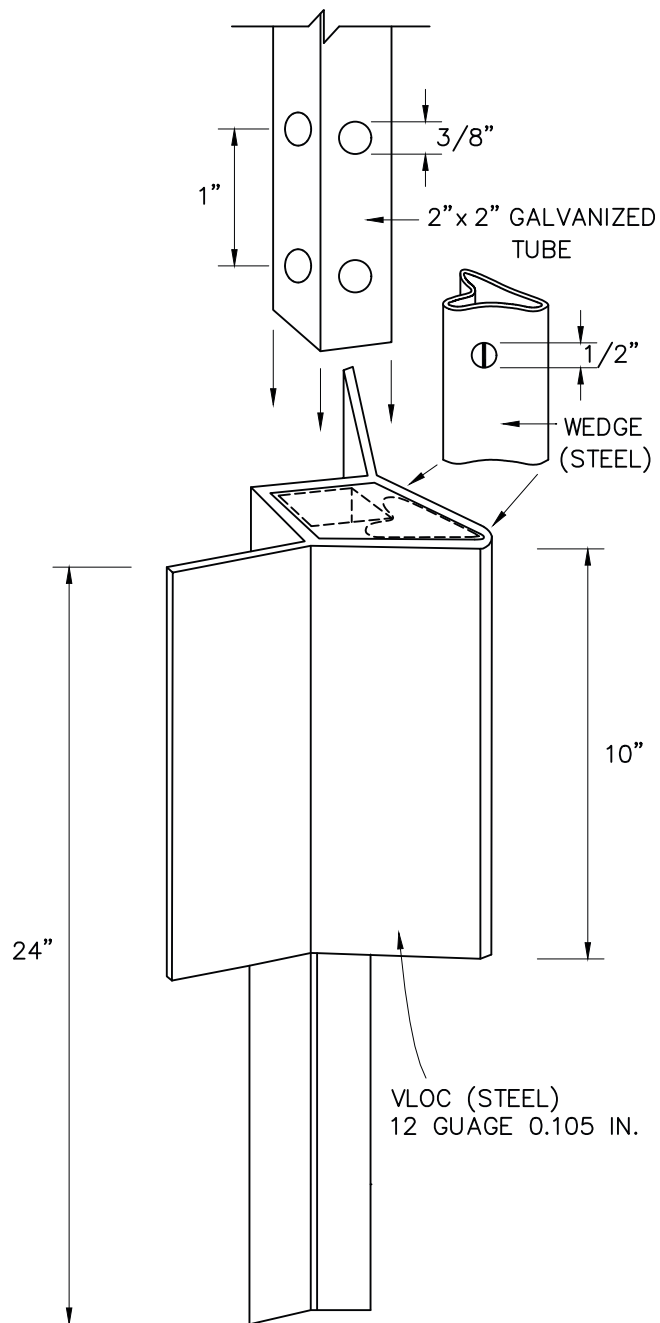
#### **NOTE:**

- \* SIGN BLANKS SHALL BE 6061 OR 5052-H38 ALUMINUM ALLOY .100"
- \* FACING SHALL BE 3M GREEN ELECTRO CUT FILM OR EQUIVALENT. \* LETTERS AND NUMBERS SHALL BE 3M HIGH INTENSITY GRADE PRISMATIC WHITE OR EQUIVALENT.
- \* ROAD TYPE (AVE, PKWY, ETC.) TO BE CENTERED IF POSSIBLE OVER GAP BETWEEN BLOCK # AND DIRECTION.
- \* FONT TYPE SHALL BE HIGHWAY GOTHIC B FED KERN REV, HELVETICA MED COMP ACCT AK REV, OR EQUIVALENT.
- \*\* POST MOUNTED OVER 40mph: 8" UPPER AND 6" LOWER.
- \*\* POST MOUNTED 40mph & UNDER: 6" UPPER AND 4.5" LOWER.

No.	Description	Dimensions (inches)		
		Overhead	Post-mounted, multi-lane, more than 40 mph	Post-mounted, other (multi-lane, 40 mph or less OR two-lane, all speeds)
a	sign height	18	9	9
b	initial capital letter height for street name	12	8	6
	lower case letter height for street name	9	6	4.5
c	initial capital letter height for street type indicator	5	3	3
	lower case letter height for street type indicator	4.5	2.25	2.25
d	length of sign	varies	varies	varies
e	edge of street type and block number to inside edge of border	0.5	0.5	0.5
f	border thickness	1	0.5	0.5
g	bolt hole center to edge of sign	n/a	1	1

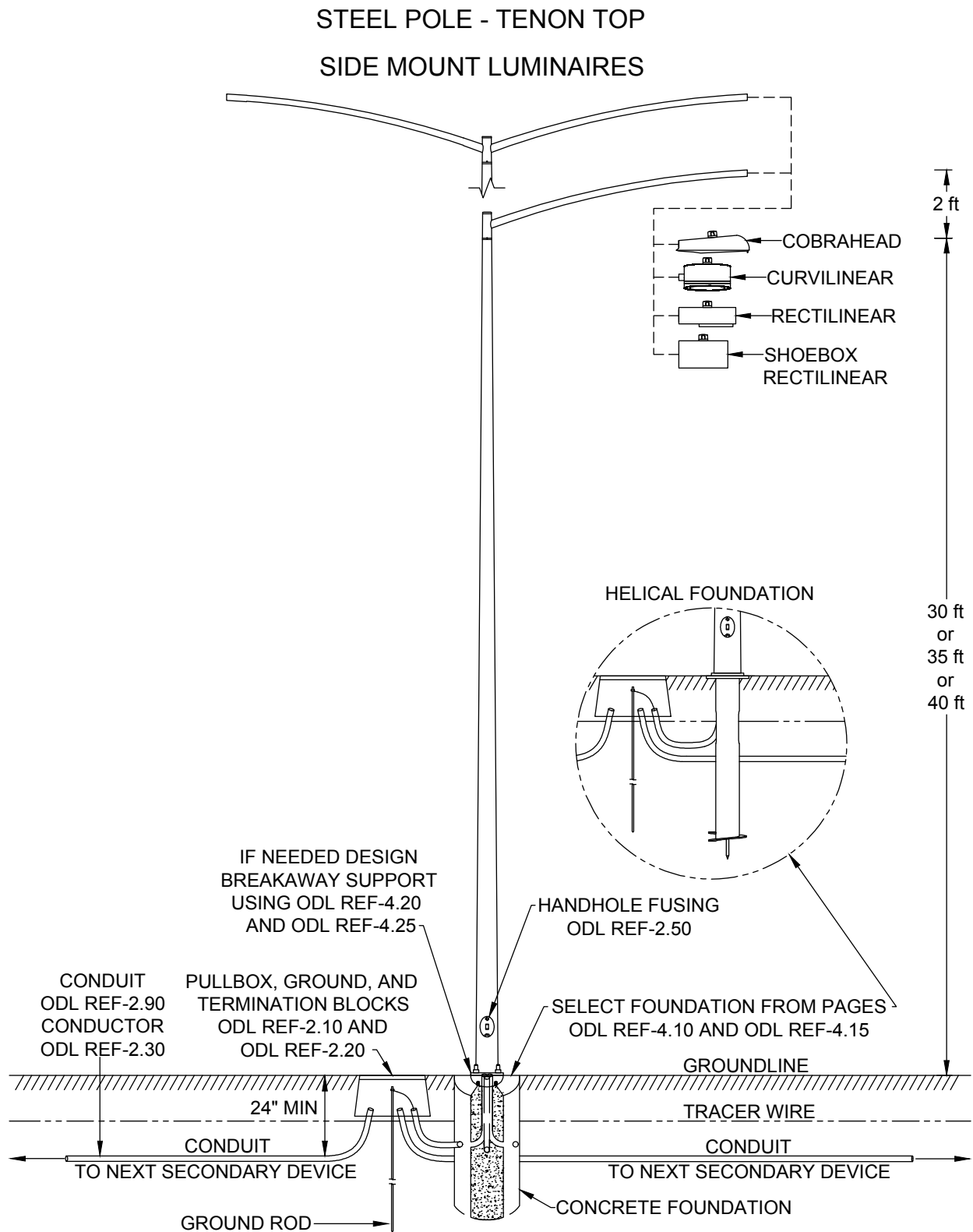
*File: Stand-12*

### **Road and Street Name Signs**



NOTE: VLOC AND WEDGE BASE SYSTEMS  
TO BE USED FOR MEDIAN INSTALLATIONS  
ONLY. ALL OTHER INSTALLATIONS TO  
USE 3' LONG X 2.25" X 2.25"  
GALVANIZED TUBE BASE.

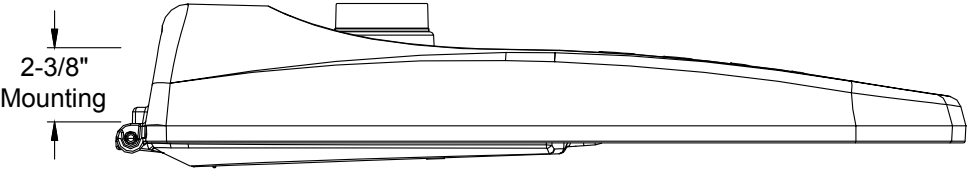
*File: Stand-13*  
**Sign Post and Base**



File: Stand-14 - 1

## Typical Arterial / Major Collector Street Lighting

## SIDE MOUNT LUMINAIRE COBRAHEAD - LED

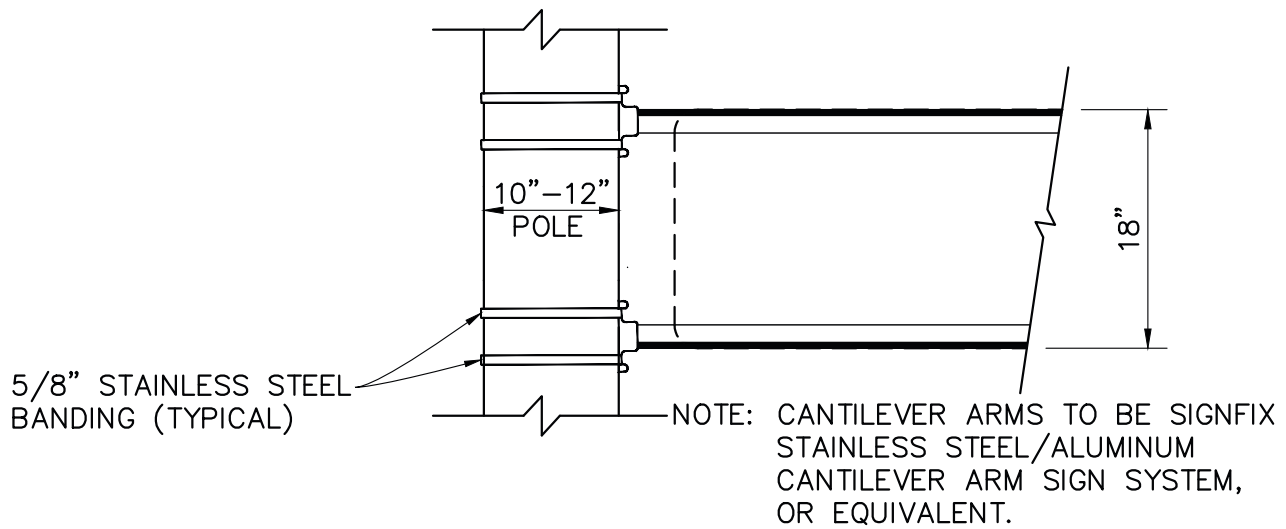
			
Description: For use on 2-3/8" OD arm	C/U	Luminaire Cat ID	Color
<b>LED</b>			
Cobrahead - 14000 lm LED - type D	<b>ESLC25LY</b>	219752	Grey8

**Notes:**

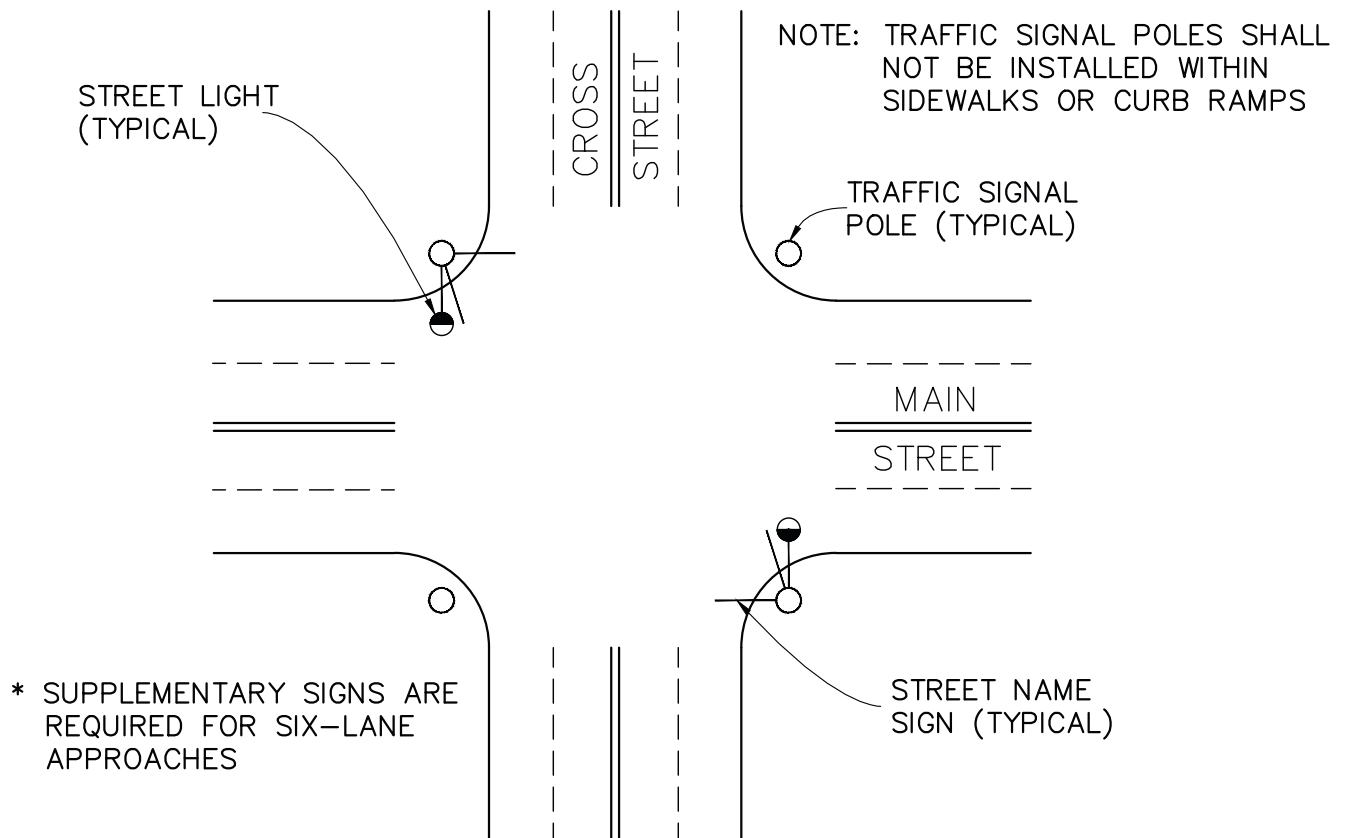
1. C/Us include the luminaire, and the Long Life photo control.
2. Design type B, type C, type D and type E for LED luminaires. Types B, C, D and E are functional equivalents to 100, 150, 250 and 400-Watt HPS luminaires respectively. The lumens (lm) shown are the delivered lumens. Please contact EDS or the latest specification for wattage rating.
3. Design poles, mast arms, foundations etc. using sections PL-INDEX, AM-INDEX and ODL REF-INDEX.
4. Cobrahead luminaires are slip fit mounted on 2-3/8" Outside Diameter (OD) pipe mast arms.
5. Check for proper illumination levels according to type of application.
6. All standard LED Cobrahead luminaires have multi-voltage drivers rated for 120- 277 V. LED lights can be designed for 120 V, 208 V, 240 V, and 277 V systems.

*File: Stand-14 - 2*

### Typical Arterial / Major Collector Street Lighting

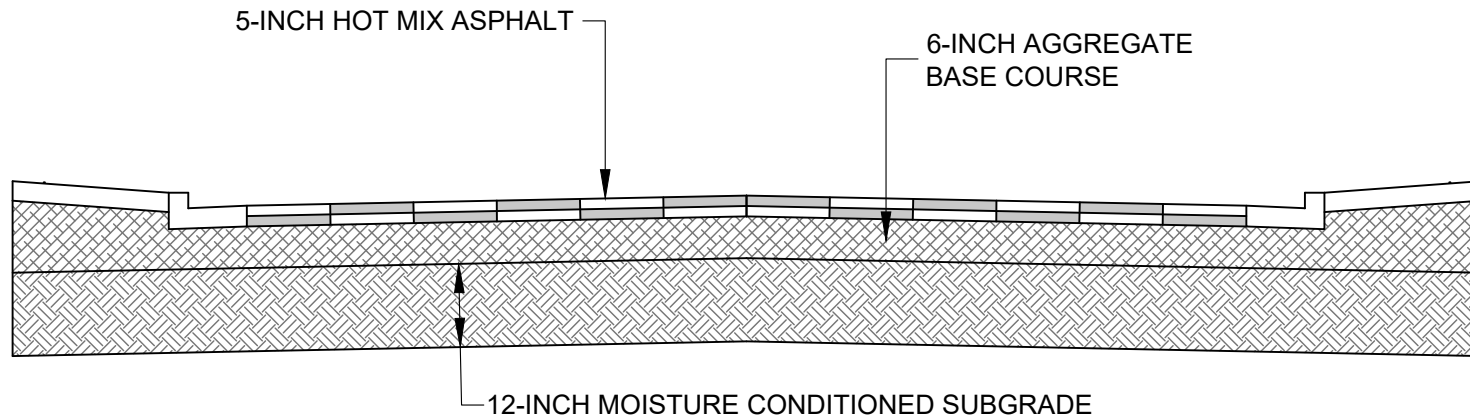


### TYPICAL INSTALLATION \*



File: Stand-15

### **Street Name Sign and Bracket on Traffic Signal Pole - Typical**



DATE: 02/12/2019

SCALE:

Drawn By: D.A.M.

Designed By: STAFF

FILE: STND-16

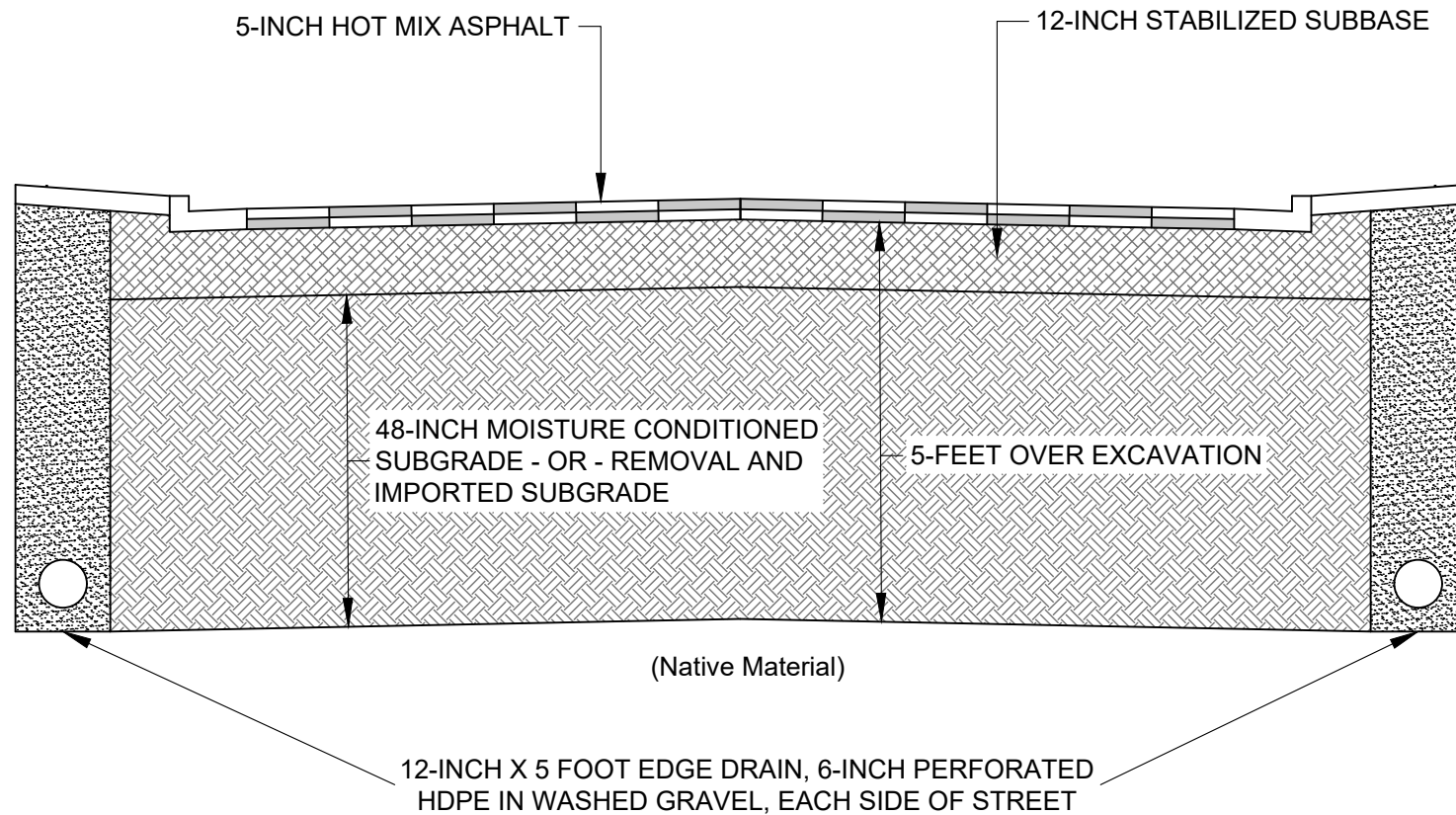
## ZONE 1 FOOTHILLS / MOUNTAIN AREA PRELIMINARY PAVEMENT DESIGN

JEFFERSON COUNTY

DIVISION of

TRANSPORTATION AND ENGINEERING  
100 JEFFERSON CNTY. PKWY., SUITE 3500  
GOLDEN, CO. 80419 (303) 271-8495





DATE: 02/12/2019

SCALE:

Drawn By: D.A.M.

Designed By: STAFF

FILE: STND-17

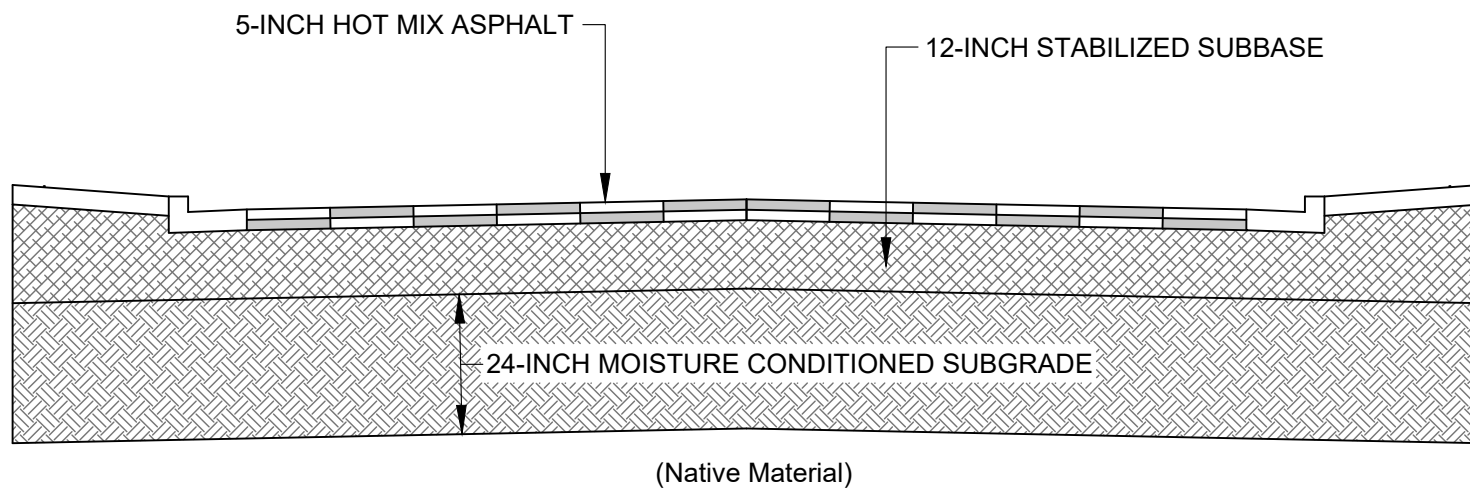
## ZONE 2 DIPPING BEDROCK AREA PRELIMINARY PAVEMENT DESIGN

JEFFERSON COUNTY

DIVISION of

TRANSPORTATION AND ENGINEERING

100 JEFFERSON CNTY. PKWY., SUITE 3500  
GOLDEN, CO. 80419 (303) 271-8495



DATE:	02/12/2019
SCALE:	
Drawn By:	D.A.M.
Designed By:	STAFF
FILE:	STND-18

## ZONE 3 FRONT RANGE AREA PRELIMINARY PAVEMENT DESIGN

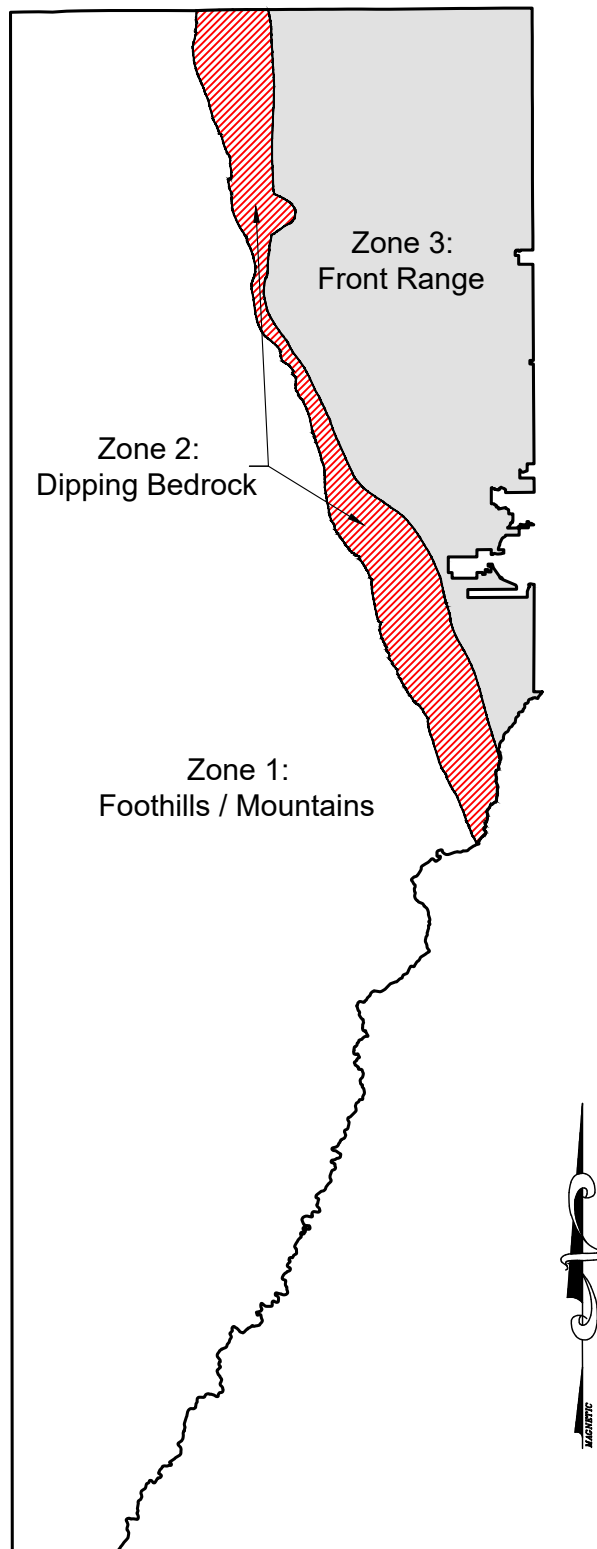
JEFFERSON COUNTY

DIVISION of

TRANSPORTATION AND ENGINEERING

100 JEFFERSON CNTY. PKWY., SUITE 3500

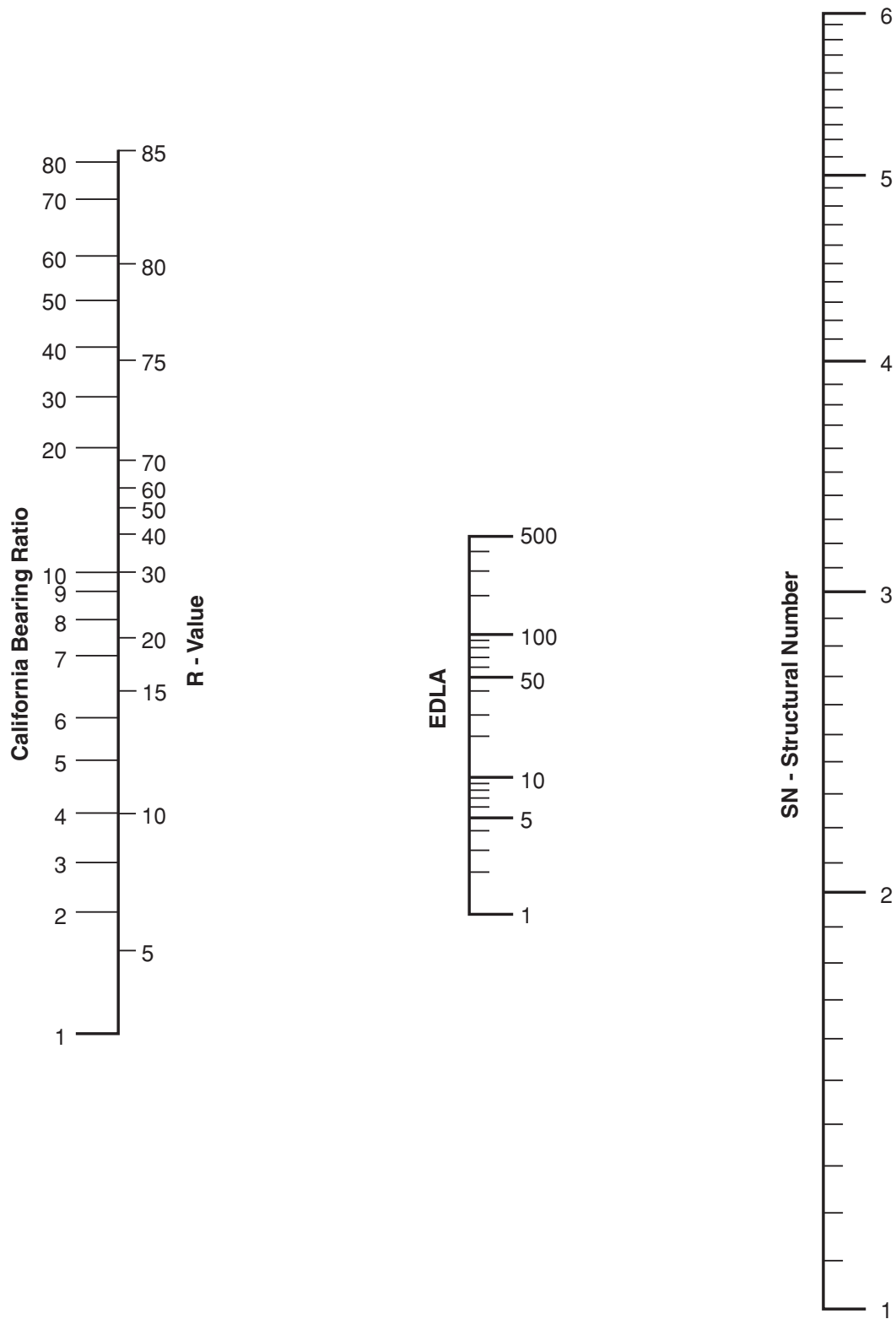
GOLDEN, CO. 80419 (303) 271-8495



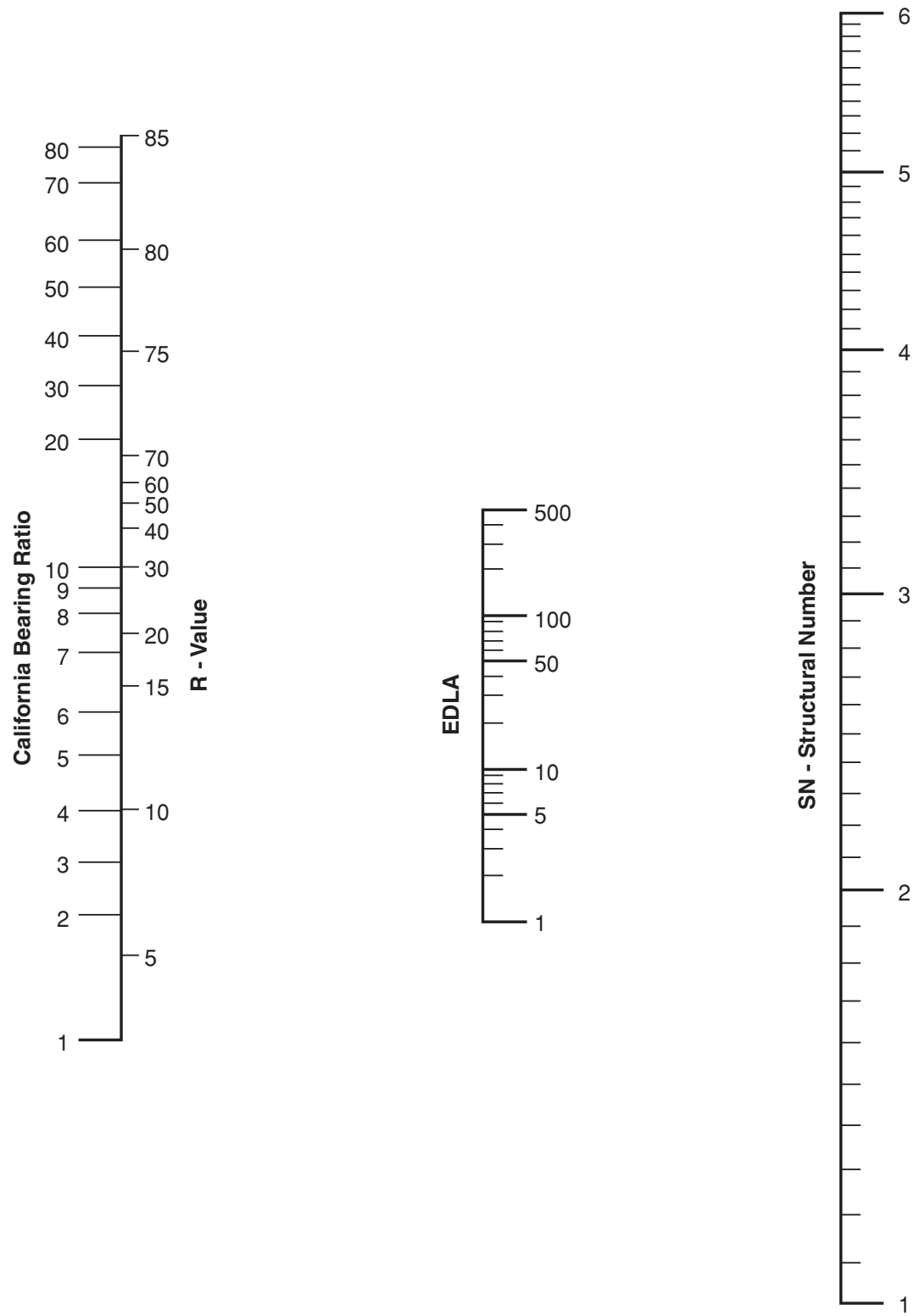
DATE: 11/06/2019	JEFFERSON COUNTY DIVISION. of TRANSPORTATION & ENGINEERING 100 JEFFERSON CNTY. PKWY., SUITE 3500 GOLDEN, CO. 80419 (303) 271-8419
DRAWN BY: D.A.M.	
CHECKED BY: STAFF	<b>DESIGN ZONE</b> <b>PRELIMINARY PAVEMENT SECTIONS</b>
SCALE:	
FILE: STND-19	

# Design Nomographs for Pavements

**Figure 4.1**  
**Design Nomograph for Flexible Pavements**  
Serviceability Index 2.0



**Figure 4.2**  
**Design Nomograph for Flexible Pavements**  
Serviceability Index 2.5



# Transportation Studies

## Table of Contents

1. Requirements for Transportation Studies

2. Responsibility for Transportation Studies

3. Transportation Study Format

    Introduction & Summary

    Proposed Development

    Existing Area Conditions

    Projected Traffic

    Transportation Analysis

    Improvement Analysis

    Findings & Recommendations

    Appendix

        Example Report Outline

        Bibliography

## I. Requirements for Transportation Studies (TS)

*General:* In considering the transportation aspects of land development, it is important to determine early in the process if and when a Transportation Study (TS) will be required. The trip generation from a proposed development is the main quantitative threshold; however, existing transportation issues such as a high crash location, complex intersection geometrics or other specific problems or deficiencies may also necessitate a TS. A TS shall be required in accordance with the Submittal Requirements Section of the Land Development Regulation.

The TS categories are as follows:

**Transportation Analysis:** A Transportation Analysis may be required by Planning and Zoning to determine the amount and/or distribution of traffic generated from a proposed development. A transportation analysis is a computation of the traffic that is generated from a proposed development that is expected to generate less than 1000 average daily trips. The analysis should address any onsite and offsite improvements that may be necessary to mitigate traffic impacts from the proposed development. Required improvements may include the addition of turning lanes and bicycle/pedestrian facilities, including any other improvements which may be suggested by the analysis.

**Minor Transportation Study:** A Minor Transportation Study is required when a proposed development is expected to generate 1000 average daily trips per day or more, and the traffic impacts are localized as determined by Planning and Zoning. The study should address any onsite and offsite improvements that may be necessary to mitigate traffic impacts from the proposed development. Required improvements may include the addition of traffic signals, turning

lanes, and bicycle/pedestrian facilities, including any other improvements which may be suggested by the study.

**Major Transportation Study:** A Major Transportation Study is required when a proposed development is expected to generate 1000 average daily trips or more, and the traffic impacts are regional as determined by Planning and Zoning. The study should address any onsite and offsite improvements that may be necessary to mitigate traffic impacts from the proposed development. Required improvements may include the widening or realigning of existing streets; the addition of new intersections or interchanges; the addition of traffic signals, turning lanes, and bicycle/pedestrian facilities, including any other improvements which may be suggested by the study.

## **2. Responsibility for Transportation Studies**

*General:* The impacts from a proposed development as assessed in the TS are the primary responsibility of the applicant and their engineer.

*Review Process:* The TS for a proposed development will undergo an iterative review process in accordance with the Land Development Regulation. The applicant shall provide a letter identifying changes to the Transportation Study, if applicable.

*Certification:* The TS shall be prepared under the supervision of a qualified and experienced transportation professional who has specific training in traffic and transportation engineering and planning. All transportation operations and design work shall be completed under the supervision of an experienced professional in conformance with the State of Colorado requirements. The TS shall be signed and sealed by a registered professional engineer in the State of Colorado.

## **3. Transportation Study Format**

### **Introduction and Summary**

The purpose of the TS should be clearly stated. This section should contain an Executive Summary that concisely summarizes the principal findings, conclusions and recommendations of the TS.

### **Proposed Development**

Provide a description of the land parcel size, general terrain features and location within the county. The offsite as well as site specific development should be described. This includes a discussion of land use and intensity, location, site plan and zoning. As required, primary and secondary access to existing streets should be proposed. Construction phasing should be introduced and addressed in this section.

### **Existing Area Conditions**

Limits of the study area should be described in this section. The limits shall be mutually agreed to between the applicant and the County. Roadways that provide access to the site as well as future roadways included in the study area are included in this section. Existing intersections within the study area as well as geometrics and traffic signals should be identified. The existing and proposed uses of the site should be identified in terms of various zoning categories of the County. The land use generating the most trips should be used for the analysis. Current traffic volume counts should be collected to determine existing traffic conditions in the study area. These counts may include those for street average daily traffic and for intersection peak hour turning movements.

## **Projected Traffic**

One of the most critical elements of the TS is estimating the amount of traffic being generated. ITE's *Trip Generation Handbook* provides guidance on how to select between rates and equations when both are available. The national published data provided by ITE should be used as starting points in estimating the amount of traffic by a specific building type or land use.

*Computer Software:* A number of computer software packages are available that are designed to either produce trip generation data or accept trip generation data for further analysis.

*Trip Distribution:* The direction from which traffic will access the site can vary depending on many factors such as the type of proposed development and the area which it will attract traffic, surrounding land uses and population and conditions of the surrounding street system. Document the methods and assumptions made in this section.

*Trip Assignment:* The final product of this process is total project generated trips, by direction and turning movement, on each segment of the TIS area roadway network. The assignment should reflect the horizon years and consider future conditions of the roadway. Typically, the County uses a 3 year projected and 20 year projected traffic volume. Additional horizon years may be necessary depending on proposed phasing.

*Internal Trips:* Trips captured internally by a proposed development may be applicable depending on the use. The internal capture rates used should be based on the current version of the ITE's *Trip Generation Handbook*.

*Pass-by trips:* Trip generation analysis yields the number of vehicle trips that a site is expected to generate at its driveways. A percentage of their trips are simply diverted from trips already passing by on the adjacent roadway system. Pass by trips diverted from a roadway should be rechecked if they represent more than 15% of the traffic volume on that roadway.

## **Transportation Analysis**

Capacity analysis is required for each of the major street and site access locations (signalized and un-signalized) within the TS area. A clearer understanding of both the transportation related implications of the project and the necessary improvements to ensure acceptable operating conditions should result from this section of the TS. In addition, the following County Plans and Program and Factors shall be considered in the transportation analysis: County Plans and Program, Major Thoroughfare Plan, Bicycle and Pedestrian Plan and Traffic Impact Fee Program.

Factors:

- Safety
- Neighborhood Impacts
- School Zone Traffic Control
- Traffic Control Needs
- Transit Needs or Impacts
- Transportation Demand Management
- Circulation Patterns
- On-site Parking Adequacy and Off-site Parking Facilities
- Pedestrian and Bicycle Movements/Continuity of Facilities
- Service and Delivery Vehicle Access



- Emergency and Fire Apparatus Access

*Transportation Safety:* The initial review of existing conditions within the TS area should include analysis of crash data from the 3 most recent years. Any intersection experiencing a crash rate of over 1 per million entering vehicles will need additional analysis. The proposed site plan should ensure that the internal circulation system and external access points improve pedestrian and bicyclists safety and minimize vehicle/pedestrian and bicyclists conflict points.

*Transportation Operations:* Impacts on transportation operations shall be measured based on the definitions contained in the current version of the *Highway Capacity Manual (Transportation Research Board)*. For each analysis period studied (typically 3 and 20 year periods) and for each phase of the project a projected total traffic volume must be estimated for each critical intersection and roadway segment being analyzed. The projected total traffic volumes (consisting of the summation of existing traffic, background growth traffic, background development traffic and site traffic) will be used in the next step-capacity analysis of future conditions.

*Signalized Intersections:* Level of Service (LOS) is based on roadway system characteristics that include:

- traffic volume
- lane geometry
- percentage of trucks
- peak hour factor
- number of lanes
- signal progression
- ratio of green time to cycle time (G/C)
- roadway grades
- parking conditions
- bicycle and pedestrian flows

The LOS categories established in the *Highway Capacity Manual*. In general, LOS ratings of A to D are acceptable while E & F ratings must be mitigated. There are a number of software programs that can determine highway capacity.

*Unsignalized Intersections:* LOS for multi-way stop controlled intersections and driveway intersections must be determined by computing or measuring control delay. Where capacity analysis shows a LOS of D or worse, an analysis should be completed to determine if a signal, roundabout, or turn restriction might be needed.

*Roundabouts:* In cases where LOS analysis indicates that an unsignalized intersection is expected to be LOS D or worse, a roundabout will be assessed before consideration will be given to a proposed signalized or multiway stop intersection. Factors for consideration of a roundabout include:

- availability of right-of-way
- crash history or potential
- traffic volume
- lane geometry
- number of lanes

- roadway grades
- parking conditions
- bicycle and pedestrian flows
- level of service

Each proposed location for a roundabout will be evaluated on a case by case basis. The capacity of a roundabout must be evaluated, and appropriate analytical software programs shall be utilized.

### **Improvement Analysis**

The improvements required to accommodate existing, background and site generated traffic are summarized in this section. Intersections serving the development should be analyzed first. The analysis should include the following steps:

- Identification of critical movements and corresponding intersection approaches.
- Determine if the intersection needs new types of traffic control such as roundabout, signalization or multi-way stop control. The Transportation Study indicates that an intersection internal, adjacent or within 500 feet of the development will satisfy the MUTCD Peak Hour Warrant or Four-Hour Warrant within 20 years.
- Evaluation of each critical movement under potential scenarios of adding lanes, altering signal phasing, signal timing or lane use.
- Evaluation of signal locations, phasing and timing, with particular emphasis on corridor signal progression.
- Evaluation of queue lengths for both turn and through lanes to ensure adequate storage space.
- Identification of potential improvements within the contexts of Right-of-Way availability, intersection spacing, signal progression, County design standards and practical feasibility.

### **Findings & Recommendations**

Throughout the TS, data should be presented in tables, graphs, maps and diagrams in lieu of a narrative, for clarity and ease of review. The examples contained in ITE's current version of Publication No. RP-020C *Transportation Impact Analysis of Site Development* is an excellent source of information.