

Gilpin County
Road Regulations, Policies,
Standards, and Specifications

- Part 1 — Road Types
- Part 2 — New County Roads
- Part 3 — Road Standards
- Part 4 — Drawings and Graphs

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Central City, Colorado, 80427

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PART 1 - ROAD TYPES

- 1.0 All roads are divided into the following types for planning purposes. Typical sections showing geometric and structural features are found in Part 4 - DRAWINGS AND GRAPHS.
- 1.1 TYPE 1 - ARTERIALS
An arterial is a continuous access controlled road for through traffic with crossings at grade.
- 1.2 TYPE 2 - COLLECTORS
A Collector is a vicinity-wide continuous access road connecting Local Access Roads to Arterials.
- 1.3 TYPE 3 - LOCAL ACCESS ROADS
A Local Access Road provides direct access from abutting properties to other roads.
- 1.4 TYPE 4 - FRONTAGE ROADS
A Frontage Road serves as a Collector or Limited Access Road used contiguous to higher type roads to control access.

PART 2 - NEW COUNTY ROADS

- 2.0 New roads are added to the County Road System by resolutions passed by the Board of County Commissioners. Sources of new roads are: additions, realignments, relinquished State Highways, Subdivisions and other developments. Ordinarily, before a new road becomes a part of the County Road System, it passes through six steps: planning, design, right-of-way acquisition or dedication, construction, inspection and a final acceptance.

2.1 PLANNING CRITERIA

Prior to the design of a new road, the Road Type and the Design Speed must be determined. The Road Types are defined in Part 1. The Road Type and Design Speed is subject to the approval of the County Engineer, County Road Supervisor and Planning Commission.

A. TERRAIN CLASSIFICATION

For the purposes of this manual, the terrain in Gilpin County is Mountainous Terrain - Average cross slope greater than 15% and the ridges and draws are steep and well defined.

B. DESIGN SPEED

Design speed is a speed selected to correlate design of those physical elements of a road that influence vehicle operation. The choice of design speed is influenced primarily

The table below gives acceptable ranges of minimum design speeds.

MINIMUM DESIGN SPEEDS - M.P.H.

TERRAIN CLASSIFICATION	ROAD TYPE			
	1	2	3	4
MOUNTAINOUS	40-50	30-40	20*-30	20-30

* 15 on approval switchbacks and in those instances where undue scaring can be avoided.

2.2

DESIGN CRITERIA

Plans and specifications are to be prepared based upon appropriate planning criteria and applicable standards and requirements. All design work is to be prepared and signed by a Registered Professional Engineer. Plans are to be completed in sufficient detail to facilitate review and are to be submitted to the County Engineer and County Road Supervisor for approval fifteen days prior to anticipated construction or in the case of subdivisions, fifteen days prior to the time of final approval which is the regularly scheduled Planning Commission Meeting. Approval on plans is good for one year, After one year, the procedure must be repeated and revisions in standards made in the interim shall apply. Plans shall include:

- A. Profiles for all roads, sewers and water lines showing the grades, length of vertical curves, stationing and elevations of BVC'S, EVC'S, and PIVC'S, existing grade or ground lines by dashed line, culverts, structures, and other controls. The vertical scale is to be distorted 10 to 1 except in those situations where other distortions can better convey the relationship peculiar to the project between vertical and horizontal elements of the design.
- B. A description of at least two usable bench marks within 1/2 mile. USGS Datum is to be used. More may be required.
- C. Layout of road showing length of tangents and curves, widths of right-of-way, slope lines to prove that the right-of-way is of sufficient width, stationing on PC'S and PT'S, curve radii, delta angles, bearings, distances, centerline stationing at 100 feet intervals, dimensions of all roads elements, utilities, easements and other structures. Location and size of culverts, designation the type and gauge or strength classification and the estimated flow along with data assumed in estimating the flow.
- D. Show north arrow, scale, street names, drainage patterns, and the typical road cross-section.

- E. Construction plans for all structures, bridges, box culverts, etc.
- F. A letter of intent stating the scope and time element of each stage of construction. Statement indicating party or parties responsible for the construction.
- G. Letters from ditch companies or other interested parties or agencies involved stating their approval of any structure constructed within their right-of-way or which may influence their rights or interests.

2.3 CONSTRUCTION CRITERIA

A. SPECIFICATIONS

All construction shall conform to County Specifications as covered in PART 3- ROAD STANDARDS.

B. CONSTRUCTION PERMITS

Seven days prior to commencement of the construction, the developer, contractor or owner shall obtain a construction permit. A list of required field tests and inspections will be attached. Applicant shall submit a written schedule covering the general sequence of the work to be performed. The permit and work schedule, when approved, shall not be changed without the written consent of the County Engineer or County Road Supervisor. Construction permits expire and must be renewed at the end of one year.

A fee will be required in accordance with the following schedule in order to cover the cost of field inspection.

<u>Type of Construction</u>	<u>Inspection Fee</u>
Issuance Fee.....	\$ 5.00
Road	
Subgrade.....	\$.01 per lin. ft.
Subbase.....	\$.005 per lin. ft.
Base.....	\$.01 per lin. ft.
Culverts.....	\$ 1.00 each
Structures (\$3.00 Minimum)	
Up to \$25,000 Valuation.....	\$ 1.00 per \$1,000.

C. SURVEY MONUMENTS

All established survey monuments in roadways or rights-of-way shall not be displaced unless supervised and relocated by a licensed surveyor. All such monuments shall be referenced with a minimum of three ties and shown on the as-built construction plans.

D. AS-BUILT PLANS

Before final acceptance by Gilpin County, complete "as-built" plans shall be submitted by the developer.

INSPECTIONS AND TESTINGA. INSPECTIONS

Adequate inspections assure compliance to County standards and are the basis for the County Road Supervisor and County Engineer's recommendation to the Board of County Commissioners for maintenance acceptance and for release of bond.

It is the responsibility of the contractor or the developer to contact the County Road Supervisor or County Engineer two days in advance of the required inspections.

In progress inspections of all elements of work will eliminate the need for extensive post-testing.

Any work or material which does not conform to County standards will be brought to the attention of the contractor or developer and if immediate corrections are not made, construction may be stopped.

The general types of inspections required are as follows:

- (1). CULVERTS: Trenching, grade, bedding, installation of pipe, backfill and compaction. Inspection to be requested when backfill is completed to 1/2 the depth of culvert.
- (2) STRUCTURES: Finished excavation, grade, forming, reinforcing steel, concrete placing, finish, and test cylinders. Inspections required: (1) prior to placing steel and (2) prior to the concrete placement.
- (3) ROADWAY: Subgrade, subbase, base course, prime and paving to be called for at each completed stage. Locations of required field tests will be determined by the County Road Supervisor or County Engineer.
- (4) FINAL: A request for the final inspection and acceptance for maintenance or release from bond must be made in writing to the County Engineer after all other inspections have been passed.

B. TESTING

When required by the County Engineer, a recognized testing firm shall certify to the quality of materials or construction. All testing shall be by recognized methods and shall be at the contractor's, developer's or owner's expense.

Until such time as a segment of road is officially accepted by the County, the developer or owner shall be fully responsible for the maintenance and correction of any faulty construction,

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ACCEPTANCE OF ROADS FOR MAINTENANCE

Dedicated roads within Gilpin County jurisdiction are accepted for maintenance by resolution passed by the Board of County Commissioners only after certain requirements are met. Summarized below are the minimum requirements. When acceptance has been requested in writing and the minimum requirements have been satisfactorily complied with, the County Road Supervisor and County Engineer will submit a recommendation for acceptance to the Board of County Commissioners for final action. Roads will be accepted for maintenance as priority allows.

A. MINIMUM ACCEPTANCE REQUIREMENTS

- (1) Roads will not be accepted until the development served by said roads provides the necessary tax revenue to assure maintenance costs. Issuance of building permits for 10% of the lots within a given subdivision will be used as a guide in evaluating this requirement.
- (2) Roads will not be accepted before the County Road Supervisor and County Engineer approve said roads and recommend acceptance.
- (3) Roads within a subdivision, or any similar type development, will not be accepted in portions shorter than block lengths and shall end at intersections or cul-de-sacs.
- (4) Roads will not be accepted unless they connect to another County accepted road.
- (5) Roads will not be accepted until all combustible or objectionable material is cleared from the roadside and until all required signs are installed in accordance with County standards.
- (6) All required subsurface utilities shall be installed prior to finishing subgrade. The longitudinal mains shall be located outside the roadway limits. All laterals crossing the roadway shall be installed prior to the road acceptance.

B. SUBDIVISION ROADS

Acceptance of platted subdivisions by the County does not constitute acceptance of the roads and rights-of-way for maintenance. Until each road is specifically accepted by resolution by the Board of County Commissioners for maintenance, the maintenance and construction are the sole responsibility of the owners of the land embraced within the subdivision.

Building permits up to 10% of the lots in a given subdivision will not be denied on the basis of unaccepted roads. After 10% have been issued, no further permits will be issued until such time as the roads have been constructed to County Standards and accepted for maintenance, or the developer has

posted a bond to cover the cost of the required construction. The 10% requirement shall also apply to private roads except that in lieu of "accepted for maintenance" " passed final inspection" shall meet the acceptance criteria."

2.6 ACCEPTANCE OF RIGHTS-OF-WAY

On occasion, individuals, organizations or other agencies may wish to dedicate land to the County for future roads. The procedure shall be as follows:

- A. Submit written request fifteen days prior to the next regularly scheduled County Planning Commission meeting to the County Engineer stating reasons for wanting the right-of-way accepted and including a map showing the topography and land parcels involved along with their legal descriptions.
- B. The County Road Supervisor and County Engineer shall review the request, form a recommendation and submit it to the County Planning Commission for consideration.
- C. If the County Planning Commission approves the request, the applicant must submit a deed acceptable to the County Attorney to the property in question for executing by the Board of County Commissioners.

2.7 ENCROACHMENT PERMITS ON EXISTING COUNTY ROADS

Contractors, developers, owners, or governmental agencies must obtain an Encroachment Permit from the Gilpin County Engineer or County Road Supervisor for any work performed within County road rights-of-way. Policies, procedures and specifications for work performed under authorization of the Encroachment Permit are contained in a booklet entitled "ENCROACHMENT PERMIT REQUIREMENTS" which can be obtained from the County Engineer or County Road Supervisor.

Utilities located within a planned or existing road right-of-way shall conform to the requirements contained in the "Encroachment Permit Requirements."

PART 3 - ROAD STANDARDS

3.1 ALIGNMENT

A. HORIZONTAL ALIGNMENT

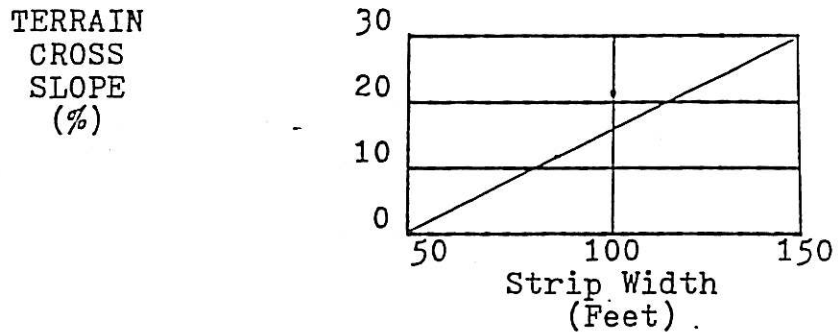
The major considerations in horizontal alignment design are: safety, grade profile, road type, design speed, sight distance, and topography. All these factors must be balanced to produce an alignment that is safest, most economical, and adequate for the type of road proposed.

(1) GENERAL CONSIDERATIONS

Road layout shall bear a logical relationship to existing or platted roads in adjacent properties.

In Mountainous Terrain, it may be preferable to provide higher standards alignment for the right-of-way than for the road itself. The initial road will be permitted to wind around within the right-of-way to reduce cuts and unnecessary scarring provided minimum standards are met. The higher standard right-of-way will permit improvement of the alignment as traffic warrants.

Roads should not be located so as to closely parallel streams or be subject to flooding. There should be a vegetated strip to trap soil carried by runoff between the toe of fill and the thread line of the streams with the width being determined as follows:



Dead end roads, permanent or temporary, shall not be more than 600 feet long and shall be provided with a turn-around at the end.

Where dead end roads longer than prescribed would be required to serve a given development, a second access must be provided for the safety and convenience of the residence and the road users.

Whenever possible, roads are to intersect at right angles. A deviation of 30° from right angle will be the maximum permissible subject to the approval of the County Engineer and the County Road Supervisor.

Opposing intersections or access opening shall be directly opposite each other or offset at least 300 feet apart on Type 1 roads, 250 feet on Type 2 roads, and 150 feet on Type 3 and 4 roads.

(2) 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.

The minimum stopping sight distance is the distance required by the driver of a vehicle, traveling at a given speed, to bring his vehicle to a stop after an object on

measured from the driver's eyes, which are assumed to be 3.75 feet above the pavement surface to an object 6 inches high on the road. The required stopping sight distance for a given design speed is as follows:

DESIGN SPEED M.P.H.	STOPPING SIGHT DISTANCE FEET
15	100
20	150
25	175
30	200
35	250
40	275
50	350

Where an object off the pavement such as a bridge pier, cut slope, or natural growth restricts sight distance, the minimum radius of curvature is determined by the stopping sight distance.

Offset clearance to achieve stopping sight distance on horizontal curves is obtained from the chart found in Part 4 - DRAWINGS AND GRAPHS. It is assumed that the driver's eye and the object are centered in the inside lane, and the line of sight is assumed to intercept the obstruction at the midpoint of the sight line and 2.5 feet above the center of the inside lane. The offset distance (m) is measured from the center of the inside lane to the obstruction.

Passing sight distance is the minimum sight distance that must be available to enable the driver of one vehicle to pass another vehicle safely and comfortably, without interfering with the speed of an oncoming vehicle traveling at the design speed. The sight distance available for passing is the longest distance at which a driver whose eyes are 3.75 feet above the pavement surface, can see the top of an object 4.5 feet high on the road.

Passing sight distance is considered only on 2-lane roads. At critical locations, a stretch of 4-lane construction with stopping sight distance is sometimes more economical than 2-lanes with passing sight distance. The required passing sight distance for a given design speed is as follows:

DESIGN SPEED M.P.H.	SIGHT DISTANCE FEET
20	700
25	900
30	1100
35	1300
40	1500
50	1800

Sight distance at intersections require that encroachments be prohibited within a line extending from the center of a non-stop vehicle (assumed to be centered in outside lane at distance back from the stopped vehicle equal to the stopping sight distance) and the stopped vehicle (assumed to be a point 40 feet back from the edge of traveled way of the through road.)

(3) CURVATURE

Following is a table which gives the minimum radius of curvature for specific design speeds. This table is based upon speed alone; it ignores the sight distance factor:

MINIMUM CURVE RADIUS

<u>DESIGN SPEED MILES PER HOUR</u>	<u>MINIMUM CURVE RADIUS (FEET)</u>
15	60
20	100
25	175
30	250
35	375
40	550
50	850

Every effort should be made to exceed the minimum values. Minimum radii should be used only when the cost of realizing a higher standard is inconsistent with the benefits. Spiral-curves using Colorado Highway Department Standards are permissible on approval by the County Engineer.

Sudden reductions in standards introduce the element of surprise to the driver and should be avoided. Where physical restrictions cannot be overcome and it becomes necessary to introduce curvature of lower standard than the design speed for the project, the design speed between successive curves shall not change by more than 10 miles per hour increments. Under no conditions, shall a curve for a design speed lower than the design speed of the project be introduced at the end of a long tangent or at other locations where high approach speeds may be anticipated. Use of lower standard curve radii must be fully justified and is subject to approval of the County Engineer.

Generally speaking, the maximum length of curve shall not exceed one-half mile, and the minimum length shall be 200 feet for design speeds of 30 M.P.H. or less and 300 feet for design speed between 30 and 40 M.P.H. and 400 feet for design speeds of 40 M.P.H. and above. Angle points less than one (1) degree require no curve radius. A compound curve should be avoided particularly where a simple curve can be obtained at small additional cost. When a compound curve is desirable, the shorter radius shall be at least 2/3 the longer radius when the longer radius is 1,500 feet or less.

Reversing curves without an intervening tangent will not

be permitted. Severe physical restrictions may dictate the use of curves in opposite directions with a short intervening tangent. In such cases, the minimum length of tangent shall be as prescribed in Section 3.1 A (4).

(4) TANGENTS

Minimum tangent lengths between curves shall be 400 feet for TYPE 1 roads and as follows for other roads:

<u>DESIGN SPEED</u>	<u>T</u>
15	50
20	75
25	100
30	150
35	200
40 & above	250

B. VERTICAL ALIGNMENT

(1) General Considerations

The grade line is the reference line by which the elevation of the pavement and other features of the road are established. It is controlled mainly by topography, the factors of horizontal alignment, safety, sight distance, design speed, drainage and construction costs. The performance of heavy duty vehicles must also be considered.

The grade line should be positioned with relation to the cross-section as follows:

- (a) It should coincide with the road centerline on two-lane and multilane undivided roads.
- (b) Separate grade lines may be required on divided multilane roads.

(2) MAXIMUM AND MINIMUM GRADES

Maximum and Minimum sustained grades shall be as follows:

MINIMUM SUSTAINED GRADES 1 %

MAXIMUM SUSTAINED GRADES

TERRAIN CLASSIFICATION	ROAD TYPE	
	<u>COLLECTOR</u> 2	<u>LOCAL</u> 3 & 4
MOUNTAINOUS	6%	8%

Increases in grade will be permitted on approval by the County Road Supervisor and the County Engineer as follows:

1 % for 500 feet

*2 % for 200 feet

* Grades in excess of 10% will not be permitted.

In Mountainous Terrain all grades shall flatten to 6% or less for at least 50 feet approaching intersections, and for at least 25 feet entering switchbacks or cul-de-sacs.

(3) VERTICAL CURVES

Properly designed vertical curves should provide adequate stopping and passing sight distance, headlight sight distance, driver comfort, good drainage and pleasing appearance.

Long, flat vertical curves should be avoided as they may develop poor drainage at the level section and tend to create driver insecurity in passing maneuvers.

The minimum length vertical curve shall be 400 feet for design speeds above 30 M.P.H. and 200 feet for design speeds for 30 M.P.H. and below. Unequal tangent vertical curves are permitted only in special circumstances as approved by the County Engineer.

(4) SIGHT DISTANCE

All portions of the grade line must meet sight distance requirements for the design speed. See Section 3.1 A (2) for definitions of stopping and passing sight distance.

C. ALIGNMENT COORDINATION

A proper balance between curvature and grades should be sought. Whenever possible, vertical curves should be superimposed on horizontal curves. This reduces the number of sight distance restrictions on a given length of road and makes changes in profile less apparent. For safety reasons, the horizontal curve should overlap the vertical curve. However, where the change in horizontal alignment at a grade summit is slight, the vertical curve may overlap the horizontal curve.

When vertical and horizontal curves are thus superimposed, the superelevation may cause distortion in the outer pavement edges particularly on multilane cross-sections. Where this may be the case, edge of pavement profiles shall be plotted and smooth curves introduced to remove any irregularities.

A sharp horizontal curve should not be introduced at or near a pronounced summit or grade sag. This is particularly hazardous at night.

Horizontal and vertical curvature at intersections should be

as flat as physical conditions permit.

On long open curves, a uniform grade line should be used in lieu of one that rolls.

In Mountainous Terrain, undulating grades are preferable to long sustained grades in order to reduce cuts and fills, reduce scarring of vegetative cover and avoid accumulation of erosive drainage in long sustained roadside ditches.

3.2 GEOMETRIC CROSS-SECTIONS

A. TYPICAL SECTIONS

A typical section for each Road Type can be found in PART 4-DRAWINGS AND GRAPHS.

B. RIGHTS-OF-WAY

The basic minimum right-of-way width is shown on each typical section. The basic minimum is sufficient only to accommodate the specified geometric cross-sectional elements and ADDITIONAL RIGHT-OF-WAY MUST BE PROVIDED for cuts and fills, drainage improvements, interchanges and other road appurtenances.

The minimum clearance from the right-of-way line to the catch point of a cut or fill slope should be 5' for all types of cross-sections. When feasible, at least 10' should be provided.

The minimum right-of-way clearances for cuts higher than 15 feet shall be $\frac{1}{3}$ the cut height but not to exceed 50 feet in width.

C. CROWN SLOPE

On undivided roads in tangent alignment, the high point of the crown shall be centered on the pavement and the pavement sloped toward the edges on a uniform grade. In Mountainous Terrain, unpaved Type 3 roads may be sloped toward the cut side of the road on a 3% slope to alleviate surface erosion provided safe speed requirements are met.

CROWN SLOPES

TYPE OF SURFACE	CROWN SLOPE (PERCENT)
Penetration treated earth or gravel	2.5
Unsurfaced graded section	3.0

D. SIDE SLOPES

(1) GENERAL

Side slopes should be designed for functional effectiveness, ease of maintenance and pleasing appearance.

Cut and fill slopes shall be as shown on the typical Section in PART 4 - DRAWINGS AND GRAPHS. Flatter slopes shall be required in unstable soils. Cut slopes steeper than the standard may be considered in special situations such as in solid material but require prior approval by the County Engineer and the County Road Supervisor.

Transition slopes shall be provided between adjoining cuts and fills. Such slopes should intersect the ground at a uniform catch point as shown on the typical Sections in PART 4- DRAWINGS AND GRAPHS.

In areas where heavy snowfall can be expected, consideration should be given to snow removal problems and snow storage in slope design. It is considered advisable to use flatter slopes in cuts on the southerly side of the roadway where this will provide additional exposure of the pavement to the sun.

The tops of all cut slopes shall be rounded where the material is other than solid rock. A layer of earth overlying a rock cut shall also be rounded.

(2) SLOPE BENCHES

The necessity for benches, their width, and vertical spacing shall be established only after an adequate materials investigation. Since greater traffic benefits are realized from widening a cut than from benching the slope, benches should be used sparingly and only where they are justified by sound engineering reasons including the following:

- (a) In unstable material where it is more economical to bench than to flatten the slope.
- (b) To intercept and store loose material resulting from minor slides or erosion.
- (c) For snow storage in special cases as in long through cuts.

For ease of maintenance, a 20-foot bench width is satisfactory. Benches should be sloped to form a valley at least 1 foot deep with the low point, a minimum of 5 feet from the toe of the upper slope. Access for maintenance equipment should be provided to the lowest bench and, if feasible, to the higher benches.

E. CLEARANCES

The following are minimum clearances to structures or other roadside obstructions. Additional clearance must be provided for sight distance and other requirements. Where streets or highways under the jurisdiction of other agencies is involved, the clearance as required by said agency, if more restrictive than County

standards, shall apply.

(1) HORIZONTAL CLEARANCE

The minimum horizontal clearance from the edge of traveled way shall be 10 feet to the right and 4 feet to the left when facing in the direction of travel.

(2) VERTICAL CLEARANCE

The minimum vertical clearance to major overhead structures shall be 15 feet above the traveled way and 14 feet above the shoulders. For minor overhead structures, such as signs, cables, etc., the minimum vertical clearance shall be 18 feet.

3.3 STRUCTURAL CROSS-SECTION

A. GENERAL POLICY ON PAVING

All roads shall be surfaced with a minimum of crushed rock or gravel surface as provided in Sections 3.3 B and C.

B. STANDARD STRUCTURAL SECTIONS

In the absence of a qualified engineer's analysis approved by the County Engineer, the structural elements shown on the typical Sections in PART 4 - DRAWINGS AND GRAPHS shall be used.

If, in the opinion of the County Engineer and the County Road Supervisor, the standard structural elements do not appear to be adequate for a given situation, a design structural section will be required.

C. DESIGNED STRUCTURAL SECTIONS

Designed structural sections may be less restrictive than the standard sections and, therefore, may be less costly. On the other hand, in certain situations, a designed structural section will be more restrictive and if required by the County Engineer, shall be used in lieu of the County standard minimum section.

The AASHO Group Index Method, the California Bearing Ratio Method, and the Hveem Stabilometer Method are to be used as stipulated below. Supporting test data and calculations shall accompany all requests for approval of a designed structural section.

(1) DESIGN METHODS

Design methods used to arrive at the final structural section (preliminary cost estimates may be based on any method deemed advisable by the design engineer) are varied to suit the type of road in accordance with the following table except that more restrictive substitutions will be permitted.

STRUCTURAL SECTION DESIGN METHODS

ROAD TYPE	DESIGN METHOD
Type 2 - Collector Type 3 - Local Access	CBR (Group Index in Mountainous Terrain) Group Index

(a) CBR METHOD

This method shall be as specified in ASTM test method D1883-67 and as specified herein. The dynamic variation may be used only as a substitution for the Group Index Method. The total gravel cover shall be as determined from Drawing No. 21 STRUCTURAL DESIGN ELEMENTS using the following curves:

ROAD TYPE	DESIGN CURVE
	Mountainous Terrain
Type 2 - Collector Type 3 - Local Access	B A

(b) GROUP INDEX METHOD

This method shall be as specified herein. The required sieve analysis (% passing 200 sieve or F), the L.L. (Liquid Limit), and the P.I. (Plasticity Index) shall be as specified in the applicable AASHO or ASTM Test Methods. The formula used to determine the Group Index shall be as follows:

$$G.I. = (F-35) (0.2 + 0.005 [L.L.-40]) + 0.01 (F-15) (P.I.-10)$$

The total gravel cover shall be determined from Drawing No. 21 STRUCTURAL DESIGN ELEMENTS Using the design curves in the table shown in Section 3.33a - 2 for the CBR Method.

(2) MATERIALS AND GRAVEL EQUIVALENTS

Aggregate base and subbase courses shall be as specified herein or in conformance with Class 6 and Class 1 Aggregate Base Courses respectively, of the Colorado State Highway Specifications for all roads except for collectors or local access roads in Mountainous Terrain where other specifications properly justified by the designer and approved by the County Engineer will be permitted. No finished asphaltic concrete layer shall be less than 2 inches in thickness for

normal traffic loadings and not less than 3 inches in thickness where significant truck or other heavy traffic is expected. No individual layer of aggregate base or subbase shall be less than 4 inches in thickness. Subbase shall be eliminated and base used exclusively where the total gravel cover is determined to be less than 8 inches.

Where expansive soils or soils with a CBR less than 2 or a group Index greater than 20 are encountered appropriate provisions are to be made for the proper total depth of cover, by subexcavating and replacement with adequate support material, increased depth of cover or for special subgrade treatment as the case may be.

Where subexcavating or subgrade treatment is needed the depth shall be one fifteenth (1/15) of the Plasticity Index. Where hydrated lime is used a minimum of 1 pound per square foot per 18 inches of depth shall be applied and thoroughly mixed with the subgrade material. See Section 3.3 E SUBSURFACE DRAINAGE for subsurface drainage requirements.

(3) ROAD CONSTRUCTION TESTING AND INSPECTION POLICY

Test sampling for design and quality control testing frequency shall be adjusted on the basis of professional judgement to suit both the advantages and limitations of the particular design method used and the peculiarities of the individual project. Quality control supervision of road construction in subdivisions or other developments shall be made by the developer's engineer at no expense to Gilpin County. The County Construction Inspector shall be permitted access to the construction site at all times to make spot checks on quality control. Any additional testing or corrective work as he may deem necessary shall be done within the time determined by the County Road Supervisor and County Engineer and at no expense to Gilpin County.

Upon completion of the construction and prior to County acceptance of the work, copies of the as-built plans, compaction test reports, and the developer's engineer's certification that the road has been constructed in conformance with the approved lines, grades, specifications and standards, shall be delivered to the County Engineer before a request for road acceptance will be considered. It shall be the responsibility of the developer to have the necessary County permits obtained prior to commencing road construction.

3.4

DRAINAGE

A. GENERAL POLICY

The primary objective of drainage design shall be the protection of County roads and property while minimizing the possible flood damage to surrounding properties and structures. It should be emphasized that good drainage is one of the most important

factors in road design. It preserves the good appearance as well as the level of service of the road while at the same time minimizing the cost of maintenance.

Culverts under all roads are to be designed to accommodate a 25-year frequency storm runoff on Road Types 2 & 3 utilizing the maximum available head. The maximum available head shall be determined by the uppermost ponding elevation, so chosen as not to cause flood damage to upstream properties.

Inlets and other facilities draining the road surface shall be designed to accommodate the 10-year frequency storm runoff. One lane width is to remain free of ponding for Type 2 Roads, and the Maximum depth of ponding may be one inch above the crown for Type 3 Roads.

All drainage installations shall also be designed to permit free unobstructed passage of debris and silt or provide for their deflection and/or collection at a point upstream in such a manner as not to create an expensive maintenance problem. Settlement basins are to be provided when a silting problem may exist downstream. Modification of natural channels or transferring runoff from one basin to another is not permitted except where no reasonable alternative exists and where the proposal has been reviewed and approved by the County Engineer and the County Road Supervisor.

B. STORM RUNOFF ESTIMATES

For small basins, under 200 acres, the Rational Method ($Q = cia$) shall be used, and for basins over 200 acres up to 640 acres the Rational Method may be used where:

- Q = estimated peak discharge in cubic feet per second.
- c = runoff coefficient (to be taken from the table on next page.)
- i = rainfall intensity in inches per hour for a storm duration equal to the time of concentration. See PART 4-DRAWINGS AND GRAPHS for intensity - frequency maps and the intensity - duration charts.
- a = runoff area in acres.

RUNOFF COEFFICIENTS

<u>MOUNTAINOUS TERRAIN</u>	<u>C</u>
Heavy Vegetation	0.30 to 0.40
Light Vegetation	0.40 to 0.45
Barren, Moderate Slope	0.45 to 0.55
Barren, Steep Slope	0.55 to 0.70
<u>FLAT OR ROLLING TERRAIN</u>	
Farmland	0.20 to 0.40
Barren	0.40 to 0.60
Irrigated	0.60 to 0.70
<u>STREETS AND PARKING LOTS</u>	
Unpaved	0.60 to 0.80
Paved	0.70 to 0.95
<u>IMPROVEMENTS</u>	
Buildings	0.75 to 0.95
Lawns	0.10 to 0.40

The time of concentration may be determined from the graph in PART 4 - DRAWINGS AND GRAPHS or may be calculated using other acceptable methods as approved by the County Engineer. Calculation sheets clearly showing the method used must be submitted. Computed times of concentration shorter than 10 minutes may be rounded upward to 10 minutes.

In all cases, calculation sheets shall be submitted clearly showing all assumptions and computations made.

C. CULVERTS

Culverts are to be located at each natural draw or water course as conditions warrant to prevent excessive accumulation of flow in roadside ditches or along the toe of slopes. Draws and water courses are to be cleared of debris for a distance of 100 feet upstream from all culvert inlets.

Inverts at the inlet should be slightly elevated above the normal flow line in steep natural draws to avoid plugging by debris. Inlets are not to be elevated in those instances where ponding or backwater curves would be objectionable (stagnation, irrigation ditches, etc.). Only in specified instances may the inlet invert be lower than the natural flow line.

The culvert should slope downward in the direction of natural flow and designed to be self-cleaning wherever possible. The outlet should be designed so as not to discharge on unprotected fills or unstable material or at adverse angles to streams or open channels. Headwalls, rip-rap, or other means of protection are required at inlets or outlets where erosion may occur.

Velocities of flow in culverts shall be calculated using acceptable design charts or formulas. Where the Manning Equation is used (Section 3.44), the following "n" values shall apply:

MATERIAL	MANNING'S "n"
Corrugated Steel Pipe	.027
Reinforced Concrete Pipe	.013
Concrete (smooth-rough)	.013 to .020
Asphalt	.016

Corrugated Steel Pipe, reinforced concrete pipe, or reinforced concrete boxes shall be used. Steel pipe shall be asphalt coated or paved where soils are corrosive or other conditions exist that may attack the steel.

Minimum diameter for round pipe shall be 18 inches. The minimum rise of arch pipes and box culverts shall be 12 inches.

When a battery of pipes is used, a clear spacing of 1/2 the pipe diameter (1 foot minimum, 4-foot maximum) must be provided. Minimum cover shall be 1 foot over pipes 48 inches in diameter or less and 2 feet over larger pipes. The maximum cover, pipe metal gauge, and strength classification shall be as recommended by the manufacturer and are subject to the approval of the County Engineer. Additional thickness or pipe protective cover may be required where conditions are erosive.

D. OPEN CHANNELS AND DITCHES

Channels and ditches are to be designed so as not to create roadside safety hazards. The minimum flow line slope shall be 0.2% if the channel is paved and 0.3% for channels of other materials. Maximum slopes shall be controlled by the maximum permissible velocities given in the table on the following page. Greater velocities of flow will require appropriate channel protection.

Manning's equation ($v = \frac{1.486}{n} R^{2/3} S^{1/2}$) shall be used to estimate flow velocities where:

v = velocity of flow in channel in feet per second.

n = roughness coefficient (to be taken from the table on the following page).

R = hydraulic radius in feet.

S = slope in feet per foot.

CHANNEL MATERIAL	MANNING'S "n"	MAXIMUM PERMISSIBLE VELOCITY IN FEET PER SECOND
Silt	.025	2.0
Sand	.030	2.5
Smooth, stiff clay	.025	4.0
Fine gravel	.035	3.5
Coarse gravel	.040	4.5
Small, sharp-edged rocks	.070	6.0
Cobbles and shingles	.060	6.0
Shales and hardpans	.030	6.0

Where the channel is comprised of a combination of these materials, the maximum permissible velocity should be selected so as not to cause undue scouring of the finer materials or silting downstream.

E. SUBSURFACE DRAINAGE

Subgrades subject to poor drainage, underground seepage or a higher water table must be adequately drained for roadbed stabilization. Drains must be installed to control or prevent the high ground water level from coming to within four feet of the roadway pavement.

3.5

BRIDGES

Bridges are to conform to Colorado Department of Highways requirements and specifications. Plans are to be prepared by a qualified registered engineer and are to be submitted to the County Engineer for review and approval.

The waterway area shall accommodate a 100-year frequency storm. Where flood studies from the U.S. Army Corps of Engineers are available, bridges shall be designed to accommodate the "Standard Project Flood". Designs based on lesser storms and the overflow sections are subject to approval by the County Engineer. A minimum of one foot of freeboard is required. Additional freeboard will be required where debris laded flows are anticipated.

3.6

TRAFFIC CONTROL DEVICES

All signs, striping, markers, delineators, signals and other traffic control devices are to conform to the requirements of the State of Colorado as outlined in "UNIFORM TRAFFIC CONTROL DEVICES".

In new developments, all required street name signs, speed limit signs, stop signs and other traffic control devices are to be installed and paid for by the developer. Non-standard signs or other traffic control devices are subject to rigid State control and approval of the County Engineer must be obtained for their use. Requests for using non-standard signs or other devices must be submitted to the County Engineer along with all data required to support the request.

3.7

DRIVEWAYS:

A driveway permit is required. Plans must show proposed alignment, grades, cut slopes, fill slopes, and drainage. Driveways may not drain onto public roads. Driveway openings are to be located at least 10 feet from the end of a curb return rounding radius. Driveway opening are to be separated by at least 10' or otherwise combined. Opening widths must be a minimum of 20'. Maximum residential driveway opening is 30'. Maximum commercial driveway opening is 40'.

RESIDENTIAL DRIVEWAY SPECIFICATIONS:

DRIVEWAY 1: Serves 1 home site only

- Maximum slope of 12% / Minimum width of 12 feet.

DRIVEWAY 2: Serves 2 to 4 home sites with no outlet. A minimum easement of 24' must be granted to Gilpin County. Not eligible for acceptance by Gilpin County for maintenance purposes.

- Maximum slope of 8% / Minimum width of 16 feet.

DRIVEWAY 3 -RURAL ACCESS ROAD: Serves 5 or more home sites with no outlet. A minimum dedicated ROW of 50' must be deeded to Gilpin County. Rural access roads are eligible for acceptance by Gilpin County for maintenance purposes.

- Maximum slope of 8%. / Minimum width of 16 feet.
- A Cul de sac with a minimum inside turning radius of 30' is required and must be located within 250' of the road terminus.

3.8

GUARD RAIL

A. PURPOSE

Guard rail is installed to prevent accidents by delineating the roadbed; to reduce accident severity by deflecting vehicles into safer paths; and to reduce the rate of deceleration in the case of pending collisions with fixed objects.

B. DESIGN AND PLACEMENT

State approved guard rail shall be used. The length of guard rail should be planned in multiples of 12.5 feet and the ends shall be so placed as not to present an abrupt or projecting end facing toward approaching traffic. Delineators shall be installed according to Colorado Department of Highways specifications.

When guard rail is used in conjunction with roadwide curbs,

the face of the guard rail must be flush with the face of the curb regardless of shoulder width. This is to prevent the take-off ramp effect which may throw a vehicle over the guard rail or turn the vehicle over. When no curb is present, the face of the guard rail shall be flush with the edge of the surfaced shoulder. If for any reason it is desirable to set the guard rail behind the curb the standard guard rail height shall extend above the top of the curb, and not from the gutter grade.

On curves requiring a reduction in approach speeds, any one of the following conditions indicate that consideration would be given to the installation of guard rail on the outside of the curves:

- (1) Height of embankment more than 10 feet.
- (2) Side slope steeper than 4:1.
- (3) Substandard pavement and shoulder widths.
- (4) Roadside hazards.

Whether on curves or on tangents, consideration should be given to the installation of guard rails if there is a concentration of running off roadway accidents or if unusually high embankments or steep terrain give motorists a feeling of insecurity.

In areas subject to dense fog or snow and ice conditions, or if traffic speed and volumes are high, guard rail is justified where its installation would be questionable under less adverse conditions.

An obstruction or sudden constriction in width may require the installation of guard rail.

An isolated sharp curve on a road otherwise built to higher standards may warrant guard rail.

Ordinarily, guard rail is placed only on the outside of the curve.

Guard rails may be needed at approaches to bridge piers, abutments, trees or other obstructions.

C. GUARD RAIL AT BRIDGE APPROACHES

Guard rail shall be placed at the ends of all bridges on the right of approaching traffic. Where pedestrians, especially school children, are expected to use the shoulder, a walkway should be provided around the end of the guard rail outside the normal shoulder line.

3.9 DRAINAGE STRUCTURES

Culvert pipes are to be installed by trenching in natural or constructed banks. The trench is to be 1' (one foot) wider on each side of the pipe and the bottom of the trench is to be smooth and free of isolated hard-bearing surfaces. A shaped uniform bedding free of rocks 3 inches or greater in diameter will be required for pipes greater than 48 inches in diameter. Backfill shall consist of pervious material free of 3 inch or larger rock

and shall be placed in maximum 8 - inch lifts. Each lift is to be compacted to 95% before the next lift is installed. Backfill material and 95% compaction is to extend to 9" (nine inches) (minimum) above the top of the pipe.

Culverts will be cambered when necessary so as to produce a uniform descending grade from inlet to outlet after backfill has been completed.

3.10

FINISHED ROADWAY

The final inspection of the finished roadway is made immediately prior to the recommendation for acceptance. All deficiencies must be resolved to the satisfaction of the County Engineer and the County Road Supervisor before a recommendation will be made to the Board of County Commissioners for acceptance or before a release from the 10% building permit requirement will be made.

PART 4 - DRAWINGS AND GRAPHS

Drawing #1	Arterials.....	Page 24
#2	Collectors	Page 25
#3	Local Access	Page 26
#4	Road Intersections	Page 27
#5	Design Elements	Page 28
#6	Stopping Sight Distances on Horizontal Curve	Page 29
#7	Stopping Sight Distances on Crests.....	Page 30
#8	Passing Sight Distances on Crests.....	Page 31
#9	Time of Concentration	Page 32
#10	Intensity - Duration Curves.....	Page 33

Approved

Gilpin County Board of County Commissioners

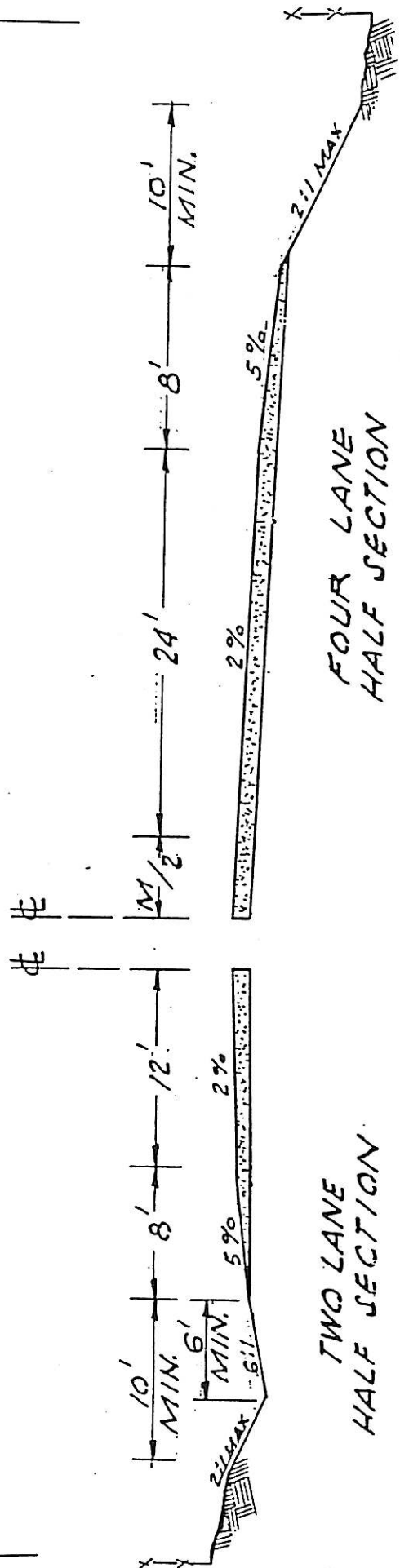
Donald J. McCallum

Acting chairman

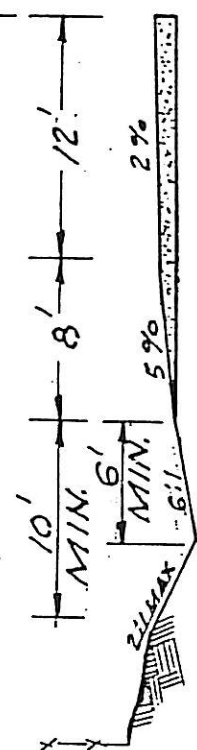
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Date

120' MINIMUM RIGHT OF WAY

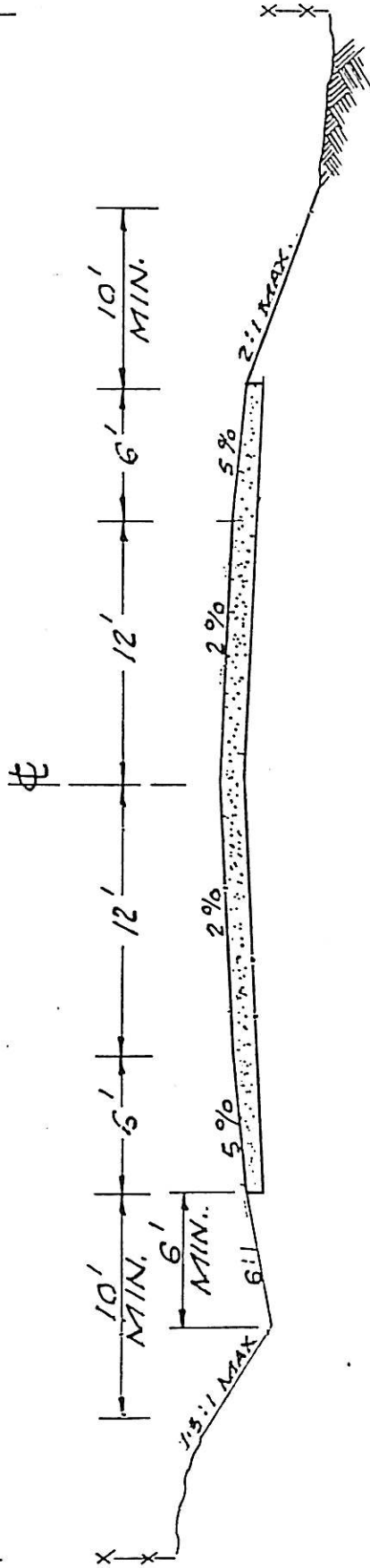


TWO LANE HALF SECTION



GILPIN COUNTY
STATE OF COLORADO
TYPICAL SECTION TYPE 2
ARTERIALS

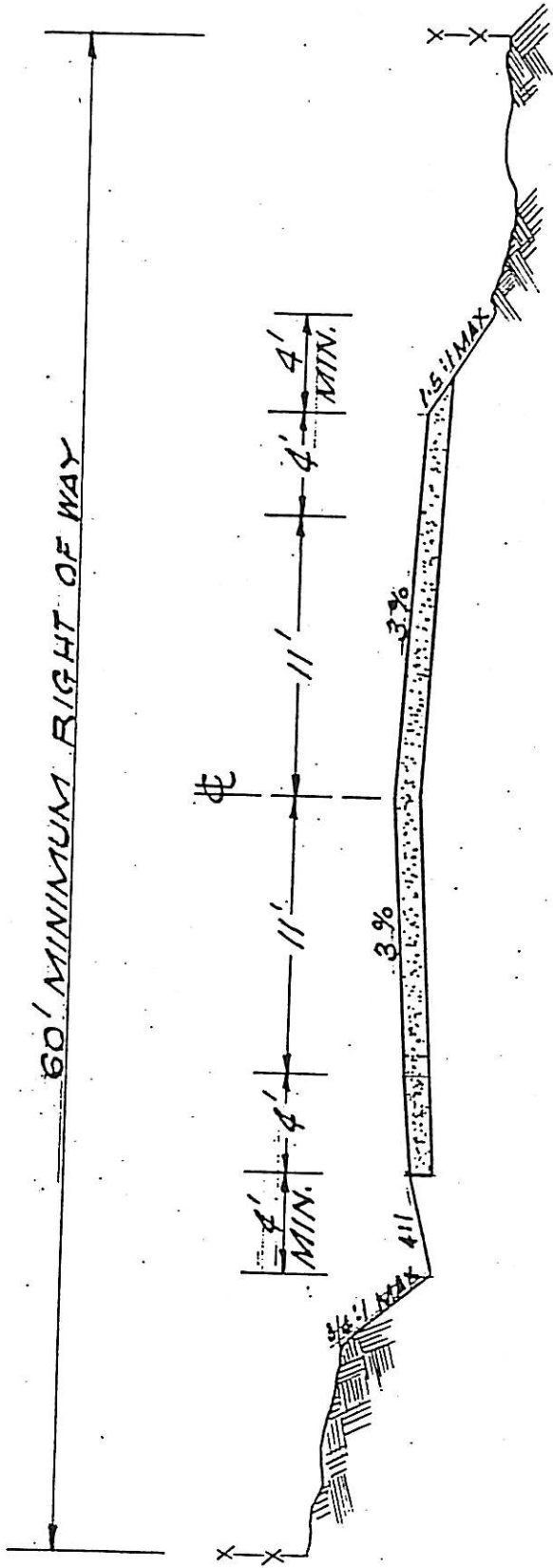
80' MINIMUM RIGHT OF WAY



GILPIN COUNTY
STATE OF COLORADO
TYPICAL SECTION TYPE 3
COLLECTORS

DWG. NO. 2 PAGE NO. 25

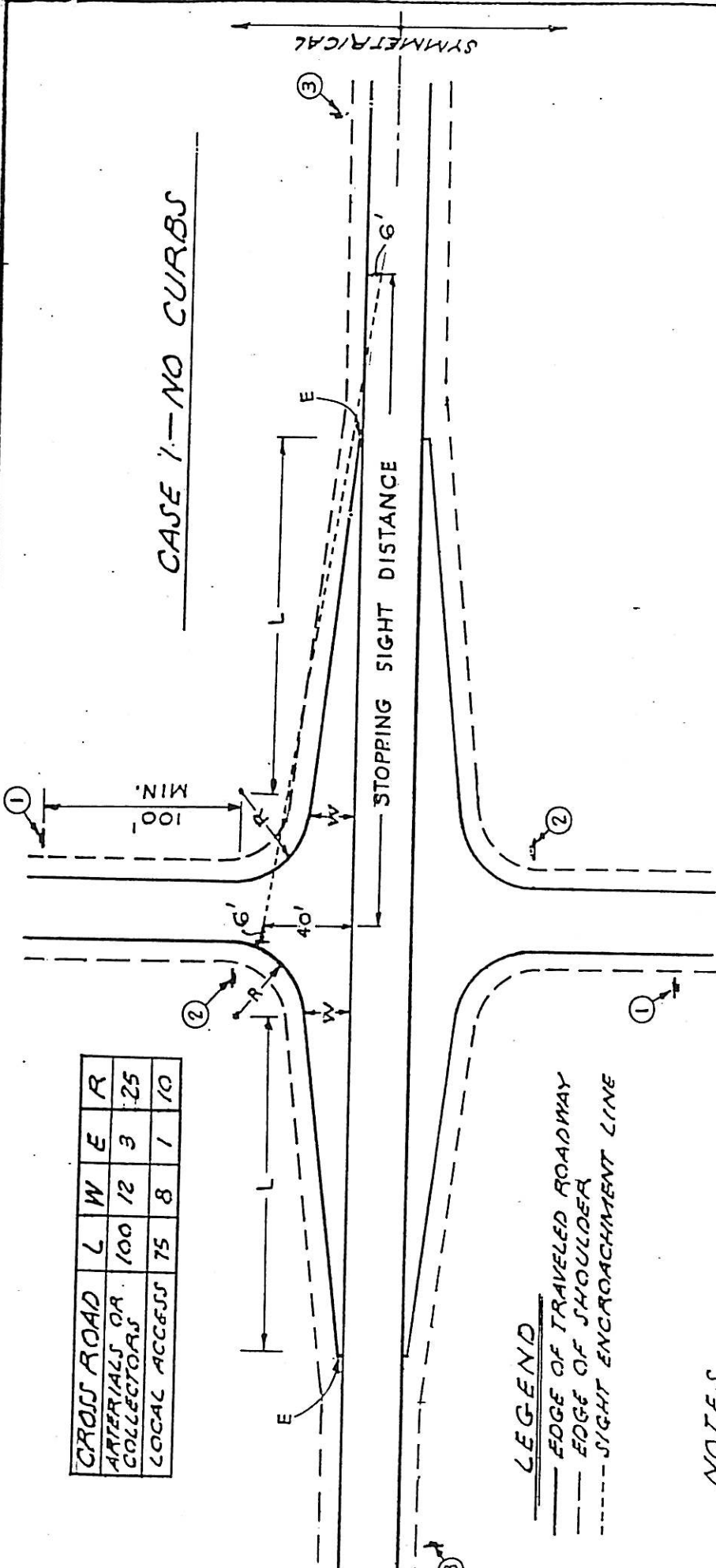
H.E.O.



GILPIN COUNTY
 STATE OF COLORADO
 TYPICAL SECTION TYPE 4
 MOUNTAINOUS TERRAIN
 LOCAL ACCESS
 DWG. NO. 3 PAGE NO. 26

H.E.D.

CASE 1 - NO CURBS



CROSS ROAD	L	W	E	R
ARTERIALS OR COLLECTORS	100	12	3	25
LOCAL ACCESS	75	8	1	10

- LEGEND**
- EDGE OF TRAVELED ROADWAY
 - - - EDGE OF SHOULDER
 - - - - SIGHT ENCROACHMENT LINE

NOTES

- ① STANDARD SPEED LIMIT SIGN. (SR 2-1 ON ARTERIALS AND COLLECTORS, CA 2-1 ON LOCAL ACCESS)
- ② STANDARD STOP SIGN. (SR 1-7) PLACED NOT MORE THAN 50', NOR LESS THAN 6' FROM EDGE OF TRAVELED ROADWAY OF MAIN ROAD.
- ③ STANDARD INTERSECTION SIGN (SW 2-1) PLACED APPROXIMATELY 250' ± SIGHT DISTANCE FROM CROSS-ROAD. EDGE OF SIGN TO BE PLACED 6' FROM EDGE OF SHOULDER. (TYPICAL)

GILPIN COUNTY
STATE OF COLORADO
ROAD INTERSECTION
DWG. NO. 4 PAGE NO. 27.

H.E.P.

DESIGN ELEMENT		ARTERIAL	COLLECTOR	LOCAL ACCESS
TERRAIN CLASSIFICATION		MTN.	MTN.	MTN.
MINIMUM RIGHT OF WAY (FEET)		120	80	60
DESIGN SPEED (M.P.H.)		40-50	30-40	20-30
NUMBER OF LANES		2-4	2	2-1
	4 LANES	52		
	2 LANES	30	30	30
	2 LANES WITHOUT PARKING			26
	1 LANE			16
ROADBED WIDTH (FEET)				
MAXIMUM GRADE (%)		6	6	8
MINIMUM E RADIUS (FEET)		550	250	100
MINIMUM RADIUS (CURB RETURN)		25	25	10
BRIDGE WIDTH		SAME AS ROADBED WIDTH		

GILPIN COUNTY

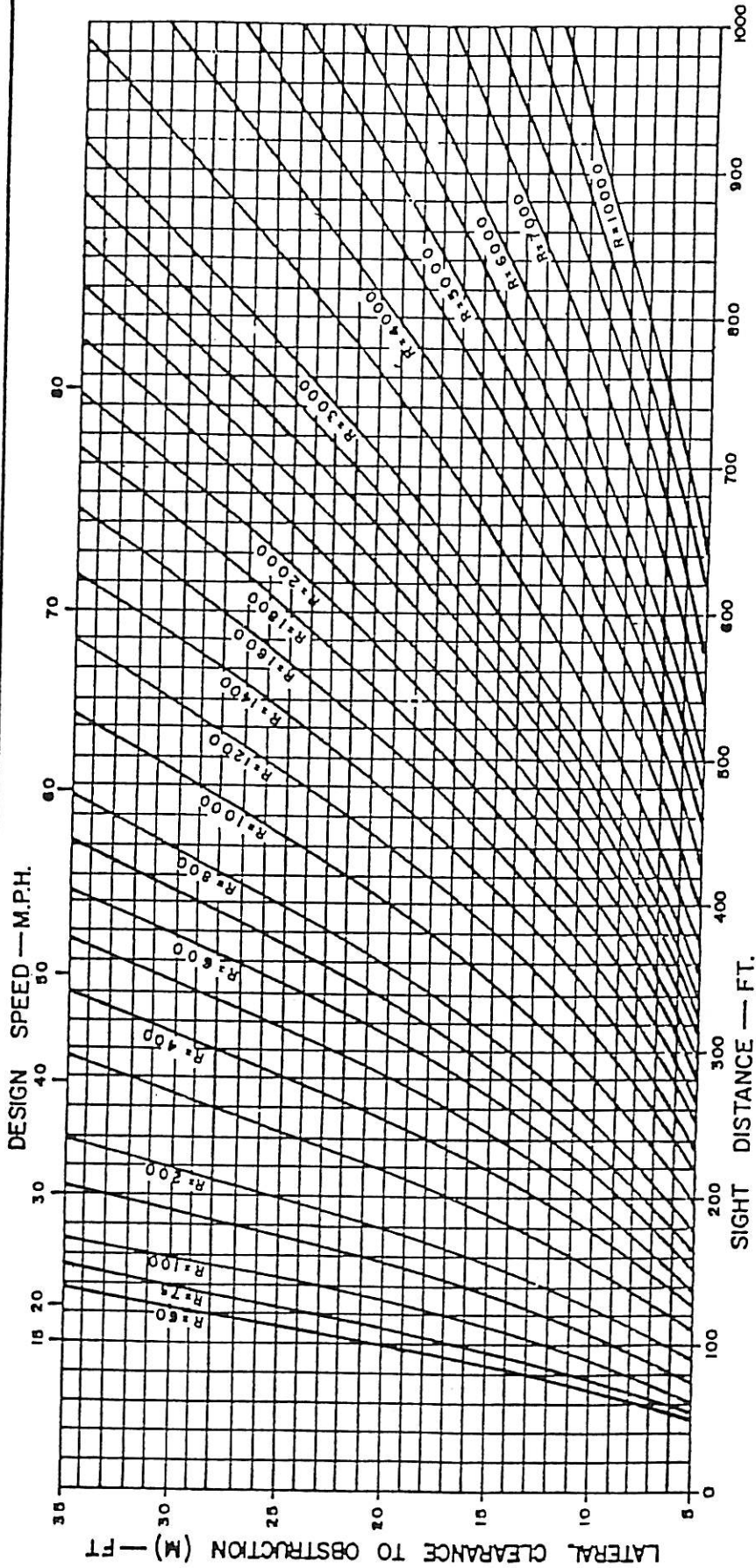
STATE OF COLORADO

SUMMARY OF
DESIGN ELEMENTS

DWG. NO. 5

PAGE NO. 28

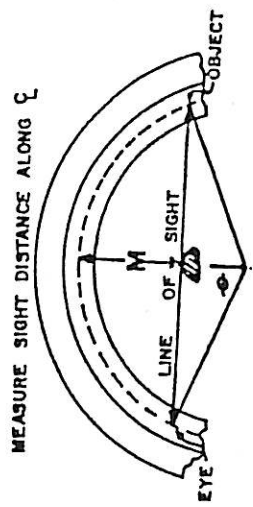
H.B.D.



$$M = R \text{ Vers } \phi$$

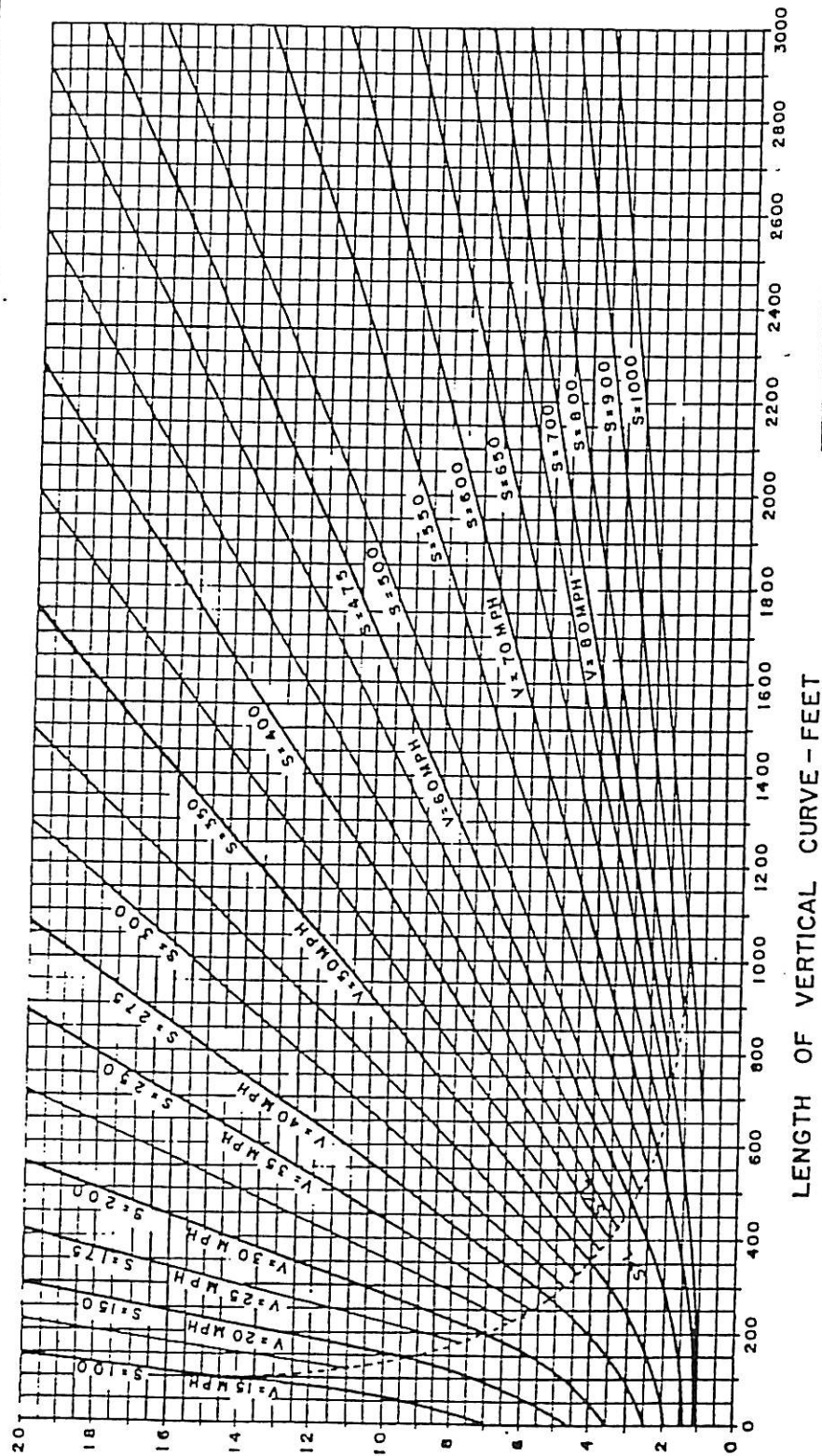
$$S = \frac{R \cos \phi}{28.65}$$

- ϕ — $\frac{28.653}{R} \cdot \frac{R-M}{R}$
- S — SIGHT DISTANCE IN FEET
- R — RADIUS OF INSIDE LANE — FT.
- M — DISTANCE FROM OBSTRUCTION TO ϕ INSIDE LANE IN FEET.



GILPIN COUNTY
 STATE OF COLORADO
 STOPPING SIGHT DISTANCE
 ON HORIZONTAL CURVE

H.E.D.



LENGTH OF VERTICAL CURVE - FEET

ALGEBRAIC DIFFERENCE IN GRADES - PERCENT

WHEN $S > L$	WHEN $S < L$
$L = 2S - \frac{1398}{A}$	$L = \frac{AS^2}{1398}$

L = LENGTH OF VERTICAL CURVE - FEET
 A = ALGEBRAIC DIFF. IN GRADES - %
 S = SIGHT DISTANCE IN FEET
 V = VELOCITY

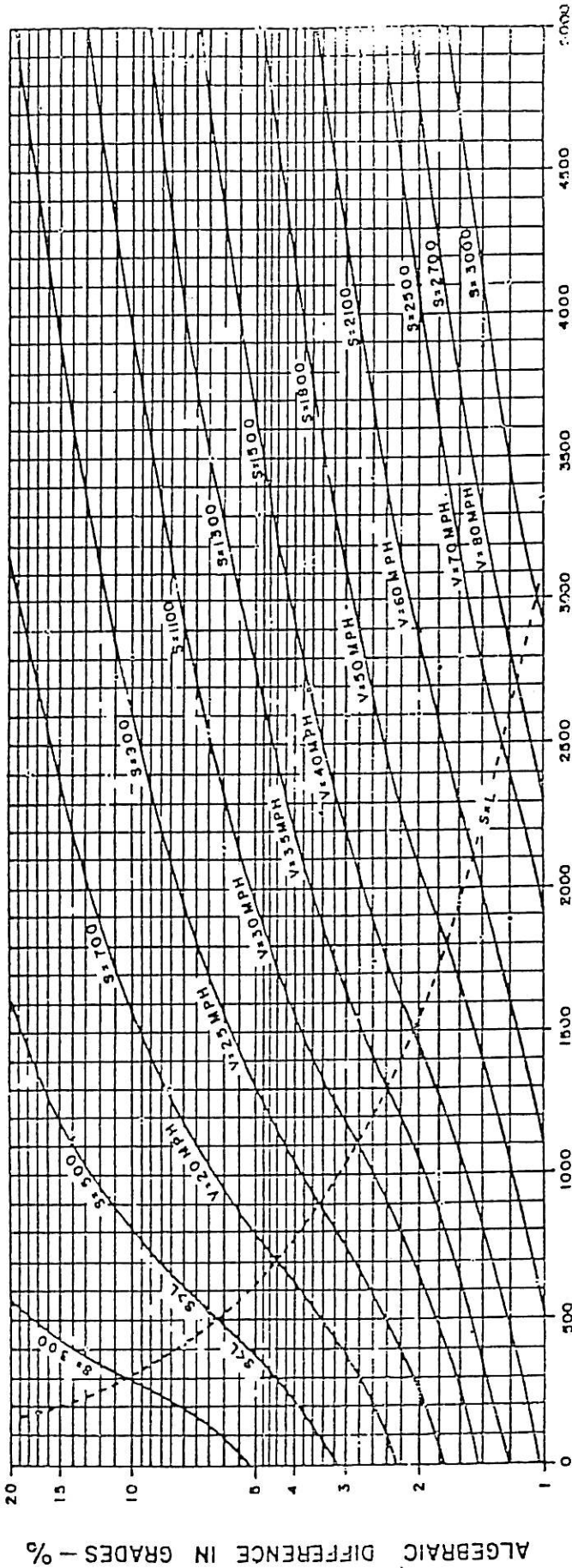
GILPIN COUNTY

STATE OF COLORADO

STOPPING SIGHT DISTANCE
 ON CRESTS

DWG. NO. 7 PAGE NO. 30

H. E. D.



LENGTH OF VERTICAL CURVE — FEET

WHEN $S > L$	WHEN $S < L$
$L = 2S - \frac{3100}{A}$	$L = \frac{AS^2}{3100}$

L = LENGTH OF VERT. CURVE — FT.
 A = ALGEBRAIC DIFF. IN GRADES — %
 S = SIGHT DISTANCE — FT.

GILPIN COUNTY
 STATE OF COLORADO
 PASSING SIGHT DISTANCE
 ON CRESTS

DWG. NO. 8 PAGE NO. 31

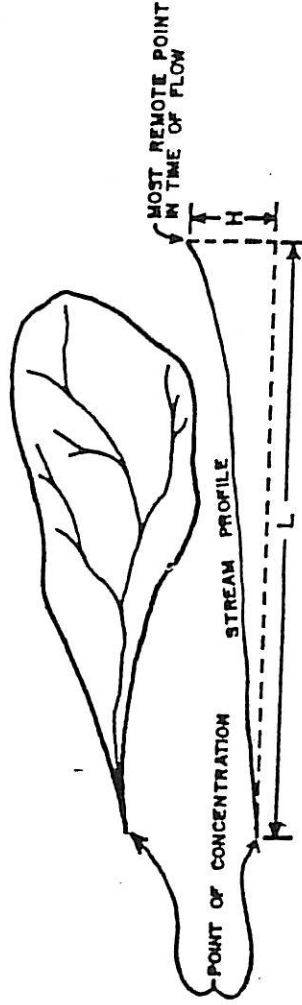
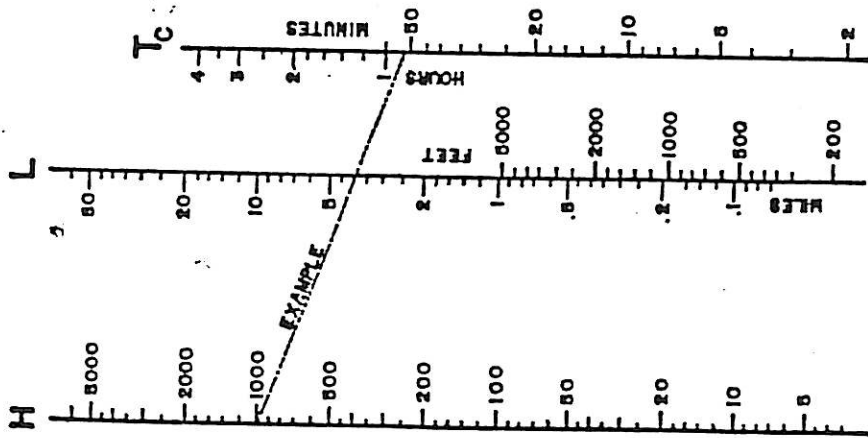
H.E.D.

NOMOGRAPH BASED ON THE FOLLOWING:

$$T_c = \left(\frac{11.9 L^3}{H} \right)^{0.385}$$

T_c = TIME OF CONCENTRATION — IN HOURS
 H = DIFF. IN ELEVATION BETWEEN POINT OF CONCENTRATION AND MOST REMOTE POINT (IN TIME OF FLOW) OF THE WATERSHED AREA — IN FEET
 L = LENGTH OF WATERCOURSE FROM MOST REMOTE POINT (IN TIME OF FLOW) TO POINT OF CONCENTRATION — IN MILES.

P O' L



NOTE: WHERE THE STREAM PROFILE IS UNEVEN OR ERRATIC, IT SHOULD BE BROKEN INTO REACHES BEFORE COMPUTING THE T_c . FOR PAVED BASINS $0.5 T_c$ SHALL BE USED. $2 T_c$ MAY BE USED IN DENSELY COVERED BASINS ON APPROVAL.

EXAMPLE:

$H = 1000$ FT.
 $L = 4$ MILES
 $T_c = 53$ MIN.

GILPIN COUNTY
 STATE OF COLORADO

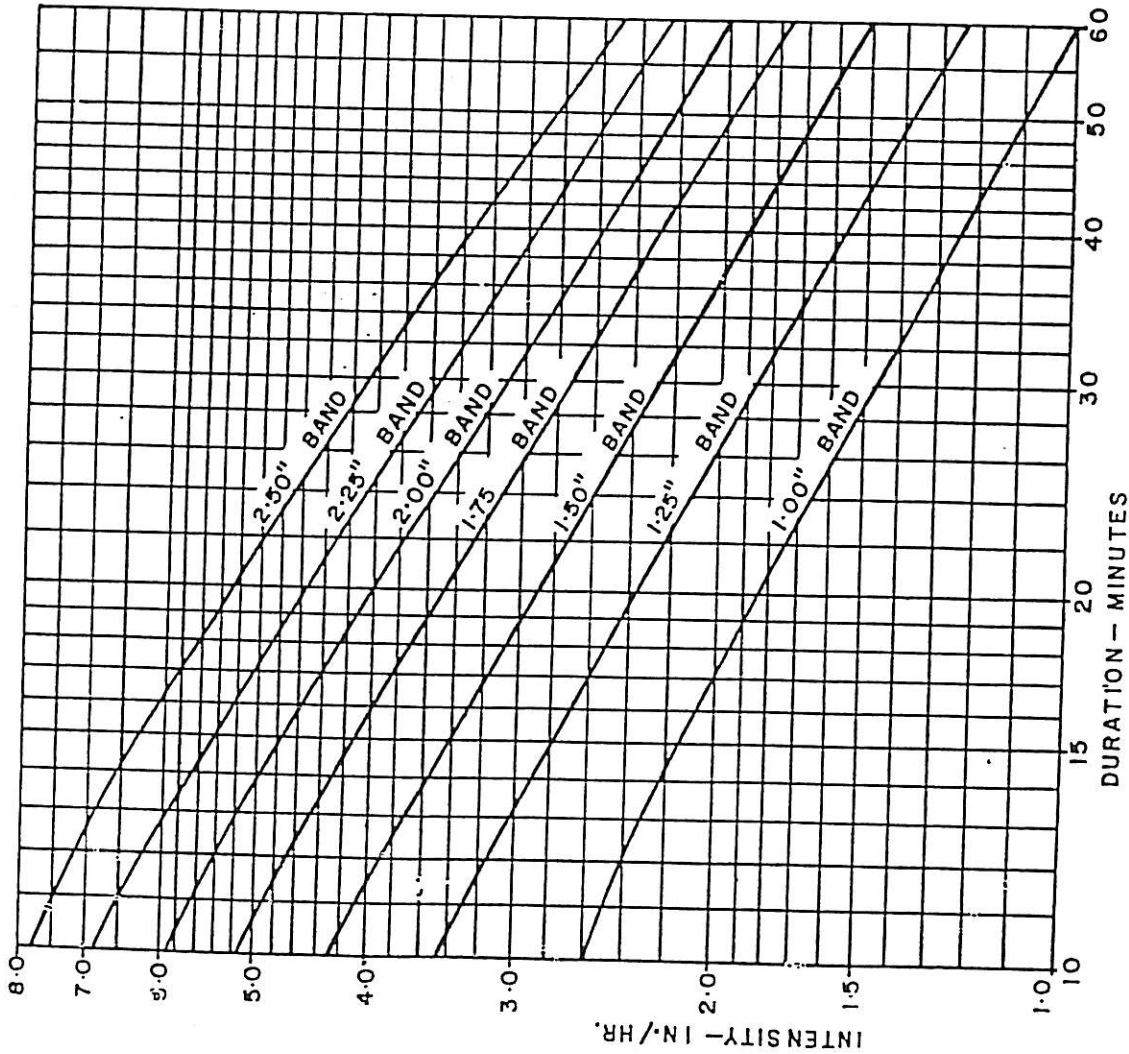
TIME OF CONCENTRATION
 DRAINAGE AREAS

DRAWING NO. 9 PAGE NO. 32

H.E.D.

NOTES:

THE CURVES ARE APPLICABLE TO THE PRECIPITATION BAND OF ANY FREQUENCY.



GILPIN COUNTY
STATE OF COLORADO

INTENSITY-DURATION
CURVES

DWG. NO. 10 PAGE NO. 33

H.E.D.