Boulder County
Road Standards and Specifications

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RESOLUTION NO. 83 - 145

CONCERNING THE ADOPTION OF THE BOULDER COUNTY ROAD STANDARDS AND SPECIFICATIONS 1983

WHEREAS, the purpose of standards and specifications is to provide for the planning, design and construction of improvements to new or existing roadway facilities; and

WHEREAS, it is necessary and desirable that any improvements or construction within a County road easement, right-of-way, or private access must be performed in accordance with uniform standards, specifications and procedures, to protect the health, safety and welfare of the public; and

WHEREAS, Boulder County is authorized to plan, design, construct and administer road facilities by virtue of Sections 43-2 (highways), 30-28-11 (zoning) and 30-28-133 (subdivision) of the Colorado Revised Statutes of 1973 as amended, together with future revisions of these sections; and

WHEREAS, the Boulder County Road Development Policies, Standards and Specifications adopted July 28, 1969 provided standards, specifications and procedures and are hereby revised; and

WHEREAS, the Boulder County Road Standards - 1983 have been referred to all interested parties to receive comments; and

WHEREAS, the Boulder County Regular Planning Commission during a public hearing adopted the Road Standards and Specifications - 1983 on October 26, 1983 as per the attached Exhibit "A".

NOW, THEREFORE, BE IT HEREBY RESOLVED that the Boulder County Road Standards and Specifications - 1983 be hereby adopted to be effective December 13, 1983.

ADOPTED this 13th day of December, 1983.

BOARD OF COUNTY COMMISSIONERS:

JOSEPHINE N. HEATH, CHAIR

JACK MURPHY

HERBERT E. "BUZ" SMITH, JR.

ATTEST:

Clerk to the Board

ARTICLE I

GENERAL PROVISIONS

ARTICLE I – GENERAL PROVISIONS

1.1 Title

These regulations, together with all future amendments, shall be known as the Boulder County Road Standards and Specifications, and will be referred to herein as these Standards and Specifications. Boulder County will be referenced herein as the County and is located within the State of Colorado.

1.2 Purpose

The purpose of this title of the code is to provide for the planning, design and construction of improvements to new or existing roadway facilities, consistent with the Boulder County Comprehensive Plan, and to provide for the administration of the County road system, consistent with State statutes and applicable County resolutions or ordinances. The intent of these Standards and Specifications is to provide for a minimum level of performance and safety. Consequently, if it can be shown that an alternate design, material or procedure will provide performance equal to or better than the required design, material or procedure, said alternate may be approved by the County Engineer. A failure to meet minimum standards creates deficiencies with resulting high maintenance or user costs.

1.3 Applicability

These Standards and Specifications apply to all new roadway facilities, public or private, to be constructed within Boulder County except where other jurisdictions have direct authority (e.g., cities, state highways, RTD). It is recognized that proposed improvements to existing roadway facilities and construction of new roadway facilities within old townsites or subdivisions may not be in conformance with these Standards and Specifications because of existing lines or grades, poorly laid out lots and other conditions. The County Engineer may therefore approve variations from these Standards and Specifications where safety is not compromised.

1.4 Authority

Boulder County is authorized by state statute to plan, design, construct and administer road facilities by virtue of Sections 43-2 (highways), 30-28-111 (zoning) and 30-28-133 (subdivision) of the Colorado Revised Statutes of 1973 as amended, together with future revisions of these sections.

1.5 Amendments

These Standards and Specifications may, when deemed necessary, be altered or amended upon recommendation of the County Engineer and approval by the Board of County Commissioners, after a 30-day public notice period.

ARTICLE II

ADMINISTRATION

ARTICLE II - ADMINISTRATION

2.1 Road Systems

The highway system in Boulder County consists of state highways, county roads, city streets, and other public and private road systems.

2.1.1 The State Highway System

The state highway system in Boulder County is administered by the Colorado Division of Highways under the direction of the Executive Director and the State Highway Commission who act as a board of directors. The state highway commissioners are appointed from Districts by the Governor upon approval of the state legislature. Boulder County is in Commissioner District #9. For operational purposes, the state is divided into engineering regions which carry out road construction and maintenance programs. Most of Boulder County is in District IV whose headquarters in Greeley. A small portion of the County in the Broomfield area is in District VI headquartered in Denver.

The Colorado Division of Highways has full responsibility for the construction and maintenance of all state highways within the unincorporated areas of Boulder County. Within incorporated areas, maintenance responsibilities may be assumed by the municipality under a maintenance agreement. Signing of County road approaches to state highways is also under the jurisdiction of the Colorado Division of Highways.

Access to the state highway system in Boulder County is administered by highways through the State Highway Access Code.

Planning for state highways is conducted by the Colorado Division of Highways in cooperation with the County, the Denver Regional Council of Governments (DRCOG), local municipalities and other agencies. Boulder County solicits requests for state highway improvements from the municipalities and interested agencies, prioritizes these requests and submits a list of recommendations to the State Highway Commission.

2.1.2 The County Road System

The State of Colorado, by statute, authorizes the Board of County Commissioners to administer the County Road System, including, but not limited to, planning, design, construction, maintenance and traffic regulation. County jurisdiction extends to all roads, other than State or Federal Highways within unincorporated lands of Boulder County.

a. The County Road Map

The Board of County Commissioners has adopted a Boulder County Road Map showing all roads that have been officially made a part of the County Road System. This map is updated annually or as needed to reflect all additions, deletions and alterations to the County Road System. All open, used and maintained public highways in the unincorporated area of the County are shown. For informational purposes, all platted non-maintained public roads are shown as well as several non-maintained jeep trails.

In zoning matters related to setbacks from or access to existing public highways, the Boulder County Road Map shall be the County's official map of the public highway system. The County Road System consists of a primary system and a secondary system of County roads. All those roads designated on the County Road Map as “freeway-expressway” and “arterial” constitute

the County's Primary System and as such form an integrated road system. All those roads designated as “collectors” and “local access” constitute the County's Secondary System for which the Board of County Commissioners assumes responsibility, though with lesser priority.

b. County Road Administration

The Board of County Commissioners, by statute, shall determine the general policies of the County as to county road matters. The Board has established three Road Districts, each administered by a County Commissioner. The Board appoints a Road Supervisor for each district who is primarily responsible for the maintenance, repair and improvement of all existing County roads within the district.

The County Public Works Department is responsible for the development and enforcement of County road standards; the design and construction of improvements to the County Road System; the inspection of private construction of improvements to the public road system; the inspection and regulation of utility installations in County rights-of-way and regulation of traffic on the County Road System. In conjunction with the County Land Use Department and subject to review and approval by the County Planning Commission and Board of County Commissioners, the Public Works Department is responsible for the planning of the County Road System.

2.1.3 City Streets/Mixed Jurisdiction

Situations arise in which both the County and a City or other agency become involved in a given development. For example, a development might be in an area of probable city annexation, or perhaps the developer may require a utility or service provided by another agency. The following procedure shall then apply:

a. The County shall be the responsible reviewing and approving agency for those developments within County jurisdiction.

b. The County shall refer development plans to involved agencies for review and comment.

c. Requirements of other agencies that not in opposition to the County's best interest shall be enforced by the County.

d. The other agencies shall be responsible for the issuance of utility permits and inspections of their respective utilities.

e. The County will be responsible for the issuance of permits and the inspection of all road construction and appurtenances thereto and for installations of all utilities in the County road Rights-of-Way.

To reduce jurisdictional problems, municipalities are encouraged to annex full width roads when annexing new areas, instead of half-widths.

2.1.4 Other Public Roads

State statute (C.R.S. 43-2-201) declares the following to be public highways:

a. All roads over private lands dedicated to the public use by deed to that effect, filed with the County Clerk and Recorder of the County in which such roads are situate when such dedication has been accepted by the Board of County Commissioners. A certificate of the County Clerk and Recorder with whom such deed is filed, showing the date of the dedication and the lands so dedicated, shall be filed with the County Assessor of the County in which such roads are situate.

b. All roads over private or other lands dedicated to public uses by due process of law and not heretofore vacated by an order of the Board of County Commissioners duly entered of record in the proceedings of said board;

c. All roads over private lands that have been used adversely without interruption or objection on the part of the owners of such lands for twenty consecutive years;

d. All toll roads or portions thereof which may be purchased by the Board of County Commissioners of any County from the incorporators or charter holders thereof and thrown open to the public;

e. All roads over the public domain, whether agricultural or mineral.

The County has authority for traffic control regulation and for keeping unobstructed all such public highways.

2.1.5 Private Roads

Private roads may be established by prescriptive use, a recorded easement, or plat dedication. Boulder County assumes no maintenance responsibility on private roads and does not regulate utilities on private roads. The use of private roads for emergency services, postal delivery or school pickups must be arranged by the owner with the proper agency.

2.2 Road System Regulations

2.2.1 Legislative Authority

Sections 42-4-101 through 42-4-1513, C.R.S. 1973 authorizes the Board of County Commissioners to regulate traffic on County roads. Section 43-3-147, C.R.S. 1973 also authorizes local governments to regulate vehicular access to or from any public highway under their respective jurisdiction from or to property adjoining a public highway in order to protect the public health, safety and welfare, to maintain smooth traffic flow, to maintain highway right-of-way drainage and to protect the functional level of public highways.

2.2.2 Traffic Control Devices

All traffic control devices installed on County roads shall conform to the most recent edition of the Manual on Uniform Traffic Control Devices and any manual or supplement thereto approved and distributed by the State Highway Commission.

The Boulder County Public Works Department shall be responsible for conducting or any accident studies, traffic analysis, traffic control studies or any other engineering studies, required by state law or by the Manual on Uniform Traffic Control Devices, which are prerequisite for the installation of traffic control devices on County roads.

The Transportation Department shall keep records of all roads or parts of roads where traffic regulations have been authorized by the Board of County Commissioners.

2.2.3 Issuance of Permits

a. Utility Installation Permits - No individual, company, corporation or public agency shall modify, install or otherwise change any utility located within a County right-of-way without first obtaining a utility installation permit from the Boulder County Public Works Department. Requirements for such installations are found in the Boulder County Utility Installation Permit Requirements.

b. Access Permits

State Highway - Pursuant to Section 43-2-147 of the 1973 Colorado Revised Statutes (C.R.S.), no person shall construct any driveway providing vehicular access to or from any state highway from or to property adjoining a state highway without an access permit issued by the State Highway Department. Requirements for access permits are found in the State Highway Access Code.

County Roads - Pursuant to Section 43-2-147, C.R.S. 1973 no person shall construct any driveway providing vehicular access to or from any County road from or to property adjoining a County road without an access permit issued by the Boulder County Public Works Department. Requirements for access permits are found in the Boulder Access Permit Requirements.

c. Construction Permits - No person shall construct any road, drainage or other improvement within County right-of-way without a Construction Permit issued by the Boulder County Public Works Department. Construction Permits shall also be required for private road construction that is a prerequisite of building permits or other development activity. Road construction shall be in accordance with engineering plans prepared by a professional engineer in conformance with these Standards and Specifications with said plans to be approved by the County Engineer.

Construction permits shall be obtained at least two weeks prior to commencement of construction. A list of required field tests and inspections will be attached to the permit. The applicant shall submit a written schedule of the work including quantities of materials and length of the job. The permit and work schedule, when approved shall not be changed without the written consent of the County Engineer. Construction permits expire and must be renewed at the end of one year.

d. Oversize/Overweight Permits - Pursuant to Section 42-4-409, C.R.S. 1973, the Boulder County Public Works Department may, upon application in writing and good cause being shown therefor, issue an Oversize/Overweight Permit to operate or move a vehicle or combination of vehicles of a size or weight of vehicle or load exceeding the maximum specified in the Colorado Vehicle Code upon any County road. The Public Works Department may limit the number of trips, the hours of operation or otherwise prescribe conditions of operation of such vehicle to ensure against undue damage to road foundations, surfaces or structures, and may require such undertaking or other security as may be deemed necessary to compensate for any injury to any roadway or structure.

2.2.4 Enforcement

It is the responsibility of the Colorado State Patrol and the Boulder County Sheriff's Department to enforce applicable provisions of Colorado traffic laws on the Boulder County Road System and insofar as possible to cooperate with the Public Works Department and other officials of Boulder County in administering the provisions contained herein and in developing ways and means to improve traffic conditions.

2.3 Road System Additions

The Board of County Commissioners is authorized by Section 43-2-112, C.R.S. 1973, to layout, widen, alter or change any County road and to acquire lands of private persons for County roads. No road or other public way shall be constructed or approved in the unincorporated territory of the County until and unless the proposed location and extent thereof has been reviewed by the County Planning Commission in accordance with Section 30-28-110, C.R.S.

1973, or approved as part of a platted subdivision.

The Public Works Department has staff responsibility for the planning, design, right-of-way acquisition, construction and inspection of all improvements to the existing County Road System as defined in Section 2.1.2. Roads constructed by others will ordinarily pass through six steps: planning, design, right-of-way dedication/acceptance, construction, inspection and acceptance.

2.3.1 Planning

The planning or layout of a new road shall be in accordance with Article III of these Standards and Specifications. If a road is created through the subdivision process, all provisions of the Boulder County Subdivision Regulations must be met. If the subdivision is exempt from the Subdivision Regulations (35 acre splits) the proposed road shall be reviewed by the County Planning Commission at a location and extent hearing, in accordance with Section 30-28-110, C.R.S. 1973.

2.3.2 Design

The design of any new road shall be in accordance with Article IV of these Standards and Specifications. Road plans and specifications shall be prepared by a registered professional engineer in accordance with these Standards and Specifications and shall be approved by the County Engineer. Approved plans expire after one year and must be resubmitted for County Engineer approval with any revisions in these Standards and Specifications applicable.

2.3.3 Right-of-Way Dedication/Acceptance

A road created through the subdivision process will normally have a specified right-of-way width shown on the plat along with a dedication statement. Acceptance of the plat by Boulder County constitutes acceptance of the right-of-way. The road, however, does not officially become accepted for maintenance and part of the County Road System until it is constructed according to these Standards and Specifications, and specifically accepted by recording with the County Clerk and Recorder an Acceptance Resolution of the Board of County Commissioners.

2.3.4 Performance Guarantee

In those cases where it is required that an entity must guarantee that public or private improvements will be built, this guarantee may be in the form of a letter of credit with a banking institution in the State of Colorado. Both the form of the letter of credit and the institution providing it must be approved by the County Attorney. Alternately, this guarantee may be in the form of a cash deposit held by the County. In either case the amount of the performance guarantee shall be equal to 115% of the Engineer's estimate to construct all required improvements. The Engineer's estimate shall be approved by the Public Works Department.

The performance guarantee can be reduced upon request by the developer or project engineer. The performance guarantee shall at all times be equal to 115% of the Engineer's estimate of the cost to complete the remaining improvements. The Public Works Department shall approve all reductions in performance guarantees.

Performance guarantees shall generally have a term of two years. Extension of performance guarantees shall be either based on current Engineer's estimates as outlined above or on the previous guarantee amount modified by the Colorado Construction Cost Index.

2.3.5 Special Improvement Districts

Special Improvement Districts - Section 30-20-20.5 and 6, C.R.S., provides for the

establishment of two types of Improvement Districts for road construction. In many old subdivisions, roads have not been constructed to County standards, the lots have been sold, a majority of the building permits issued, and the original developer cannot be required to complete the road construction. In order to assure funds to bring the roads to County standards for acceptance for maintenance one of the following approaches may be followed:

a. The first, "Public Improvement District", is established by the County Commissioners upon petition by a majority of the tax paying electors who own property in the proposed district. Such a district is empowered to levy taxes against the property owners within the district, and to construct and operate the road improvements. The burden of proof as to the economic and practical feasibility of a special road district is on the petitioners. The County Commissioners are authorized to issue bonds for the district, but if indebtedness is $5000 or more such indebtedness must be approved by a district election.

b. "Local Improvement District", is established by the County Commissioners upon proper notice to all property owners in the district. The Commissioners are empowered to set special assessments according to benefits received, and to make street improvements. A special election of the entire County is required to allow the Commissioners to incur an indebtedness on behalf of the County. Special assessment bonds may, however, be issued without an election when payment of the bonds is to be made only from the special assessments collected.

2.3.6 Construction

Construction of new County roads shall conform to the provisions of Article V - Construction Specifications. Construction permits shall be obtained as per Section 2.2.3.

2.3.7 Inspection

Adequate inspections and observations ensure compliance with these Standards and Specifications and are the basis for the County Engineer's recommendation to the Board of County Commissioners for maintenance acceptance and for release of the performance guarantee. Requirements for inspections are found in Article V - Construction Specifications.

2.3.8 Acceptance of Public Roads for Maintenance

Roads within the jurisdiction of Boulder County are accepted for maintenance by the Board of County Commissioners by resolution only after the following requirements are met:

a. The roads have a usable traveled way of at least twenty-two feet to provide for two lanes of traffic. No single-lane roads will be accepted for maintenance by Boulder County.

b. The County Engineer and Road Supervisor have inspected the roads in accordance with Article V - Construction Specifications, and recommend acceptance.

c. The roads connect to another maintained County road, state highway or city street.

d. Roads that are within subdivision, or similar type developments must be constructed through intersections or to the end of cul-de-sacs.

e. All required street signs and traffic control devices have been installed in accordance with these Standards and Specifications.

f. A performance bond for 15% of the total cost of the improvements has been submitted

to the County to warrant the road construction for one year after the date of acceptance.

g. All required subsurface utilities shall be installed prior to finishing subgrade. All laterals crossing the roadway shall be installed prior to the road acceptance.

h. All survey monuments, in roadways and rights-of-way as required by Section 4.14 have been installed.

i. As-built plans certified by a registered professional engineer have been submitted to the Public Works Department.

2.3.9 Private Road Construction and Inspection

The creation of a private road will follow the same process and procedure as a public road except for the following:

a. Construction permits shall be required for private road construction that is a prerequisite for building permits or other development activity.

b. The Public Works Department will inspect the construction in accordance with the construction permit.

c. A registered professional engineer must certify and document that the road improvements are constructed within the prescribed right-of-way and conform to the County approved plans in order to release the performance guarantees or issue building permits.

d. No acceptance for maintenance is required but the road must pass a final inspection in order to release the performance guarantees or building permits.

2.4 Deletions from the Road System

2.4.1 Abandonment

a. Abandoned State Highway - When a portion of a state highway is relocated and, because of such relocation, a portion of the route as it existed before such relocation is, in the opinion of the state highway commission, no longer necessary as a state highway, such portion shall be considered as abandoned. If it appears that the abandoned portion is necessary for use as a public highway, street or road, then such abandoned portion shall become a County road, upon adoption of a resolution to that effect by the Board of County Commissioners, within ninety days after such abandonment. If the portion of the road is not needed as a public highway, title to it shall revert to the owner of the land through which, or adjacent to, such abandoned portion may lie.

b. Abandoned County Roads - When a portion of the County road system is relocated and because of such relocation a portion of the route as it existed before such relocation is in the opinion of the Board of County Commissioners no longer necessary as part of the County road system, such portion shall be considered as abandoned, and title to it shall revert to the owner of the land through which such abandoned portion may lie subject to the Section 43-2-301 to 303, C.R.S. 1973 Vacation Proceeding: Roads, Streets and Highways.

2.4.2 Road and Easement Vacations

On occasion, vacation of County roads or easements, may become warranted due to peculiar circumstances or changes in overall development patterns. The Board of County

Commissioners may vacate any County road or any portion thereof subject to the provisions of Section 43-2-301 to 303, C.R.S. 1973. No road or part thereof shall be vacated so as to leave any parcel adjoining said roadway without an established public or private road connecting said land with another established public road.

When a vacation of roads or easements is initiated by others, the applicant must obtain the required forms from the County Land Use Department and fill in a complete and accurate legal description of the area requested for vacation. He must then obtain the signatures of adjacent land-owners, representatives of any public utilities and other interested parties as may be required. He must submit the completed forms along with any required fee to the County Land Use Department, at least twenty-eight (28) days prior to the next regularly scheduled Planning Commission meeting.

The County Land Department will then notify adjacent land-owners of the time and place of the meeting at which the request will be considered and submit the request to the County Engineer for review and approval. If it is a road vacation, the County Land Use Department will post the road. Based upon all available information, the County Planning Commission will then make its recommendations and submit the request to the Board of County Commissioners. The Board of County Commissioners must approve the vacation request before it becomes effective.

2.5 Road Name Changes

In certain instance, an existing road name may create confusion and inconvenience to residents living along the road, delivery man, repair men, and/or public agencies. Therefore, the Road Name Change Process was established to accommodate desired changes by affected residents. Road naming shall conform to the Boulder County Roadway Naming and Housing Numbering Guide as adopted by the County. No road names shall be used which will duplicate or may be confused with the names of existing city streets in the immediate vicinity or other County roads.

The applicant must obtain the required forms from the County Land Use Department and submit the completed form along with an illustration of the road location, a list of names and addresses to abutting property owners and any required fee to the County Land Use Department at least 28 days prior to a regular Planning Commission meeting. The Planning Commission will hold a public meeting, make its recommendations and submit the request to the Board of County Commissioners. The Board will also hold a public meeting and must approve the new change before it becomes effective.

If the road in question has been accepted by the County for maintenance, then the County will be responsible for changing the applicable road name signs. When the road name change is for a road that has not been accepted by the County for maintenance, then the applicant or the developer of the affected subdivision is responsible for changing the road name signs.

ARTICLE III

TRANSPORTATION PLANNING

ARTICLE III – TRANSPORTATION PLANNING

3.1 The Comprehensive Plan

Boulder County, pursuant to 30-28-106, C.R.S. 1973, as amended, has adopted a comprehensive plan for the physical development of the County's unincorporated territory. The Boulder County Comprehensive Plan, adopted in 1978 and amended thereafter, is designed to be utilized by both the public and private sectors of the County as a policy guideline for making orderly and desirable decisions concerning the future use of land in the County. A major component of the Comprehensive Plan is the Transportation Element which includes goals, policies, map sheets and background data relating to existing and planned transportation facilities in Boulder County.

3.2 The Transportation Plan

The adopted portions of the Transportation Element include goals and policies, transit, highway and bikeway map sheets and short- and long-range capital improvement programs.

3.2.1 Goals, Objectives and Policies

The transportation goals and objectives of the Comprehensive Plan address the provisions for an efficient multi-modal system, the preservation of environmental characteristics through the design of improvements to the transportation system and the special accommodation of the needs of the County's elderly and handicapped population. Specific policies intended to achieve these goals are given to provide direction to the various County departments charged with the design of improvements to the transportation system.

3.2.2 The Transit Plan

The transit plan consists of areas of existing regular bus service, planned corridors of future regular bus service, planned corridors for future para-transit (served by vans or other small vehicles) and planned primary segments, secondary segments and possible future extensions of a high quality automated transit service.

The Regional Transportation District (RTD) is responsible for the provision of all fixed route public transportation services in Boulder County. RTD coordinates all transit planning activities with Boulder County and the County, through its subdivision regulations and capital improvements programs, provides bus pull-outs, bus stop pads and other transit facilities where deemed necessary.

3.2.3 The Highway Plan

The highway plan was developed after a careful consideration of social, economic, land use and environmental concerns. The planned system is closely tied to the travel demands of projected land uses and is financially realistic in that most of the improvements can be carried out with the financial resources expected to be available during the planned period.

The highway plan is actually a hierarchy of road systems called functional classifications. There are two basic functions that a road can perform: moving traffic; and providing access to abutting land uses. The higher functional classifications are devoted more to moving traffic, while the lower classifications primarily serve abutting land uses. The functional classifications that make

up the highway plan are the following:

FREEWAY: Provides for the movement of large volumes of through traffic at relatively high speeds. A freeway is devoted entirely to traffic movement and provides no direct land service. It is characterized by multi-lane divided roadways with full control of access and grade-separation intersections (interchanges). It can accommodate 40,000 - 60,000 vehicles per day.

EXPRESSWAY: Provides for the movement of large volumes of through traffic at moderately high speeds. It is characterized by multi-lane divided roadways but does not have full control of access, nor are all intersections grade-separated. Thus, some land access is provided. An expressway can accommodate 25,000 - 50,000 vehicles per day.

PRINCIPAL ARTERIAL (PA): Provides for the movement of through traffic between major population and employment centers and across urban areas. While the primary purpose is the movement of traffic, some access to abutting land uses may be permitted. A principal arterial is usually a divided multi-lane facility designed to accommodate 12,000 - 28,000 vehicles per day.

MINOR ARTERIAL (MA): Provides for the movement of through traffic between minor population and employment centers and across urban areas. While the primary purpose is the movement of traffic, some access to abutting land use is a normal secondary function. A minor arterial is a two- or four-lane facility designed to accommodate 6,000 - 18,000 vehicles per day.

MAJOR COLLECTOR (MC): Provides access to the arterial system and simultaneously provides access to abutting land uses. Since a collector does not carry very long trips, it need not be continuous for a long distance. It is usually a two-lane facility designed to accommodate 2,500 - 8,000 vehicles per day.

RESIDENTIAL COLLECTOR (RC): provides for internal movement within a residential area. Driveway cuts and on-street parking should be discouraged wherever possible. It is a two-lane facility designed to accommodate 500 - 3000 vehicles per day.

LOCAL ACCESS (LA): Provides access to abutting land uses, serves local traffic movements, and connects to collector roads and/or minor arterials.

3.2.4 The Bikeway Plan

The Comprehensive Plan recognizes the bicycle as a legitimate mode of transportation along with the transit and the automobile. The bikeway plan is intended to link the urban service areas together as well as to the many recreational opportunities in the unincorporated portions of the County. The following types of bikeway facilities are included:

Bike Path - a separate path or trail which is for the exclusive use of bicycles. Where such a path or trail forms part of a highway, it is separated from the roadways for motor vehicle traffic by an open space or other physical barrier.

Bike Lane - a portion of a roadway designated for preferential or exclusive use of bicycles. It is distinguished from the portion of the roadway for motor vehicle use by a paint strip, curb or other similar device.

Another type of bikeway, bike route, is not included in the bikeway plan. Most subdivision and local access roads in the County have low enough volumes that they can adequately accommodate bicycles without the need for special markings. Most of the bike paths on the bikeway plan will be designed to accommodate pedestrians, equestrian and other non-motorized trail uses rather than being for the exclusive use of bicycles. Incompatible uses shall be adequately separated.

3.3 Land Development Proposals - Conformance

Land development proposals may include subdivision, building permits, uses by special review and other proposals which change or intensify the use of the land. All such proposals shall conform to the goals and policies of the Comprehensive Plan in regards to the provisions for transportation facilities. Right-of-way dedications shall be made in conformance with the highway plan for new subdivisions and shall use the centerline of the existing right-of-way as a base.

The highway plan will serve as a guide for the location and design of new roadway systems. In the case of proposed new alignments, however, detailed site planning and alignment studies may be required to reserve corridors for major facilities. Also, the highway plan does not provide sufficient detail for the layout of residential collector and local access systems. The planning principles for local circulations system given in Section 3.5 shall be followed for land development proposals.

3.4 Setbacks from Highway Facilities

The setbacks adopted in the Boulder County Zoning Resolution are as follows:

FUNCTIONAL CLASSIFICATION	SETBACK (FEET)
Freeway	160
Expressway	160
Principal Arterial	110
Minor Arterial	
Plains	110
Mountains	55
Major Collector	
Plains	90
Mountains	45
Residential Collector	Zoning Yard Setbacks apply
Local Access	

Setbacks are measured from existing roadway centerlines.

3.5 Planning Principles for Local Circulation Systems

Basic considerations in the design of local circulation systems must recognize the following factors:

Safety - for both vehicular and pedestrian traffic

Efficiency of Service - for all users

Livability - especially as affected by traffic elements in the circulation system

Economy - of both construction and use of land

Each of the following principles is an elaboration on one or more of these four factors. The principles are not intended as absolute criteria, since instances may appear where certain principles conflict. The principles should, therefore, be used as guides to proper systems layout.

a. Insure Vehicular and Pedestrian Access

The primary function of local streets is to serve abutting properties. Street widths, placement of sidewalks, patterns of streets and number of intersections are related to safe and efficient access to abutting lands.

b. Minimize Through Trips

Through traffic on local and collector streets increases the average speed and volume and thus the accident potential, thereby reducing residential amenities. Through traffic can be discouraged by creating discontinuities in the local street intersections and by channelizing or controlling median crossings along peripheral routes.

c. Control Access to Arterials

Local circulation systems and land development patterns should not detract from the efficiency of peripheral arterial facilities. Ideally, land development should occur so that no parcels require direct access to arterial routes. The number of access points between the local circulation system and the arterial system should be minimized. Intersections along arterial routes should be properly spaced for efficient signalization and traffic flow. The streets that do intersect the arterial system will tend to have high volumes since they are the only exit points. The livability on these collector streets will be less than other local streets. The number of residential lots that have direct access onto these collectors should therefore be minimized. Variations in the land development pattern (i.e., permissible land uses, building setbacks, etc.) might also be considered to compensate for the reduction in amenities.

d. Discourage Speeding

Residential streets should be designed to discourage fast movement (more than 25 m.p.h.) through the use of curvilinear alignments and discontinuities in the street system.

e. Minimize Pedestrian - Vehicular Conflicts

Pedestrian travel within the area or from within the area or from within the area should require a minimum of street crossings. Sometimes this may be achieved through proper design of street patterns, land use arrangements and pedestrian routes. Typical methods includes use of cul-de-sac and loop streets, special pedestrian routes or walkways and the proper placement of high pedestrian traffic generators. In general, while vehicular flow must be outward oriented to the peripheral arterials, pedestrian travel should be inward-oriented to avoid these heavier vehicular flows.

f. Minimize Space Devoted to Street Use

It is desirable to minimize local street mileage to reduce construction and maintenance costs as well as to permit the most economic land use. Streets should also have an appearance commensurate with their function. They should be in keeping with the residential character.

g. Relate Streets to Topography

Local streets will be more attractive and economical if they are constructed to closely

adhere to topography. The important role that streets play in the overall storm drainage system can be enhanced by using the topography of the area.

h. Minimize Circuitous Travel

Ideally, every part of a residential area should be interconnected with every other part, and with peripheral developments, as directly as possible. Although strict application of the principle may conflict with other principles, excessive indirect travel is annoying to the individual area's livability and dangerous when emergencies occur. Moreover, the added vehicle-miles of travel within the neighborhood increases mid-block frictions, such as with parked cars, driveways and pedestrians, with resultant increased hazard.

i. Layout Streets to Achieve Optimum Subdivision of Land

The arrangements of streets should permit economical and practical patterns, shapes and sizes of development parcels. Streets as a function of land use must not unduly hinder the development of land. Distances between streets, angles of intersections, number of streets, and related elements all have a bearing on efficient subdivision of an area. Access to adjoining properties should also be considered.

j. Access for Emergency Services on Dead-End Roads

Dead-end road systems should be provided with an emergency access if the main access is within the 100-year floodplain of a drainage channel with the 100-year frequency runoff of 200 c.f.s. or if the main access is located in an area subject to a forest fire hazard where trees cannot be readily restricted from that area adjacent to the centerline of at least the mature height of said trees, or any other unusual safety hazards.

ARTICLE IV

DESIGN STANDARDS

ARTICLE IV – DESIGN STANDARDS

4.1 Application of Design Standards

4.1.1 Minimum Standards

The standards described herein generally represent minimum values. The word "minimum" implies the lowest acceptable limit in design.

4.1.2 Departure from Standards

Design standards are not inflexible. Higher standards may be used as long as maintenance and operational costs are not increased and safety is not compromised. Lower standards may not be used unless approved in writing by the County Engineer.

4.1.3 Innovation in Design

These design standards provide for a certain level of performance. If an alternate design or material or procedure can be shown to provide performance equal to or better than the required design, material or procedure, said alternate may be approved by the County Engineer.

4.1.4 Use of AASHTO or Colorado State Highway Standards and Specifications

Boulder County generally follows the American Association of State Highway and Transportation Officials policies on Geometric Design of Rural and Urban Highways and the Colorado Division of Highways Roadway Design Manual. When the Boulder County standards differ from AASHTO or Colorado standards, the Boulder County standards shall govern.

4.2 Design Factors

4.2.1 Terrain Classification

For the purpose of these standards, the terrain in Boulder County is divided into two categories:

Flat or Rolling Terrain: Average cross slope less than 15 percent and the ridges and draws are not well defined. Most of the land east of Foothills Highway falls into this category.

Mountainous terrain: Average cross slope greater than 15 percent and the ridges and draws are steep and well defined. Most of the land west of Foothills Highway falls into this category.

4.2.2 Road Classification

The functional classifications used herein are defined in Section 3.2.3 and in the Transportation Element of the Boulder County Comprehensive Plan. When not specified in the Transportation Element, a functional classification shall be selected based on projected traffic volumes.

4.2.3 Projected Traffic Volumes

A traffic analysis is normally required to project future traffic volumes. A key element in any traffic analysis is trip generation by land use type. The report entitled Trip Generation published by the Institute of Transportation Engineers shall be the County's guideline where no detailed trip generation data is available.

"As a general guideline for residential development the trip generation rates shall be 10 ADT per unit for single-family residences in the plains, 7 ADT per unit for multi-family residences in the plains, and 5 ADT per unit in the mountains.

The Public Works Department shall make a determination on a case-by-case basis of whether a traffic analysis will be required. Guidelines for Traffic Studies are given in the Appendices.

A 20-year design period or full development shall generally be used to project traffic volumes. Factors provided by the Colorado Division of Highways or the Boulder County Public Works Department shall be used to adjust average daily traffic volumes to design hourly volumes.

4.2.4 Design Speed

Design speed is selected to correlate design of those physical elements of a road that influence vehicle operation. The choice of a design speed is influenced primarily by the terrain classification, functional classification and economics. The design speed is generally slightly higher than the eventual posted speed. Acceptable ranges of minimum design speeds are as follows:

	TERRAIN CLASSIFICATION			
	FLAT OR ROLLING		MOUNTAINS	
Functional Classification	Design Speed	Posted Speed	Design Speed	Posted Speed
Arterial	60	45-55	50	30-40
Major Collector	50	35-45	40	30
Residental Collector	35	30	30	25
Local Access	25	20-25	25	20
Two Lane Private Rd.	25	-	20	-
Private Driveway	15	-	15	-

4.2.5 Development Density

For the purposes of these standards, urban sections will be used on roads in commercial and industrial developments and on roads with adjacent residential lot frontages that are predominately less than 140 feet in width. Rural sections shall be used on all other roads.

4.3 Geometric Standards

4.3.1 Horizontal Alignment

a. General Considerations

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

b. Types of Horizontal Curves

Figure 4-1 shows simple and spiral curves and their functions.

c. Sight Distance

Horizontal alignment must provide at least minimum stopping sight distance for the design speed at all points. This includes visibility at intersections as well as around curves and roadside appurtenances.

The minimum stopping sight distance is the distance required by the driver of a vehicle traveling at a given speed to bring the vehicle to a stop after an object on the road becomes visible. Stopping sight distance is measured from the driver's eye which is assumed to be 3.5 feet above the roadway surface, to an object six inches high on the road.

The required stopping distance along a road segment for a given design is as follows:

Design Speed (MPH)	Stopping Sight Distance (Ft.)
15	100
20	150
25	175
30	200
35	250
40	300
35	350
40	400
50	450
60	650

In some cases passing sight distance may be required on residential collectors, major collectors or arterials. Passing sight distance is given in the Colorado Division of Highways Transportation Roadway Design Manual.

Where an object off the pavement such as a bridge pier, cut slope, or natural growth, restricts sight distance, the minimum radius curvature is determined by the stopping sight distance. Offset clearance to achieve stopping sight distance on horizontal curves is shown in Figure 4-2. 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 mid-point of the sight line and 2.5 feet above the inside lane. The offset distance (m) is measured from the centerline of the road to the obstruction.

d. Tangents

Minimum tangent lengths between curves shall be 400 feet for all roads except residential collectors and local access. For these road classifications the tangents between curves shall be as shown on the following table:

Design Speed (MPH)	Tangent (Feet)
15	50
20	75
25	100
30	150
35	200
40 & above	250

e. Standards for Curvature

Tables 4-1 through 4-4 give the minimum curve radii and the maximum allowable rate of superelevation for the various functional classifications. The tables are based on design speed, friction factors and superelevation and do not consider sight distance. Minimum radii should be used only when the cost of realizing the higher standard is inconsistent with the benefit.

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 or a lower standard than the design speed for the project, the design speed between successive curves shall not change by more than 10-mile-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 by the County Engineer.

The minimum curve length shall be 200 feet for design speeds of 30 mph or less, 300 feet for design speeds between 30 mph and 40 mph and 400 feet for design speeds of 40 mph and above. Angle points less than one degree require no curve radius. A compound curve will not be permitted.

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 4.3.1.d.

A broken-back curve is two curves in the same direction joined by a short tangent. Broken-back curves are not permitted.

f. Alignment at Bridges

Ending a curve on a bridge is undesirable and adds to the complications of design and construction. Likewise, curves beginning or ending near a bridge should be placed so that no part of the spiral or superelevation transitions extend onto the bridge. If curvature is unavoidable, every effort should be made to keep the bridge within the limits of a simple curve.

g. Coordination with Vertical Alignment

To avoid the possibility of introducing serious traffic hazards, coordination is required between horizontal and vertical alignment. Particular care must be exercised to maintain proper sight distance at all times. Sharp horizontal curves introduced at or near the top of pronounced crest or bottom of sag vertical curves should be avoided.

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, particularly in flat or rolling terrain. For safety reasons, the horizontal curve should overlap the vertical curve. Where the change in horizontal alignment at a grade summit is slight, however, the vertical curve may overlap the horizontal.

When vertical and horizontal curves are superimposed, the resulting superelevation may cause distortion in the outer pavement edges, particularly on multi-lane cross-sections.

Where this may be the case, edge of pavement profiles should be plotted and smooth vertical curves introduced to remove any irregularities.

4.3.2 Vertical Alignment

a. General Considerations

The centerline profile is a reference line by which the elevation or grades of the pavement and other features of the roadway are established. It is controlled mainly by topography structure clearances, horizontal alignment, safety, sight distance, design speed, construction costs and the performance of heavy vehicles on a grade.

The centerline profile should be positioned with relation to the cross-section as follows:

1. It should coincide with the road centerline on two-lane and multi-lane undivided roads.
2. On multi-lane divided roads, the grade lines should be placed at the edge of the travel lane nearest the median.

b. Minimum and Maximum Grades

Minimum sustained grades shall be no less than 0.25 percent, on Urban Roads and 0.50 percent on Rural Roads.

Maximum sustained grades for new roads are related to design speed as follows:

MAXIMUM SUSTAINED GRADES (%)							
		Design Speed (MPH)					
Terrain Classification	15	20	25	30	40	50	60
Flat and Rolling	6	6	6	6	6	5	4
Mountainous	12	10	9	9	8	6	NA

The maximum design grade should be used infrequently rather than as a value to be used in most cases. At the other extreme, for short grades less than 500 feet, the maximum gradient may be increased by one percent.

In Flat or Rolling Terrain all grades shall flatten to four percent for at least 100 feet

approaching intersections and for at least 50 feet entering and leaving turnarounds or cul-de-sacs. In Mountainous Terrain all grades shall flatten to six percent or less for at least 50 feet approaching intersections and entering switchbacks on cul-de-sacs.

c. Vertical Curves

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

Vertical curves shall be parabolic. Figure 4-3 gives the mathematical relations for computing a vertical curve, either at crests or sags. Design controls for vertical curves are given in Table 4-5.

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

d. Sight Distance

Minimum lengths of crest vertical curves are controlled by stopping sight distance requirements as shown in Figure 4.4.

e. Superelevation

One of the most important factors to consider in highway safety is the centrifugal force generated when a vehicle transverses a curve. Centrifugal force increases as the velocity of the vehicle and/or degree or curvature increases. The standard superelevation rates shown on Table 4-1 and 4-4 are such as to hold the side function factor within tolerable limits for those operating speeds expected for the range of curve radii given.

For undivided roads, the axis of rotation for superelevation is usually the centerline. Where curves are preceded by long relatively level tangents, however, the plane of superelevation may be rotated about the edge of pavement to improve perception of the curve. Drainage pockets caused the axis of rotation to move from the centerline to the inside edge of pavement.

A superelevation transition is variable in length depending upon the amount of superelevation. With respect to the beginning and end of the curve, two-thirds of the transition is in the tangent approach and one-third within the curve. This results in two-thirds of the full superelevation at the beginning and at the end of the curve. Where spiral curves are permitted, the transitions are to be designed using Colorado Division of Highways Roadway Design Manual.

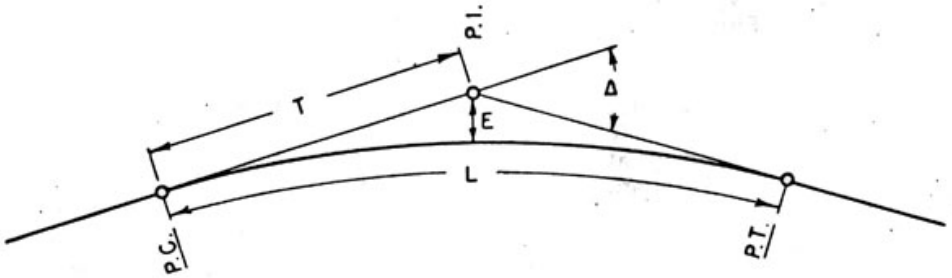
After a superelevation transition is computed, profiles of the pavement edges should be plotted and irregularities removed by introducing smooth curves. For wide pavements, it is often advantageous to plot intermediate profiles.

On curved roadways, a pronounced sag may develop on the low side of the superelevation. This is corrected by adjusting the grades on the two edges of pavement throughout the curve.

FIGURE 4-1

TYPES OF HORIZONTAL CURVES

SIMPLE CURVE



$R = \frac{5{,}729.58}{D}$

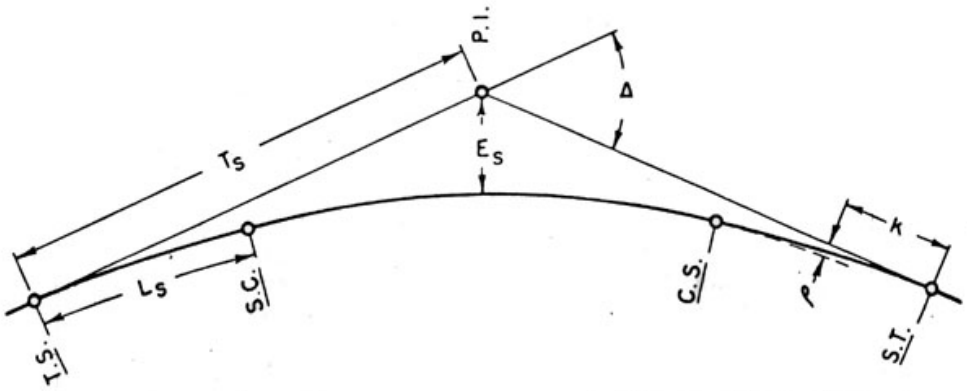
$T = R \text{ TAN.} \frac{\Delta}{2}$

$E = R \text{ EXSEC.} \frac{\Delta}{2} = \frac{R}{\cos. \frac{\Delta}{2}} - R$

$D = \frac{5{,}729.58}{R}$

$L = 100 \frac{\Delta}{D}$

SPIRAL CURVE



$T_S = (R_C + \rho) \text{TAN.} \frac{\Delta}{2} + K$

$E_S = (R_C + \rho) \text{ EXSEC.} \frac{\Delta}{2} + \rho = \frac{R_C + \rho}{\cos. \frac{\Delta}{2}} - R_C$

ρ AND K VARY WITH L_S

NOTE:

Curve data is based on the radius of a 1° 00' curve being 5,729.58'.

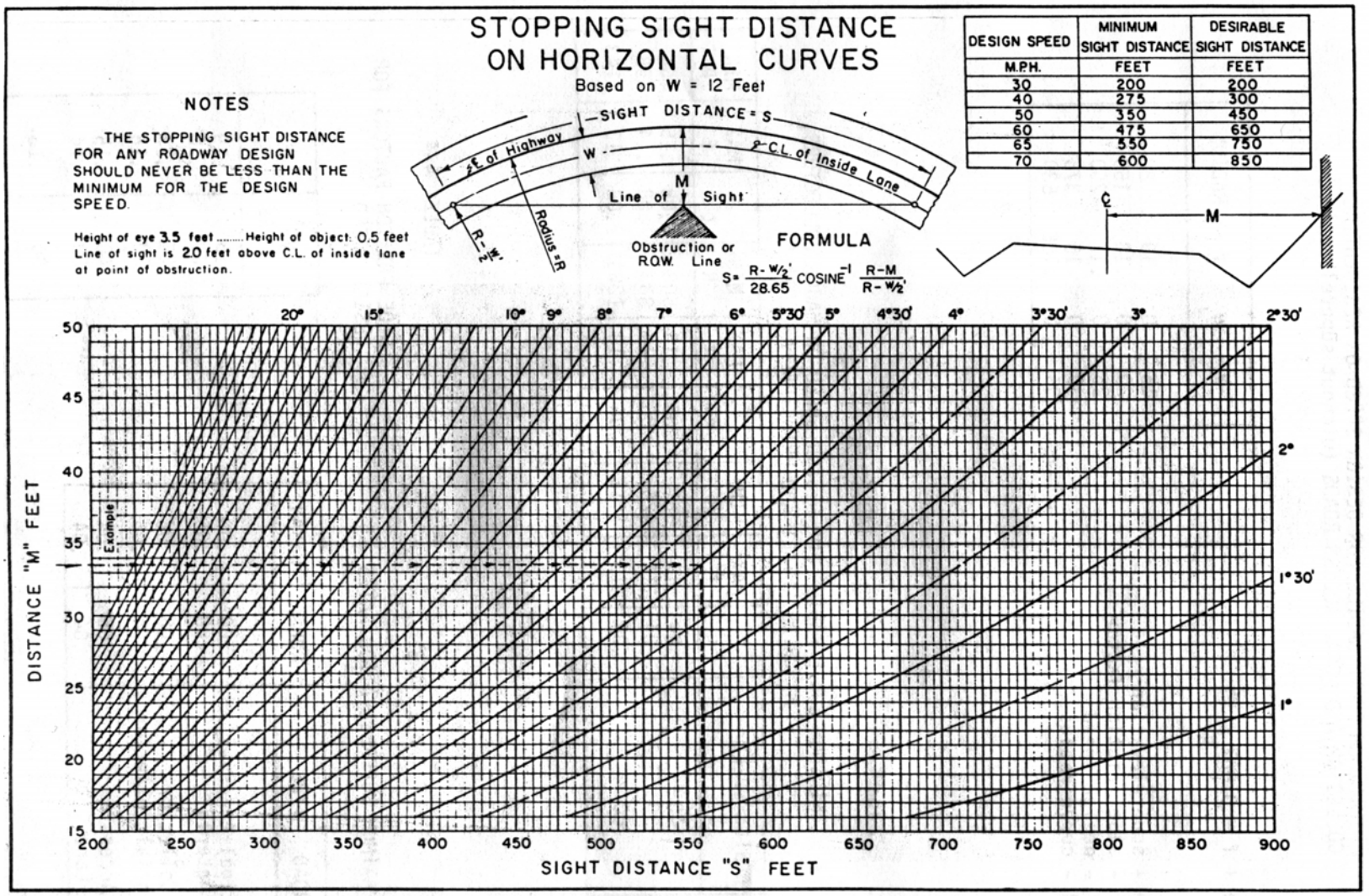


FIGURE 4-2

EXAMPLE:

Given:
M = 33.5'
D = 4°
R = 1432.5'
W = 12'

By Formula:

$S = \left(\frac{1426.5}{28.65}\right)\left[\cos^{-1}\left(\frac{1399}{1426.5}\right)\right]$

$S = 49.79058 \times 11.26666$

S = 561'

$\frac{1399}{1426.5} = 0.98072 = 11° 16'$ approx.

$11° 16' = 11.26666°$

By Chart

S = 558'

TABLE 4-1

MINIMUM CURVE RADIUS FOR DESIGN SPEED ON RESIDENTIAL COLLECTOR AND LOCAL ACCESS ROADS (without superelevation)

$$e + f = \frac{0.067 \times V^2}{R}$$

e - superelevation
f - side friction factor
V - design speed
R - curve radius

V	e	f	RADIUS
15	0	.19	80
20	0	.18	150
25	0	.17	250
30	0	.16	375
35	0	.155	530

TABLE 4-2

MINIMUM CURVE RADIUS FOR DESIGN SPEED ON MAJOR COLLECTORS, MINOR ARTERIALS AND PRINCIPAL ARTERIALS.

DESIGN SPEED V	e	MAX f	MIN R	e	MAX f	MIN R	e	MAX f	M N R
40	.04	.15	561	.06	.15	508	.08	.15	464
50	.04	.14	926	.06	.14	833	.08	.14	758
60	.04	.13	1412	.06	.13	1263	.08	.13	1143

TABLE 4-3

MAXIMUM SUPERELEVATION RATES

ROAD TYPE	RURAL	URBAN
Prinicipal Arterial	.08	.06
Minor Arterial	.08	.06
Major Collector	.08	.06
Residential Collector	.06	.06
Local Access	.06	.04
Single Lane	.04	.04

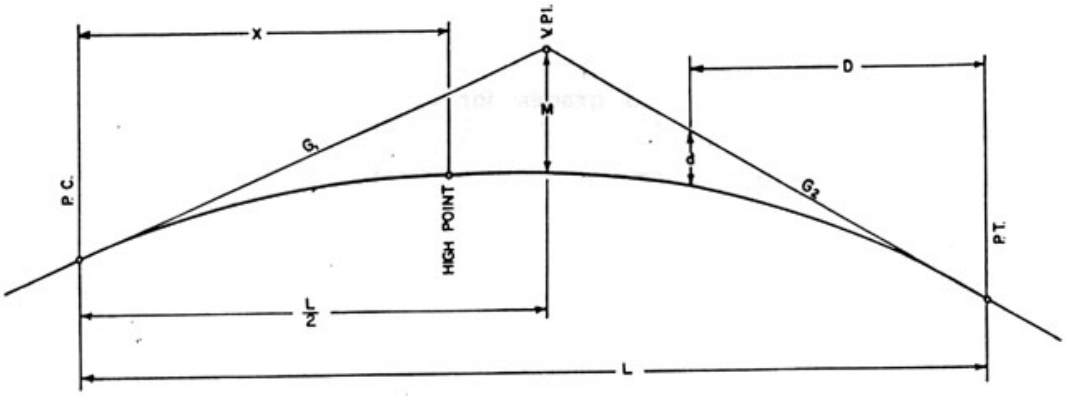
TABLE 4-4

SIDE FRICTON FACTORS FOR DESIGN SPEED

V	f
15	.19
20	.18
25	.17
30	.16
40	.15
50	.14
60	.13

FIGURE 4-3

TYPES OF VERTICAL CURVES



TYPE I

CREST VERTICAL CURVE

L = LENGTH OF CURVE IN STATIONS

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

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

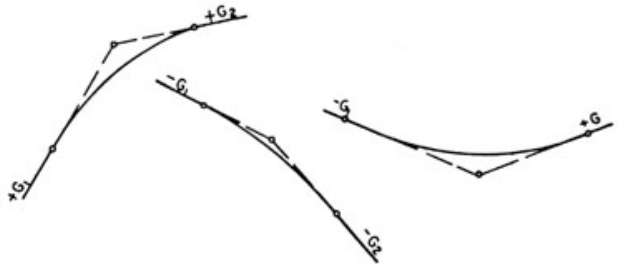
$$d = 4M\left(\frac{D}{L}\right)^2 \quad \text{OR} \quad d = \frac{\text{ALGEBRAIC DIFF.} \times D^2}{2L}$$

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

USE THE FOLLOWING:

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

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

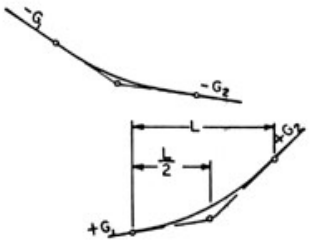


TYPE II

CREST VERTICAL CURVES

TYPE III

SAG VERTICAL CURVES



TYPE IV

SAG VERTICAL CURVES

TABLE 4-5

DESIGN CONTROLS FOR VERTICAL CURVES

DESIGN SPEED MPH	STOPPING SIGHT DISTANCE		LENGTH = "K" TIMES ALGEBRAIC DIFFERENCE IN GRADES K			
	MINIMUM (FT.)	DESIRABLE (FT.)	CREST		SAG	
			MINIMUM	DESIRABLE	MINIMUM	DESIRABLE
30	200	200	28	28	35	35
40	275	300	55	65	55	60
50	350	450	85	145	75	100
60	475	650	160	300	105	155

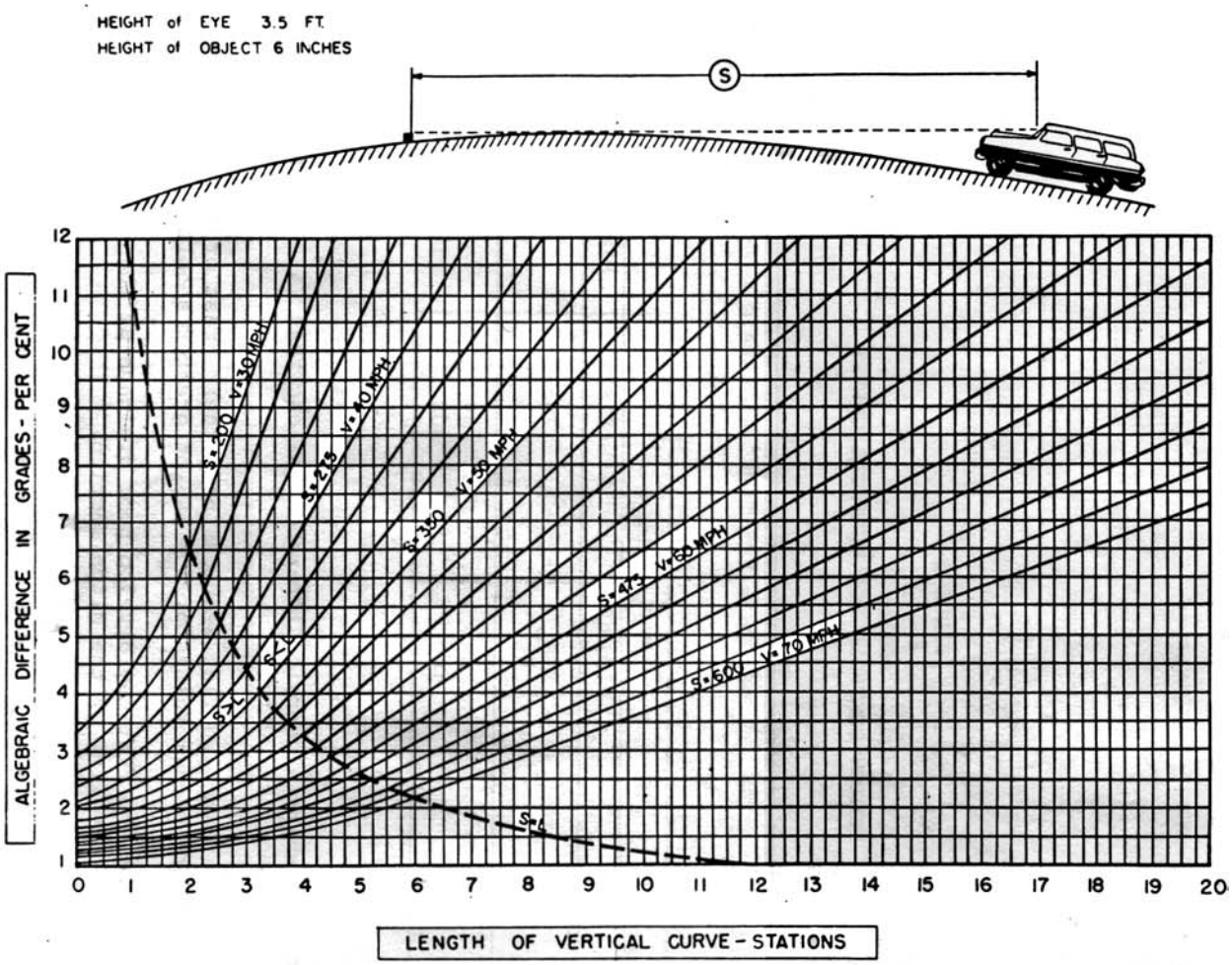
1. Vertical curves are not required where algebraic difference is less than 2%. The desirable minimum length of vertical curves, both crest and sag, is 200 feet.

2. Vertical curves that have a level point and flat sections near their crest or sag should be evaluated for drainage where curbed pavements are used. Values of K = 143 or greater should be checked for drainage.

3. Also vertical curves that are long and flat may develop poor drainage at the level section. This difficulty may be overcome by adjusting the flow line of the ditch section.

FIGURE 4-4

STOPPING SIGHT DISTANCE ON CREST VERTICAL CURVES



WHEN S > L	WHEN S < L
$S = \frac{6645}{A} + 50L$	$S = 3646\sqrt{\frac{L}{A}}$

L = Curve length - stations
A = Algebraic grade difference — %
S = Sight distance — ft.
V = Design speed — M.P.H. for "S"

DESIGN SPEED M. P. H.	MINIMUM SIGHT DISTANCE FEET	DESIRABLE SIGHT DISTANCE FEET
30	200	200
40	275	300
50	350	450
60	475	680
65	550	750
70	600	850
75	675	950
80	750	1050

TABLE 4-6

SUMMARY OF DESIGN ELEMENTS

FUNCTIONAL CLASSIFICATION	DESIGN HOURLY VOLUME (1)	AVERAGE DAILY TRAFFIC (1)	# OF LANES	LANE WIDTH	SHOULDER WIDTH	TOTAL ROADWAY WIDTH	RIGHT-OF-WAY WIDTH
Principal Arterial	1800-4200	12,000-28,000	4	12'	10'	84 [2]	120'
Minor Arterial	1500-2700	10,000-18,000	4	12'	8'	78 [3]	120'
	900-1500	6,000-10,000	2	12'	6'	36	120'
Major Collector	150-1200	1,000-8,000	2	12'	6'	36	80'
Residential Collector	75-375	500-2,500	2	12'	4' [4]	32	60'
Local Access-Urban	15-75	150-500	2	11'	6'	34 [5]	50'
Local Access-Rural	15-75	150-500	2	11'	6'	34 [5]	60'
Private Roads - two lanes	15-75	150-500	2	11'	2'	26 [5]	50'
Private Driveway	0-5	0-150	1	12'	0'	12	20' [7]

NOTES:

1. Based on full development.
2. Provides for a 16 foot paved or raised median.
3. Provides for a 14 foot paved or raised median.
4. Assumes no parking. Increase shoulder width to six feet if parking is permitted.
5. Paving of roadway may be waived if 20 year projected traffic volume is less than 150 ADT.
6. If at least six off-street parking spaces per lot are provided then shoulder width may be reduced to two feet.
7. An access easement may be used in lieu of right-of-way, adequate width must be provided to contain all road appurtenances.

4.4 Cross-Section Standards

4.4.1 Typical Sections

Typical sections for each functional classification are given in Standard Drawings 1 through 5. Table 4-6 also provides a summary of design elements. Variations from these sections may be approved by the County Engineer when there is sufficient evidence that certain design elements can be reduced or eliminated.

4.4.2 Right-of-Way Width

The basic minimum right-of-way width for each typical section is shown in Table 4-6. This width is sufficient only to accommodate the specific geometric cross-sectional elements that are required. Additional right-of-way may be required for curb returns, drainage improvements, or separated bikeways or trails. Cut and fill slopes beyond the hinge point and right-of-way may require slope easements as shown on Standard Drawings 1 through 5. The minimum right-of-way clearances for cuts higher than 30 feet shall be one-third of the cut height but not to exceed 50 feet in width.

4.4.3 Roadway and Shoulder Width

Roadway and shoulder width as functions of functional classification and traffic volume are given in Table 4-6.

The shoulder widths given in Table 4-6 do not apply where curb and gutter sections, speed change lanes or climbing lanes are used. For curb and gutter sections, the shoulder width given is for parking or bike lanes.

4.4.4 Crown Slope

On undivided roads in tangent alignment, the high point of the crown shall be at centerline of the pavement and the pavement sloped toward the edges on a uniform grade. In Mountainous Terrain, local access roads may be sloped toward the cut side of the road on a constant three percent slope to alleviate surface erosion due to runoff, provided safe speed requirements are met. On divided multi-lane standard roads on tangent alignment, each pavement should have a uniform cross slope with the high point at the edge of the inside shoulder. At intersections, or in unusual situations, the crown position may vary depending upon drainage or other controls.

Standard crown slopes to be used on the traveled way for different pavement and surface types are as follows:

CROWN SLOPES	
Type of Surface	Crown Slope (Percent)
Bituminous Mix Pavements	2.0
Gravel Surfacing	3.0

4.4.5 Side Ditches

Side ditches shall be used in all cut sections. The slope from the edge of shoulder to the bottom of the ditch shall not be steeper than 5:1.

4.4.6 Curbs and Gutters

Curbs and gutters are required as follows:

a. On roads in commercial and industrial developments and on roads with adjacent residential lot frontages that are predominately less than 140 feet in width.

b. When required by drainage, traffic or public safety.

All curbs and gutters shall be concrete construction with a vertical or barrier face type formation. Approved types are shown in Standard Drawing 6.

All curbs and gutters are to be constructed with Class A concrete (Colorado Division of Highways Standard Specifications) except that temporary installations may be constructed with asphaltic concrete on approval of the County Engineer.

4.4.7 Cut and Fill Slopes

All slopes should be designed for functional effectiveness, ease of maintenance and pleasing appearance and shall be revegetated with low growing, erosion resistant grasses. The revegetation seeding plan shall be approved by the County Engineer.

Cut and fill slopes shall be as shown on the typical cross-sections shown in Standard Drawing 1 through 5. 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 required prior approval by the County Engineer.

The tops of all cut slopes shall be rounded with a minimum of 10 foot radius where the material is other than solid rock and shall be revegetated.

The backslopes at ends of all cuts, except rock, shall be flattened. The ditch at the lower end of cut shall be widened gradually to discharge side ditch drainage away from base of adjacent fill slopes in order to avoid erosion and improve appearance.

In areas where right-of-way width is fairly constant, a pleasing appearance can be obtained by keeping the catch points for a given cut a fixed distance from the centerline. This constant distance catch point will:

a. Provide a smooth transition from cut to fill

b. Allow smooth rounding at ends of cuts and fills

c. Permit the flattest possible slopes within the right-of-way limitations, thus encouraging better revegetation and erosion control

The necessity of benches, their width and vertical spacing shall be established only after an adequate materials investigation of the site. 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 principles.

When benches are allowed, for ease of maintenance, a 12-foot bench width is satisfactory. Benches should be sloped to form a valley of at least one-foot deep with the low point~~,~~ a minimum of four 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.

4.4.8 Sidewalks and Curbwalks

Sidewalks and curbwalks are required along urban roads where, in the opinion of the County Engineer, significant pedestrian usage is anticipated. Curbwalks shall only be allowed on cul-

de-sac or local access roads. Sidewalks and curbwalks shall be constructed in accordance with Standard Drawings 7 and 8.

4.4.9 Ramps for the Physically Handicapped

All sidewalks and curbwalks shall provide a ramp for accommodation of the handicapped at all intersections in accordance with Standard Drawing 9. Handicapped ramps shall have:

a. A maximum grade of one foot rise in 12 feet of run

b. A non-slip surface (concrete surfaces shall be broom finished)

c. A level platform at the top of at least 60 by 60 inches and a straight, level clearance of at least 72 inches at the bottom of the ramp

4.4.10 Bikeways

a. Bikepaths - separate bikepaths shall be constructed of concrete, according to Standard Drawing 10. The minimum width is eight feet and the minimum thickness is four inches. An adequate, sterilized base shall be provided. Sustained grades for bikepaths shall not exceed five percent. The design speed shall be 20 m.p.h. and minimum centerline radius shall be 80 feet.

b. Bikelane - extra shoulder or roadway width shall be provided on roads shown on the Boulder County bikeway plan as needing bikelanes. A shoulder width of four feet or more is necessary for a bikelane.

4.4.11 Horizontal and Vertical Clearances

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

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

The minimum vertical clearance for all overhead structures including signs, cables, etc. shall be 18 feet from center of roadway, or travel lane in the case of a divided facility.

4.4.12 Cul-de-sacs

Cul-de-sac radii and right-of-way requirements must be in conformance with the details on Standard Drawing No. 11.

In mountainous terrain, the minimum radius may be 35 feet if construction will cause undue cut and fills.

The minimum right-of-way in mountainous terrain shall be a 50 foot radius. Temporary turnarounds shall be a minimum 35 foot radius with a 50 foot radius right-of-way easement. Cul-de-sac grades shall be maximum 4 percent in flat and rolling terrain and 6 percent in mountainous terrain. In situations where adequate right-of-way is not available or in cases where the construction of a cul-de-sac will create undue scarring, a "T" or "Y" design may be used with approval of the County Engineer.

4.5 Private Driveway Standards

Minimum standards for private driveways are as follows:

a. 12 foot-wide traveled way

b. 8 foot-wide, 60 foot long turn out areas located no further apart than 400 feet where visibility is less than 400 feet

c. 12 percent maximum sustained grade. The grade may be increased to 14 percent for a maximum of 200 feet.

d. 80 foot radius centerline

e. Stable cut and fill slopes no steeper than 1 :1

f. Roadside drainage ditches

g. Lines and grades as approved by the County Engineer

h. Minimum 20 foot easement width or wide enough to contain required physical improvements

i. Other road and drainage facilities and appurtenances as deemed necessary by the County Engineer

j. A minimum of 4 inches Aggregate Base Course Class 6 (3/4") must be constructed on the surface.

k. Any traffic control devices necessary such as stop signs, private road, dead end.

l. Cross-section Standard Drawing No. 5 shall be used for design.

4.6 Access Control Standards

The lack of adequate access management on the County Road system and the proliferation of driveway and other access approaches is a major contributor to highway accidents and a major contributor to the functional deterioration of County Roads. As new access approaches are constructed the speed and capacity of roads decrease, and congestion and hazards to the traveling public increase. As a result, significant amounts of tax dollars must be spent to widen County Roads, provide additional operational and safety measures and construct new roads.

The objective of these standards is to conserve both safety and roadway capacity while at the same time allowing accessibility to adjacent land uses, in a manner consistent with the functional classifications of roads described in Section 3.2.3.

4.6.1 Principal and Minor Arterials

a. Private Direct Access

Private direct access to principal and minor arterials shall be permitted only when the property in question has no other reasonable access to the general street system. When direct access must be provided, the following shall be considered:

1. Access shall continue until such time that some other reasonable access to a lower functional category street or highway is available and permitted. The access permit shall specify the future reasonable access location and, if known, the date the change will be made. Subdivisions shall be designed, if possible, to provide for alternative access at a future date.

2. No more than one access approach shall be provided to an individual parcel or to contiguous parcels under the same ownership unless it can be shown that additional accesses would be significantly beneficial to the safety and operations of the road or the local circulation system.
3. On two-lane roads, access approaches may be limited to right turns only, if the approach is within 500 feet from the nearest signalized intersection.
4. Access approaches on multi-lane divided roads shall be limited to right turns only unless either the approach does not have the potential for signalization, and it can be shown that allowing left turns would significantly reduce congestion and safety problems at a nearby intersection; or there are no intersections, existing or planned, which allow a U-turn; and left turns can be safely designed without signalization, or a painted median is present which allows continuous turning storage.

b. Spacing and Signalization

1. For rural road sections where significant development is not expected in the forseeable future, spacing of all intersecting public streets, roads and highways shall be on one-half mile intervals for principal arterials and one-quarter mile intervals for minor arterials, plus or minus approximately 200 feet. Where topography makes such spacing inappropriate, location of public approaches shall be determined by topography, property ownerships, property lines and physical design constraints. The final location should serve as many properties and interests as possible to reduce the need for direct private access to the Road System.
2. In urban or developing areas where higher volumes are present or growth is expected in the forseeable future that will require signalization, it is imperative that the location of all public approaches be planned carefully to ensure good signal progression. An approved traffic engineering analysis shall be made to properly locate all proposed connecting access approaches that may require signalization.
3. Minimum spacing of private driveways where allowed shall be as shown in Standard Drawing 12.

4.6.2 Major Collector

a. Private Direct Access

No more than one access approach shall be provided to an individual parcel or to contiguous parcels under the same ownership unless it can be shown that additional access approaches would not be detrimental to the safety and operation of the road, and are necessary for the safety and efficient use of the property.

b. Spacing

Spacing of major intersecting roads, i.e., major or residential collector should desirably be at one-quarter mile intervals plus or minus 200 feet.

Spacing of public and private local roads where intersection channelization improvements are not required shall be at intervals no less than 300 feet, providing that reasonable access cannot be obtained from lower classification roads. Spacing of private driveways is as shown in Standard Drawing 12.

4.6.3 Residential Collector

a. Private Direct Access

Access to residential collectors shall be permitted only when the property in question has no other reasonable access to a lower classification road. Back-out drives shall not be allowed.

b. Spacing

Spacing of public and private local road intersections shall be at 150 foot intervals. Spacing of private driveways where allowed shall conform to Standard Drawing 12.

4.6.4 Local Streets

a. Private Direct Access

The number of access approaches shall be controlled by the minimum spacing requirements as provided in Standard Drawing 12.

b. Spacing

Intersecting public and private streets shall be located either opposing where possible or be offset by a minimum of 150 feet. Driveway spacing shall be as shown in Standard Drawing Number 12, but in no case exceed more than one access point per lot.

4.7 Intersections at Grade

4.7.1 General

Most roads intersect at grade. The intersectional area is at once an integral part of each road. To minimize the resulting conflicts and to provide adequately for the anticipated crossing and turning movements, geometric design of the intersection at grade must be given careful consideration. Intersections occurring on horizontal or crest vertical curves are undesirable from the standpoint of sight distance and the application of superelevation. When there is latitude in the selection of intersection locations, vertical or horizontal curvature should be avoided. A line or grade change is frequently warranted when major intersections are involved.

4.7.2 Intersection or Access Approach Widths

Access approach width shall be measured exclusive of the radii or flares, between the ends of the return radii for approaches without curbs and those with street style curbed entrances. Driveways with curb cuts shall be measured behind the flared section. Access approach width shall be as required for roadway and shoulders as provided in Standard Drawings 13, 14 and 15.

4.7.3 Intersection or Access Approach Radii

a. No access approach shall have an equivalent turning radius of less than 20 feet.

b. A minimum of 50 foot equivalent turning radii shall be used for driveways when multi-unit vehicles, or single unit vehicles exceeding 30 feet in length, are intended to use on a daily basis.

c. The access approach equivalent turning radii shall not be less than that necessary to accommodate the turning radius of the largest vehicle for which the access approach is intended to use on a daily basis.

d. If the frequency of multi-unit vehicles, or single unit vehicles over 30 feet in length, is such that two of these vehicles, one entering and one exiting, use the access at the same time, radii shall be adequate to accommodate both vehicles with no turning

conflicts.

e. Local access on to local access approaches shall have a 20 foot turning radius.

f. Any local access approach onto a residential collector or higher reclassification shall have a 35 foot turning radius.

g. Any residential collector approach onto a higher classification shall have a 35 foot turning radius.

h. Intersections involving Major collector and arterial roads are to be designed individually.

4.7.4 Channelization Principles

Channelized intersections should be provided where traffic volumes, complexity of movements or other considerations warrant expansion beyond the minimum standard intersection.

The provisions of direct free-flowing high-standard alignment to give preference to major movements is good channelization practice. This may require some degree of control of the minor movements such as stopping, directing, funneling or even eliminating them.

Large all-paved intersectional areas are usually undesirable. The hazards of conflicting movements become magnified due to confusion and the inability of drivers to anticipate movements of other vehicles within these areas. Channelization reduces areas of conflict by separating or regulating traffic movements into definite paths of travel by the use of pavement markings or traffic islands.

A right-angle intersection provides the shortest crossing distance for intersecting traffic streams. It also provides the most favorable condition for drivers to judge the relative position and speed of intersection vehicles.

It is generally desirable to regulate subordinate traffic movements to a single lane where they enter or leave a moving traffic stream. The entrance to a separate turning lane should be flared or widened to afford easy entrance and then channeled or narrowed to permit regulation to a single lane.

If properly designed, channeling discourages undesirable overtaking and passing in a conflict area. Funneling must be made readily apparent to the driver.

Channelization may provide locations for the installation of essential traffic control devices, such as stop and directional signs. Traffic islands constructed solely for this purpose should be carefully designed in order that they not become a built-in hazard.

In application of the principles of channelization, judgment must be exercised in order that traffic islands designed to separate and regulate traffic movements do not introduce confusion due to complexity or become punitive due to excessive restriction. These precautions are particularly important in rural or high speed areas.

4.7.5 Speed Change Lanes

a. Speed change lanes for right turning movements are required according to Table 4-7.

b. For left turning movements, speed change lanes are required to be placed within the median or constructed according to Table 4-8.

c. Speed change lanes shall normally be 12 feet wide exclusive of gutter pan or shoulder. If existing through travel lanes are less than 12 feet wide, a lesser width may be used provided a minimum of 10 feet of width is attained. Generally a four foot shoulder is

required for speed change lanes.

d. For the purposes of Tables 4-7 and 4-8, the DHV for the access approach location is considered synonymous with the term "average peak hour volume" often used for development analysis.

e. Speed, as used in these tables, refers to the posted legal speed limit at the access location at the time of permit application. A higher design speed shall be used if the section of highway is presently being redesigned or reconstructed to a higher speed or an approved access control plan requires a higher speed.

f. Where access permits are required the applicant shall submit an estimate of the volume and type of traffic to use the access approach. The Public Works Department will assist any applicant requesting DHV and ADT traffic estimates for the purpose of obtaining an access approach permit.

g. When an access approach will exceed a DHV of 50 vehicles per hour it is recommended that a traffic analysis be completed by the applicant as outlined in the Appendix - Guidelines for Traffic Studies.

h. When speed change lanes are required, they shall be designed as shown in Figure 4-5.

i. Speed change lanes, both deceleration and acceleration, may require changes in length in accordance with the roadway grades. In instance where grades exceed three (3) percent, multiplication factors available in the Colorado Division of Highways Roadway Design Manual shall be used to determine speed change length.

j. For deceleration lanes where vehicle turning movements are 30 DHV or greater, additional storage length is required to accommodate turning vehicles according to the following:

TURNING VEHICLE PER HOUR	REQUIRED LENGTH IN FEET
30	25
60	50
100	100
200	175
300	250

For every 15 dhv of trucks larger than single unit, the length of the average truck plus 10 feet shall be added to the storage length above.

4.7.6 Sight Distance

a. Maintaining adequate sight distance at intersections is crucial to the safety of the traveling public. The required stopping sight distance necessary as measured from the traveling vehicle to the intersection or access approach shall be determined according to Section 4.3.1(c).

b. In addition to the stopping sight distance necessary for vehicles traveling on the highway

to see objects in the traveled way it is also necessary to provide the entering vehicle adequate sight distance in order to enter or cross the highway. Table 4-9 shall be sued to establish the minimum sight distance necessary for the entering vehicles.

c. Required sight distance for several types of controlled and uncontrolled intersections is shown in Figure 4-6.

d. Access permits or Building permits shall not be issued that include any design elements or allow any turning movements, where the stopping sight distances are not adequate to allow the safe movement of any motorist using the access approach or motorist passing the access approach.

4.7.7 Other Design Elements

a. Within the right-of-way, maximum grades for low volume residential driveways shall be as shown on Standard Drawing 15.

b. The horizontal axis of an approach to the highway shall normally be at a right angle to the centerline of the highway and extend a minimum of 40 feet beyond the traveled way. An angle between 90 and 60 degrees shall be acceptable only if physical constraints required a skew angle less than 90 degrees. An angle less than 60 degrees is not acceptable.

c. An access approach that has a gate across it shall be designed so that the longest vehicle using it can completely clear the traveled way when the gate is closed.

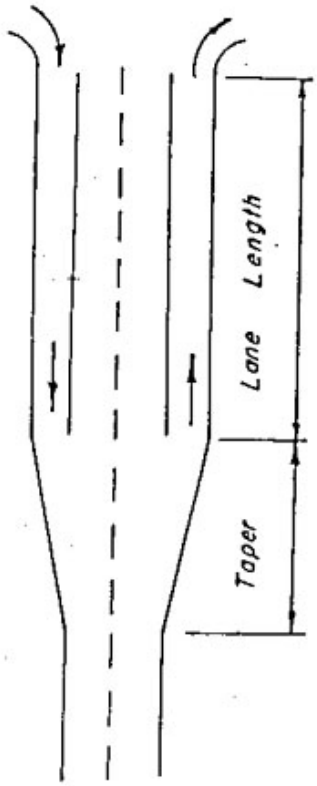
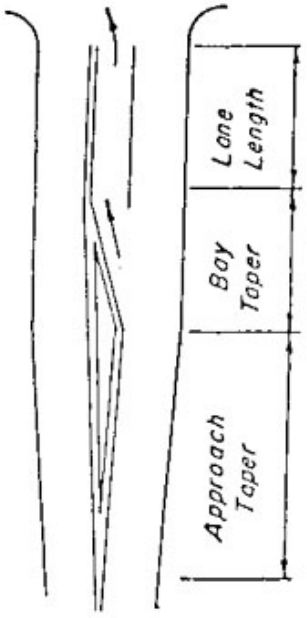


FIGURE 4-5
SPEED CHANGE LANES

ACCELERATION LANE			DECELERATION LANE	
POSTED SPEED (MPH)	LANE LENGTH (FT.)	TAPER (FT.)	LANE LENGTH (FT.)	TAPER (FT.)
30	90	100	105	80
35	165	125	130	105
40	200	180	150	140
45	270	210	190	160
50	440	240	225	180
55	500	300	250	240

NOTES:

1. Assumes 12' lane width greater than 40 MPH and 10' lane width less than 40 MPH
2. Assumes stop condition for acceleration lane and 15 MPH turning speed for deceleration lane
3. Lane length does not include storage requirements as determined in Section 4.7.5
4. If roadway grades exceed 3% length to be adjusted per Section 4.7.5.(i).



LEFT TURN LANE

POSTED SPEED	APPROACH TAPER	BAY TAPER	STORAGE LENGTH
30	140	100	135
35	175	125	150
40	210	150	165
45	280	175	200
50	315	200	235
55	350	250	250

NOTES:

1. Assumes 14' left turn island with 10' lane width
2. Assumes stop condition
3. Does not include storage requirement as determined in Section 4.7.5.
4. Assumes taper is taken equally on both sides of intersection. If widened on one side only double approach taper length.
5. Lane length does not include storage requirements as determined in section 4.7.5.
6. If roadway grades exceed 3% deceleration lengths to be adjusted per Section 4.7.5.(i).

TABLE 4-7

RIGHT TURN LANE WARRANTS

Posted Speed of Highway in MPH					
	25	30 to 40	45 to 50	55	For a
If the *DHV of the highway	500 1400	400 1200	200 800	150 600	2 lane highway 4 or more lanes
	DHV/ADT	DHV/ADT	DHV/ADT	DHV/ADT	
and the DHV OR ADT access approach	50/450 70/625	40/350 60/550	20/175 40/350	15/150 25/225	2 lane highway of the 4 or more lanes

*The DHV of the roadway may be obtained from the Public Works Department and for the purpose of Section 4.6 is considered to be the average peak hourly volumes for a 20-year projection.

a. For highways with four or more through travel lanes, DHV highway values shall be measured only in the direction of the access approach.

b. A right turn acceleration lane is not normally required when the posted speed is 40 mph or less, nor is it required at a signalized intersection.

TABLE 4-8

LEFT TURN LANE WARRANTS

Posted Speed of Highway in MPH					
	25	30 to 40	45 to 50	55	For a
When DHV of the highway will exceed	500 1000	400 900	200 600	150 400	2 lane highway 4 or more lanes
	DHV/ADT	DHV/ADT	DHV/ADT	DHV/ADT	
and the left turning DHV or *ADT into the access approach will exceed	30/250 45/375	20/175 30/250	15/125 20/175	12/100 12/100	2 lane highway 4 or more lanes

*In high employment areas average weekday traffic estimates may be required to be used instead of ADT.

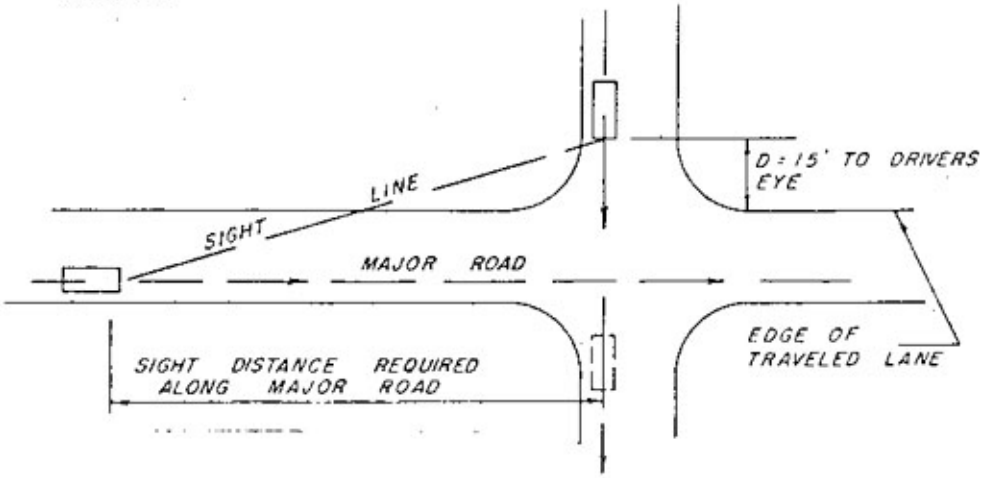
a. For highways with four travel lanes, DHV highway values shall be measured only in the direction of the median speed change lane.

b. This table applies for a normal percentage mix of vehicle types. If the access approach will have a larger percentage of vehicles exceeding 30,000 pounds gross vehicle weight, values of one-half of the access approach values in the table may be used to required median speed change lanes in the interest of public safety.

FIGURE 4-6

SIGHT DISTANCE AT INTERSECTIONS

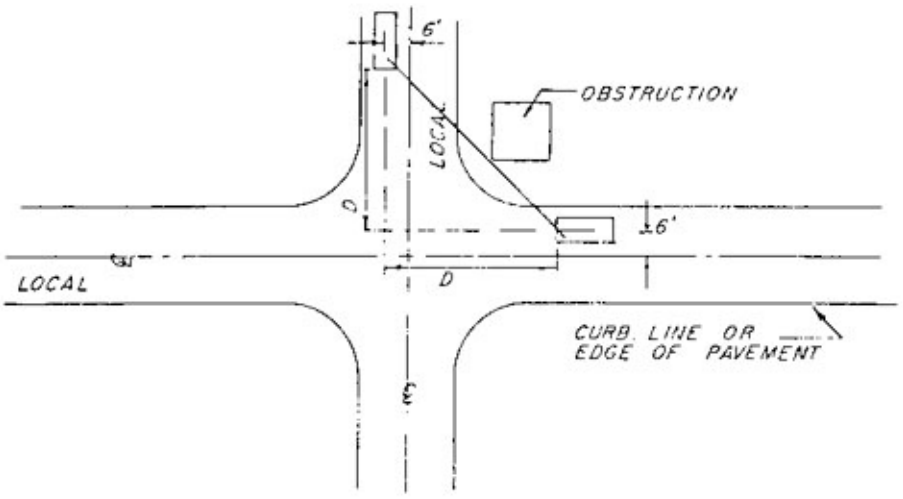
SIGHT DISTANCE REQUIREMENT FOR INTERSECTION INVOLVING A STOPPED CONDITION



DESIGN OF SPEED ON THRU ROADWAY (MPH)	MINIMUM SIGHT DISTANCE FOR STOPPED VEHICLE (FT)
15	100
20	150
25	175
30	200
35	250
40	300
50	450
60	650

NOTES:
1. Vehicles are assumed to be centered in their respective lanes.
2. Distance corrections for grades greater than 3% are required as determined in Section 4.7.5.(i).

SIGHT DISTANCE REQUIREMENT FOR UNCONTROLLED LOCAL STREET INTERSECTION



POSTED SPEED	DISTANCE(D) FT.
20	90
30	130

Applicable only to low volume, low speed intersections.

TABLE 4-9

INTERSECTION SIGHT DISTANCE

*Vehicle expected to enter or cross highway	Sight distance is given in feet per 10 mph of posted speed limit	
	2 lane	4 lane
Passenger car	100	120
Single Unit Truck	130	150
Multi-Unit Trucks	170	200

a. Sight distance shall be measured at a height of 3.5 feet between the entering driver and the oncoming vehicle.

b. The entering driver's eyes shall be considered to be 15 feet back from the edge of the traveled way.

c. If there is no median or if the median is too narrow to safely store a left turning or crossing vehicle, the entire roadway width shall be considered from the approach.

d. If the median can safely store the turning or crossing vehicle, then sight distance shall consider a two stop condition. The vehicle will stop once at the outside edge of the traveled way and again within the median. Each one-way highway direction shall be considered separately.

*e. The vehicle shall be the largest vehicle normally intended to use the access approach. Normally means exceeds an average of one per day.

f. After sight distance requirements are met and an access permit issued, a sign structure or parked vehicle shall not be permitted where it will obstruct the required sight distance.

4.8 Pavement Structure Design

4.8.1 General Policy

The policy and procedure for the design of pavement structure section shall be based on the most current edition of the Colorado Division of Highways Roadway Design Manual - Section 600.

4.8.2 Pavement Structure Design Report

A pavement design report shall be prepared by a Colorado registered professional engineer, and shall be considered a requirement of road plan approval.

The pavement design report shall include the following minimum information:

a. Soil logs along the proposed roadway alignment at a maximum of 500 foot intervals.

b. Each log shall have a soil profile of the four feet below proposed subgrade elevation.

c. Representative samples for pavement design from each log shall be within two feet below proposed subgrade elevation.

d. Each representative sample shall be classified according to the AASHTO Unified Soil Classification Table, along with a Atterberg Limit's Test and a sieve analysis.

e. The pavement design procedure is based on the Hveem Stabliometer Test or the Expansion Pressure Test which is used to compute a Resistance Value (r) of the subgrade. On private roads, local access roads and residential collectors a California Bearing Ratio (CBR) may be used to determine subgrade evaluation. Figures 4-7 and 4-8 correlates CBR and R values.

f. Proposed average daily traffic volumes (ADT) for each road shall be based on 100% of full development including an adjustment for construction traffic. Traffic analysis for the purpose of pavement design shall be as given in Section 4.2.3.

g. Recommended structural sections, based on the design considerations, proposed typical sections, and sections of roadway which may require additional stabilization or treatment.

4.8.3 Design Considerations

The following elements are to be used in the design procedure, with some minimum criteria to avoid considerable effort in transportation planning and design.

a. The design procedure is based on the number of 18,000 pound single axle equivalent daily load applications (18k EDLA) per traveled lane. The 18k EDLA shall be equivalent to 100% of fully developed ADT adjusted for construction traffic (110%). In no case will the 18k EDLA be less than 10 on local access roads and 30 on residential collectors.

b. The serviceability index (SI) for private roads, local access roads and residential collectors will be 2.0. The SI for major collectors and arterials will be 2.5.

c. The regional factor shall be summarized as per Table 4-10. In no case will the regional factor be less than 0.50. In cases where the Regional Factor exceeds 2.00 treatment of the subgrade or underdrains may be required. Underdrains will be required where high groundwater is present.

d. Evaluation of subgrade soils, and pavement structure materials shall follow the

procedure in the CDH Roadway Design Manual and Table 4-11. Evaluation of subgrade soils shall be revised as per Section 4.8.2(e).

e. An economic evaluation of alternate structure section is recommended. In making adjustments to the various layers of the pavement structure a more economical design may result. For example by increasing the asphalt thickness a decrease in gravel and earthwork may result. By stabilizing a poor subgrade with lime or cement a thinner structure section may result. Also the use of asphalt treated base or cement treated subbase may be a more economical use of materials.

4.8.4 Minimum Structural Sections

The minimum depths of Hot Bituminous Pavement (HBP) and Aggregate Base Course (ABC) Class 6 (3/4") per road type which will be allowed are the following:

	HBP	ABC	
Private Roads	2"	4"	
Local Access	2 1/2"	4"	
Residential Collector	2 1/2"	4"	
Major Collectors	3"	4"	
Arterials	3"	4"	

Evaluation of the pavement design as per Section 4.8.3(e) may result in an increase in HBP or substituting ABC with Plant Mix Bituminous Base (PMBB) or Portland Cement Treated Base. In no case will substitute sections be any less than 3 inches in depth.

FIGURE 4-7

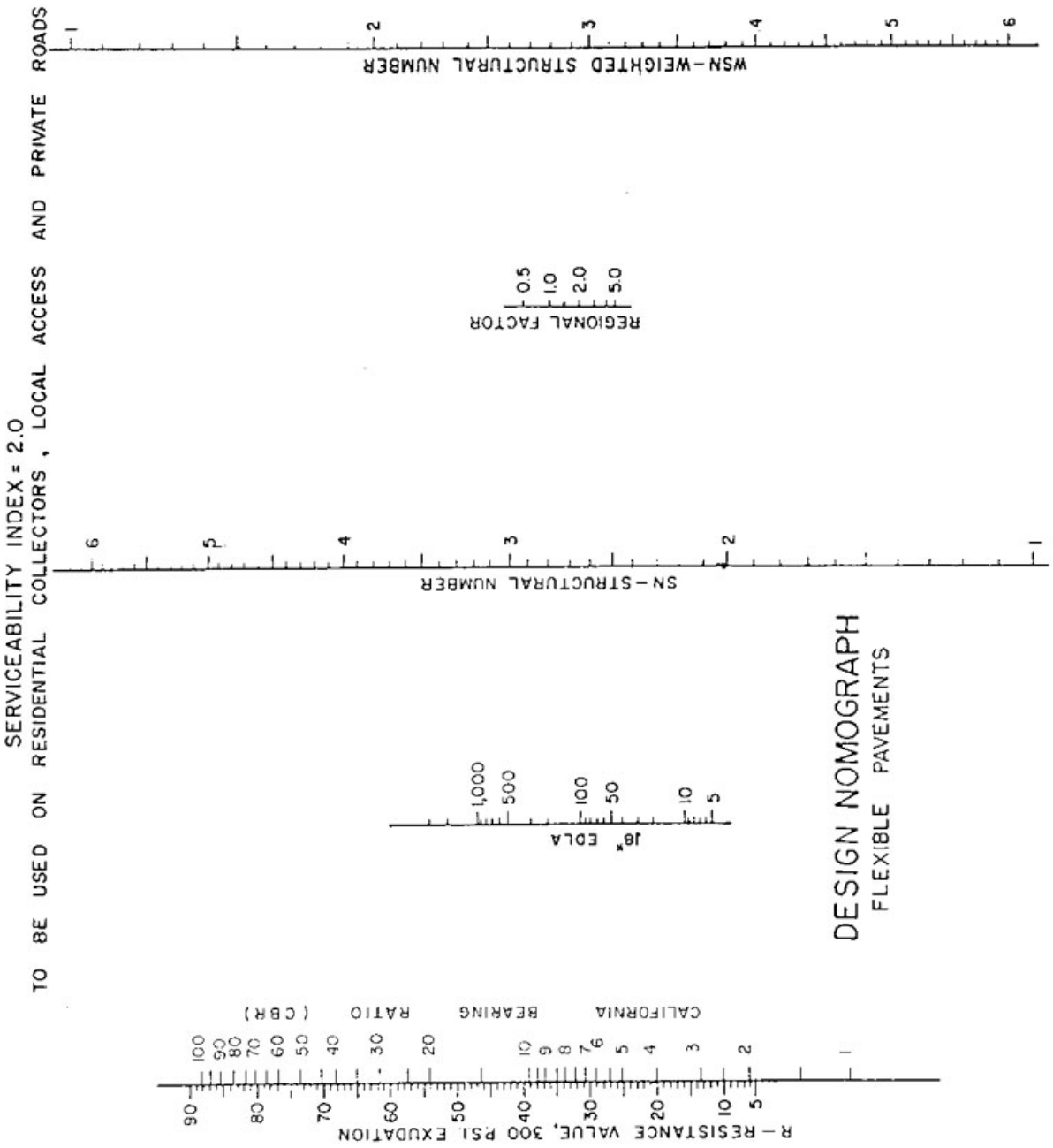

DESIGN NOMOGRAPH
FLEXIBLE PAVEMENTS
SERVICEABILITY INDEX = 2.0
TO BE USED ON RESIDENTIAL COLLECTORS, LOCAL ACCESS AND PRIVATE ROADS
W18 EDLA
1,000
500
100
50
10
5
REGIONAL FACTOR
0.5
1.0
2.0
5.0
SN - STRUCTURAL NUMBER
WSN - WEIGHTED STRUCTURAL NUMBER
R - RESISTANCE VALUE, 300 PSI EXUDATION
CALIFORNIA BEARING RATIO (CBR)

FIGURE 4-8

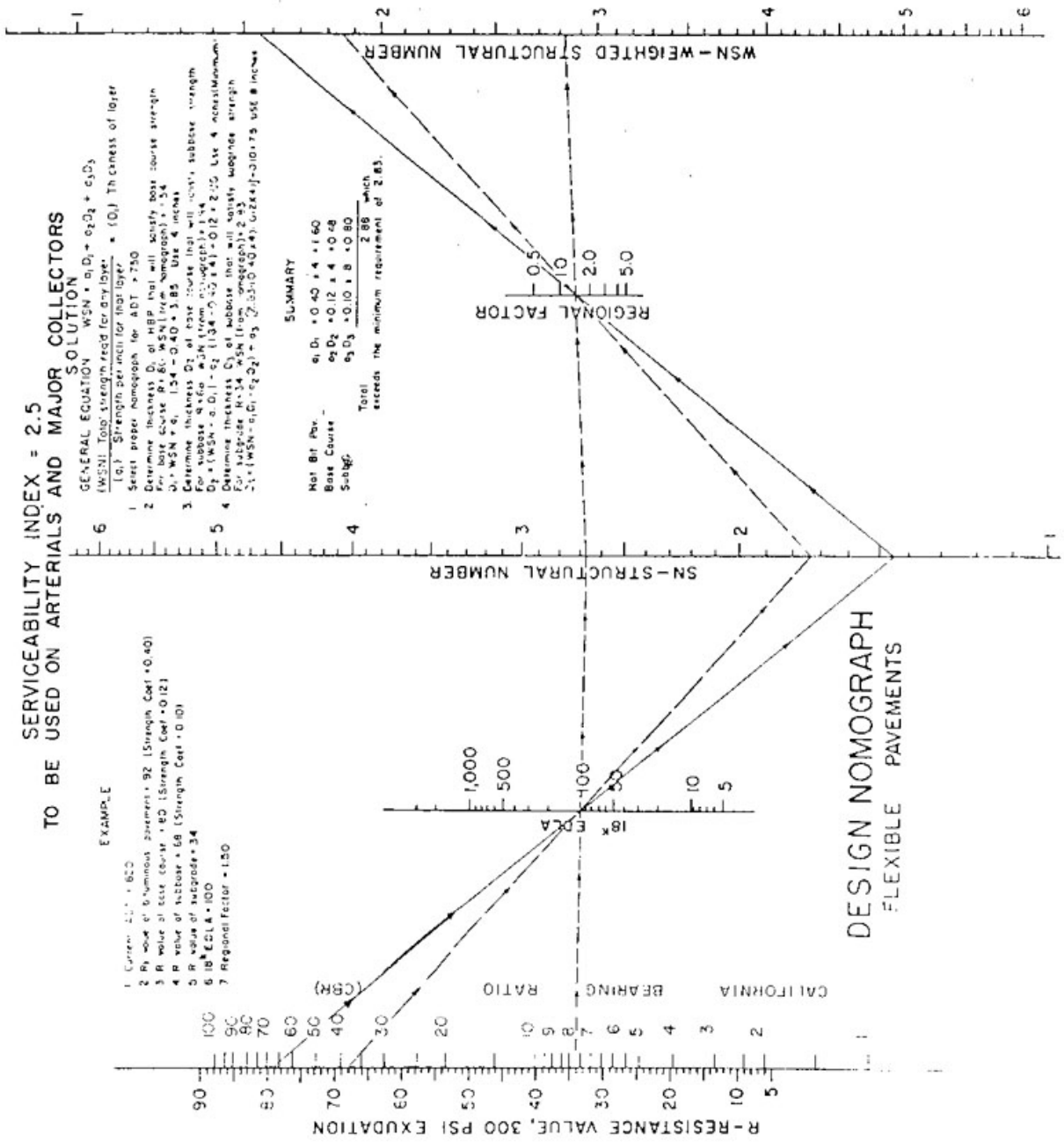

DESIGN NOMOGRAPH
FLEXIBLE PAVEMENTS
SERVICEABILITY INDEX = 2.5
TO BE USED ON ARTERIALS AND MAJOR COLLECTORS
SOLUTION
EXAMPLE
SN-STRUCTURAL NUMBER
WSN-WEIGHTED STRUCTURAL NUMBER
REGIONAL FACTOR
R-RESISTANCE VALUE, 300 PSI EXUDATION
CALIFORNIA BEARING RATIO (CBR)
SUMMARY

Table 4-10

PAVEMENT DESIGN REGIONAL FACTOR

Annual Precipitation	
Over 34"	1.00
24"-34"	0.50
18"-23"	0.00
14"-17"	-0.25
Less than 14"	-0.50

Elevation	
Over 9500	1.50
8500-9500	1.00
7500-8500	0.50
Less than 6500	0.25

Drainage	
*Very poor	1.00
Poor	0.50
Fair	0.25
Good	-0.25
*High groundwater table	

Frost	
**Frost boils in area	3.00
**Frost susceptible soil, frost penetration over 28"	1.00
Frost susceptible soil, frost penetration under 28"	0.25
**Moisture available when subject to frost action	

The Minimum Region Factor shall be .50 factors over 2.00 may require additional subgrade treatments or underdrains.

Other conditions that may influence the choice of regional factors are:

(1) Elevation of the grade line, especially in swampy areas where the roadbed soils may be saturated for long time periods.
(2) Number of freezing and thawing cycles during winter and early spring.
(3) Steep grades with large volume of heavy trucks.
(4) Areas of concentrated turning and stopping movements, such as bus stops, etc.

TABLE 4-11

PAVEMENT DESIGN
STRENGTH COEFFICIENTS

Component	Limiting Test Criteria	Coefficient
Plant Mix Seal		0.25
Hot Bituminous Pavement	$R_t \geq 95$	0.44
" " "	$R_t = 90-94$	0.40
" " "	$R_t = 87-89$	0.35
" " "	$R_t = 84-86$	0.30
" " "	$R_t \leq 83$	0.25
Road Mix Bit. Pavement		0.20
Existing Bituminous Pavement		0.20 to 0.44
Plant Mix Bit. Base	$R_t \geq 90$	0.34
" " " "	$R_t = 85-89$	0.30
" " " "	$R_t = 80-84$	0.25
" " " "	$R_t \leq 79$	0.22
Aggregate Base Course [A.B.C.]	"R" ≥ 84	0.14
" " " " " "	"R" $= 78-83$	0.12
" " " " " "	"R" $= 70-77$	0.11
" " " " " "	"R" ≤ 69	0.10
Emulsified Asphalt Treated A.B.C.	$R_t \geq 95$	0.23
" " " " " "	$R_t = 90-94$	0.20
" " " " " "	$R_t = 84-89$	0.15
" " " " " "	$R_t \leq 83$	0.12
Cement Treated A.B.C.	7-day test ≥ 650 psi	0.23
" " " " "	" " $= 400-649$ psi	0.20
" " " " "	" " ≤ 399 psi	0.15
Hydrated Lime Treated A.B.C.	"R" ≥ 84	0.14
" " " " "	"R" $= 78-83$	0.12
Borrow Material		0.10 *

* Used only to determine a value of strength for layers of soil and/or borrow material which are located above the soil layer from which the soil support value of the subgrade is determined.

NOTE: The minimum strength coefficient for the Base Course on highways having a current ADT volume of 750 or greater shall be 0.12.

4.9 Storm Drainage Design Standards

4.9.1 Applications

This section presents general recommended guidelines for the design road drainage systems. Specific design parameters as well as procedures for determining drainage performance for urban and rural roads can be found in the Boulder County Drainage Criteria Manual.

4.9.2 Design Criteria

Roads are an integral part of the urban drainage system and can be used for transporting storm runoff up to reasonable limits. Design criteria for the collection and movement of runoff water on public roads are based on the frequency of traffic interference; that is, the character of the street determines whether certain traffic lanes can be fully inundated or whether no encroachment is allowed on any traffic lane (Table 4-12).

Depth of allowable cross street flow (Table 4-12) differs for minor (10 year) and major (100 year) storms. Cross street flow falls in two general categories:

a. Runoff that has been flowing in a gutter, then flows across the street to the opposite gutter or to an inlet; and

b. Flow from some external source, such as a drainageway, that will flow across the crown of a street when the conduit capacity beneath the street is exceeded. Culverts should be used whenever it is necessary to transport runoff across streets without curb and gutter.

4.9.3 Hydrology

Runoff from a design storm event must be computed before drainage systems can be planned or engineered. Most of the simpler techniques for computing runoff were not developed for a wide range of conditions. Four computational techniques are recommended for use in Boulder County because of the various hydrologic conditions encountered.

a. Rational Method - The rational method is recommended for storm sewer, culvert design and overland flow drainage basins generally less than 200 acres. It is simple, and when used with adequate input parameters it provides reasonable results for use in project design. The basic equation is:

   $Q = C\ I\ A$

   Where:

   Q - Peak discharge in cubic feet per second (cfs)

   C - Coefficient of runoff (dimensionless)

   I - Average rainfall intensity for a duration equal to the time of concentration of the watershed (inches/hour)

   A - Drainage area of the watershed (acres)

   Input parameters developed specifically for Boulder County can be found in the BCDCM.

b. Colorado Urban Hydrography Procedure (CUHP) - CUHP was developed with data from gauging stations in the Denver region. This method is recommended for the urbanizing plains region along the Front Range of Boulder County since its use is limited to flatter slopes. It is particularly applicable for areas that will undergo significant urbanization in

the future, and are from 50 acres up to 10 square miles in size.

Procedural information on this method can be found in the Urban Storm Drainage Criteria Manual, 1977 revision, adopted by the Denver Regional Council of Governments (DRCOG), Urban Drainage and Flood Control District.

c. Soil Conservation Service (SCS) Method - The SCS method was developed particularly for agricultural watersheds. This widely used method is applicable to the mountainous regions on areas from 200 acres up to 10 square miles, and above 6000 feet in elevation. The method is presented in Procedures for Determining Peak Flows in Colorado - 1977 Edition (U.S. Department of Agriculture, Soil Conservation Service, 1977).

d. Regional Analysis - A statistical or regional approach appears to be most appropriate for those areas in Boulder County where peak flows occur from seasonal snow melt. Also, where large watersheds are expected to undergo significant urbanization, computer simulation techniques should be utilized.

4.9.4 Culverts

a. Materials - Culverts shall be constructed from reinforced concrete or corrugated steel. The minimum pipe size shall be a 18-inch-diameter round pipe or shall have an equivalent 18-inch round cross sectional area for other shapes.

b. Inlets and Outlets - One of the most important considerations in the design of a culvert is the inlet configuration, since the inlet often limits the hydraulic capacity of the culvert. The inlet type can also increase the overall structural integrity by retaining the fill slope, and by preventing inlet scour with subsequent undermining of the culvert.

All culverts shall be designed either with headwalls, wingwalls, or flared-end sections at the inlet and outlet. Additional protection in the form of riprap will also be required at the inlet and outlet due to the potential scouring velocities.

c. Hydraulics - When evaluating the capacity of a culvert, the following data shall be used:

Roughness Coefficient - Table 4-13

Entrance Loss Coefficients - Table 4-14

Capacity Curves - to assist in the review of the culvert design computations and to obtain uniformity of analysis, the following data shall be used:

Concrete Pipe - Concrete Pipe Design Manual, ACPA Arlington Virginia, February 1970

Corrugated Metal Pipe - Handbook of Steel Drainage and Highway Construction Products, A151, Washington, D.C. 1971

The maximum headwater for the 100 year design flows shall be 1.5 times the culvert diameter or culvert rise dimension.

d. Velocity - A minimum culvert velocity of three feet per second is recommended in order to assure a self-cleaning condition.

The maximum culvert velocity is dictated by the channel conditions at the outlet. If the outlet velocities are less than 7 fps for grassed channels, then only a minimal amount of protection is required, due to the eddy currents generated by the flow transition. Higher outlet velocities will require substantially more protection. The maximum outlet velocity shall be 12 fps along with the proper erosion protection.

e. Structure - All culverts, as a minimum, shall be designed in accordance with the procedures of AASHTO Standard Specifications for Highway Bridges and with the pipe manufacturers recommendations.

4.9.5 Roadside Ditches

In areas where no curb and gutter is required, the allowable capacity for the roadside ditch should be calculated through the use of Manning's formula with an appropriate roughness coefficient. If the natural channel slope would cause erosive velocity, suitable channel protection such as drop checks or riprap shall be limited to 1.0 foot, and preferably 1.5 feet. Standards for Erosion Control Ditch checks and Embankment Protectors are given in Standard Drawings 15 and 16.

The most desirable roadside drainage ditches are those lined with grass. The grass will stabilize the body of the ditch, consolidate the soil mass of the bed, and check the erosion on the ditch surface and the movement of soil particles along the ditch bottom. The presence of grass in ditches can result in turbulence which means loss of energy and increased retardance of flows. Therefore, the design must give full consideration to sediment deposition and to scour, as well as hydraulics. Tables. Only roadside ditches lined with grass will be considered acceptable. See Table 4-15.

4.9.6 Bridges and Low Water Crossings

a. Permit Requirements

The permit requirements for bridges and low water crossings are as follows:

Floodplain Development Permit - This permit is obtained from the Boulder County Public WorksDepartment for bridges or low-water crossings which cross creeks or rivers as per the requirements of the Floodplain Overlay District of the Boulder County Zoning Regulations.

State Water Quality Control Commission - This permit is obtained by contacting the Boulder County Health Department and showing that the structure and methods of construction will not have a detrimental effect on the water quality of the stream being crossed.

Corps of Engineers 404 Permit - The need for this permit will be determined by the State Water Quality Control Commission, who will also act as the coordinator between the applicant and the Corps of Engineers. Generally speaking, a 404 permit is required if more than 200 cubic yards of material is placed in a waterway below the normal high water mark.

b. Standards for Bridge

The design and supporting calculations for all bridges must be prepared and certified by a Colorado registered professional engineer.

The minimum standards for private bridges are:

1. Bridge Design Elements

	LOAD DESIGN	CLEAR LANE WIDTH	MINIMUM SHOULDER WIDTH
Private Driveways	HS-10-44	12 ft	--
Two-Lane Private	HS-15-44	22 ft	--
Local Access	HS-20-44	22 ft	4 ft
Collectors	HS-20-44	24 ft	4-6 ft
Arterials	HS-20-44	24 ft	8-10 ft

2. Grade Criteria: Minimum of 0.5 percent
   Maximum of 4.0 percent

3. Hydraulic Criteria:

   Low steel shall be a minimum of one foot above the 100-Year water surface elevation as determined by the County Engineer.

   Where bridge abutments and foundations are located below the 100-Year water surface elevation, concrete wingwalls shall be required at 40 degree to 60 degree angles tied to the existing side slopes to prevent erosion behind the abutments.

   At no time shall the waterway section at the bridge cause a significant rise (one foot) in the 100-Year water surface elevation or cause flow to accelerate to velocities sufficient to scour and undermine the bridges abutments and wingwalls.

c. The minimum standards for private low water crossings are:

1. See Bridge Design Elements.
2. Road approach grade criteria: Minimum of 0.5 percent
   Maximum of 10.0 percent
3. Side slopes shall not be steeper than 3:1 and shall be protected by a six-inch concrete facing or by 18-inch riprap.
4. The culverts used must be corrugated steel pipe with a minimum of 18 inch diameter.
5. Minimum cover over the culverts will be as follows:

   Round pipe - 12" or as recommended by the manufacturer

   Arch pipe - 18" or as recommended by the manufacturer
   or 12" if HS-10-44 loading is applied

6. Hydraulic criteria:

   Culverts shall have the capacity to carry the 10-year peak discharge as determined by the County Engineer.

   At no time shall the waterway section at the crossing cause a significant rise (one foot) in the 100-year water surface elevation or cause flows to accelerate to velocities greater than those expected during the 100-year flood.

7. Typical section as shown in Standard Drawing 20.

TABLE 4-12

ALLOWABLE USE OF STREETS AND OF CROSS STREET FLOW AS PART OF DRAINAGE SYSTEM DURING MINOR AND MAJOR STORM RUNOFF

Street Classification	10 Year Storm Minor Storm Runoff (Maximum roadway encroachment)	100 Year Storm Major Storm Runoff (Allowable depth and inundation)
LOCAL ACCESS	No curb overtopping; where no curbing exists, encroachment shall not extend over property lines. Flow may spread to crown of street.	Inundation: Residential dwellings, public, commerical and industrial buildings shall not be inundated at ground line, unless buildings are floodproofed. Depth of water over gutter flowline shall not exceed 18".
RESIDENTIAL COLLECTOR	No curb overtopping; same as above). Flow spread must leave at least one lane free of water in each direction.	(same as above)
MAJOR COLLECTOR AND ARTERIALS	No curb overtopping; (same as above). Flow spread must leave at least one lane free of water in each direction.	Inundation: (same as above). Depth of water at street crown shall not exceed 6", to allow operation of emergency vehicles. Depth of water over gutter flowline shall not exceed 18".

ALLOWABLE CROSS STREET FLOW

LOCAL AND RESIDENTIAL COLLECTOR	Where cross pans allowed depth of flow shall not exceed 6".	Depth of water over gutter flowline shall not exceed 18".
MAJOR COLLECTOR AND ARTERIALS	None	Depth of water at crown shall not exceed 6".

TABLE 4-13

MANNINGS N-VALUES FOR CULVERTS

A. Corrugated Metal Pipe

Corrugations	Annular 2 2/3" x ½"	Helical 1½" x ½"		Helical 2 2/3" x ½"				
	All Diam.	8"	10"	12"	18"	24"	36"	48"
Unpaved	.024	.012	.014	.011	.014	.016	.019	.020
25% Paved	.021					.015	.017	.020
Fully Paved	.012					.012	.012	.012

Corrugations	Annular 3" x 1"	Helical - 3" x 1"					
	All Diam.	36"	48"	54"	60"	66"	72"
Unpaved	.027	.021	.023	.023	.024	.025	.026
25% Paved	.023	.019	.010	.020	.021	.022	.022
Fully Paved	.012	.012	.012	.012	.012	.012	.012

B. Structural Plate Metal Pipe

Corrugations 6" x 2"	Diameters 5 ft.	7 ft.	10 ft.	15 ft.
Plain-unpaved	.033	.032	.030	.028
25% Paved	.028	.027	.026	.024

C. Concrete Pipe/Culvert

TYPE	N-VALUE
Pre-Cast	0.012
Cast-in-Place	-----
With Steel Forms	0.013
With Wood Forms	0.015

TABLE 4-14

CULVERT ENERGY LOSS COEFFICIENTS
(ENTRANCE LOSS)

Type of Entrance	Entrance Coefficient, Ke
Pipe	
Headwall	
Grooved edge	0.20
Rounded edge (0.15D radius)	0.15
Rounded edge (0.25D radius)	0.10
Square edge (cut concrete and CMP)	0.40
Headwall and 45 Wingwall	
Grooved edge (RCP)	0.20
Square edge	0.35
Headwall with Parallel Wingwalls Spaced 1.25D apart	
Grooved edge	0.30
Square edge	0.40
Beveled edge	0.25
Projecting Entrance	
Grooved edge (RCP)	0.25
Square edge (RCP)	0.50
Sharp edge, thin wall (CMP)	0.90
Sloping Entrance	
Mitered to conform to slope	0.70
Flared-end Section	0.50
Box, Reinforced Concrete	
Headwall Parallel to Embankment (no wingwalls)	
Square edge on 3 edges	0.50
Rounded on 3 edges to radius of 1/12 barrel dimension	0.20
Wingwalls at 30 to 75 to barrel	
Square edged at crown	0.40
Crown edge rounded to radius of 1/12 barrel dimension	0.20
Wingwalls at 10 to 30 to barrel	
Square edged at crown	0.50
Wingwalls parallel (entension of sides)	
Square edged at corwn	0.70

NOTE: The entrance loss coefficients are used to evaluate the culvert capacity operating under outlet control.

TABLE 4-15

PERMISSIBLE VELOCITIES FOR ROADWAY DRAINAGE DITCHES

Roadside channels, lined with various grass covers (uniformed stand; well maintained):

COVER	Slope Range (%)	Permissible Velocity (fps) Soils that are	
		Erosion Resistant	Easily Eroded
Bermuda grass Crested wheatgrass Buffalo grass Kentucky bluegrass Smooth brome Blue grama	0 - 5 5 - 10 over 10	6.0 5.0 4.0	5.0 4.0 3.0
Grass mixture	0 - 5 5 - 10	4.0 3.0	3.0 2.5
Weeping lovegrass Yellow bluestem Kudza Alfalfa Crabgrass Common lespedeza Sudan grass	0 - 5	3.0	2.0

SOIL TYPES	
Easily Eroded	Erosion Resistant
Fine sand (noncolloidal) Sandy loam (noncolloidal) Slit loam (noncolloidal) Ordinary firm loam Alluvial silts (noncolloidal)	Fine gravel Stiff clay (very colloidal) Graded, loam to cobbles (noncolloidal) Graded, slit to cobbles (noncolloidal) Alluvial silts (colloidal) Coarse gravel (noncolloidal) Cobbles and shingles Shales and hard pans

4.10 Parking Facilities

4.10.1 Residential Parking Requirements

Residential Parking Requirements stated Boulder County Zoning Resolution.

4.10.2 Non-Residential Parking Requirements

Off-street parking requirements for non-residential uses are stated in the Boulder County Zoning Resolution.

4.10.3 Handicapped Parking Design Standards

The Handicapped Parkway Space Requirements are stated in the Boulder County Zoning Resolution.

Handicapped parking spaces shall be at least nine-feet wide and shall have an adjacent access aisle at least five feet wide. Two handicapped parking spaces may share a common access aisle. Parked vehicle overhangs shall not reduce the clear width of an accessible (can be approached, entered, or used by physically disabled people) circulation route.

Handicapped parking spaces that serve a particular building shall be located on the shortest possible accessible circulation route to an accessible entrance of the building. In separate parking structures or lots that do not serve a particular building, handicapped parking spaces shall be located on the shortest possible circulation route to an accessible pedestrian entrance of the parking facility.

When handicapped parking spaces are required, such stalls shall be signed. Sign materials and installations shall conform to the Manual on Uniform Traffic Control Devices (MUTCD). These signs should read "RESERVED PARKING" followed by a blue handicapped symbol and a green arrow indicating the stalls restricted to handicapped parking.

4.10.4 Small Car Parking

Small car parking requirements are stated in the Boulder County Zoning Resolution

4.10.5 Bicycle Parking Design Standards

The requirements for bicycle parking are stated in the Boulder County Zoning Resolution. The design standards are as follows:

a. A typical bicycle space shall be a minimum of two (2) feet in width and six and one-half (6.5) feet in length or less, if a permanent device is provided to stand the bicycle on end. A backout or maneuvering space of approximately five (5) feet as well as adequate width to employ a locking device shall be provided.

b. Bicycle racks or lockers shall be anchored so that they cannot be easily removed and shall be of solid construction, resistant to rust, corrosion, hammers, saws, etc.

c. Bicycle parking areas shall be well lighted and located on permanent surfacing as near to the building or facility entrance as possible, without interfering with pedestrian traffic.

4.10.6 Parking Lot Design Standards

a. Parking lots for all public, office, commercial, industrial and multi-family uses shall be paved. In addition, for all other uses, parking lots shall be paved where the expected usage of the lot will exceed 150 daily vehicle trips averaged over a consecutive

operating three day period.

b. The size of a parking stall, its angle, and the width of the access aisle shall conform to Figure 4-9.

c. Parking spaces shall be defined by painted lines or other suitable means.

d. Both sides of a parking stall shall be the same angle. The layout of the parking area shall be such that no vehicle shall protrude into a traffic lane.

e. Dead-end aisles shall provide back-around space of three (3) feet in depth and the same width as the aisle.

f. Parking lots shall be designed to conform to the requirements of Section 4-9 Drainage and Flood Control. All paved areas shall be sloped to drain. Finished slope of areas paved with asphalt shall not be less than 0.5 percent.

g. Entrance and exit signs and directional signs shall be installed as required by the County Engineer.

h. All off-street parking areas with more than 6 spaces shall be partially screened from public view by providing either decorative fencing or walls, contoured earth mounds or suitable landscaping. Fencing or walls shall be a minimum height of four feet and shall be at least 50% solid in the horizontal plane. Contoured berms shall be completely treated with ground cover to reduce erosion, i.e., grass, cobbles or rock and shall not exceed 3:1 slope.

   Landscaping shall include a mix of trees, shrubs and ground covers and shall be designed to consider ease of maintenance, hardiness and water requirements. At 3/4 mature size, landscaping shall result in at least a 30 percent screen in the horizontal plane.

i. Lighting used to illuminate the parking lot or any building shall have no direct rays which extend beyond the boundaries of the property from which the lighting originates.

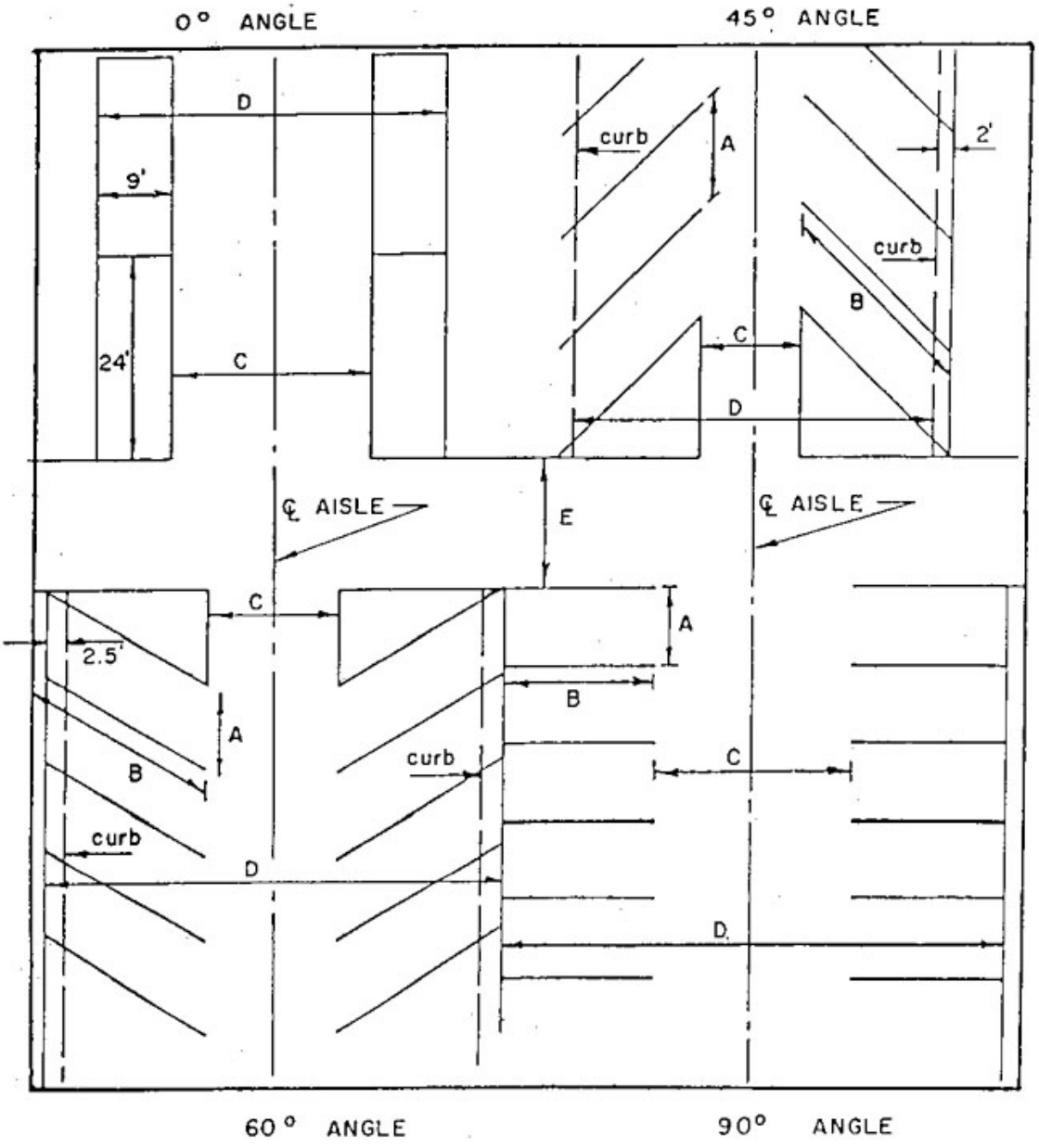
j. Wheel or bumper guards shall be located so that no part of any vehicle shall extend beyond the boundary lines of the parking area, intrude on pedestrian ways, or come in contact with walls, fences or plantings.

k. Except for parking areas provided for single family units, suitable curbs or barriers shall be provided to protect public sidewalks and to prevent parking in areas where parking is not permitted.

FIGURE 4-9

PARKING LAYOUT DIMENSIONS

	on diagram	PARKING ANGLE 0°	45°	60°	90°
		DIMENSIONS			
Stall width, parallel to aisle	A		13	10	9
Stall length	B	24	24	22	18
Aisle width between stalls	C	24	12	16	24
Parking bay width	D	42	43	50	60
Cross aisle, one-way	E	16	16	16	16
Cross aisle, two-way	E	24	24	24	24



4.11 Transit Facilities

The location of transit facilities within County right-of-way shall be jointly determined by Boulder County and the Regional Transportation District (RTD). Boulder County may require the construction of transit improvements such as bus pullouts, bus pads and passenger waiting areas in conjunction with major developments which lie on established or proposed RTD routes.

The standard for bus pads is shown in Standard Drawing 20.

4.12 Road Appurtenances

4.12.1 Street Signs

All street signs shall conform to the latest edition of the Manual on Uniform Traffic Control Devices and any Colorado supplement. Street names signs shall be green in color with white lettering. Non-standard signs shall be subject to approval by the County Engineer.

The selection of materials shall be consistent with the County's ability to inventory materials to maintain the signs after acceptance.

4.12.2 Traffic Control Devices

All signs, striping, delineators, signals and other traffic control devices shall conform to the latest edition of the MUTCD and any Colorado supplement. When a traffic analysis indicates that a particular development impacts a road or roads to a point that a traffic signal is deemed necessary for the safety and efficiency of vehicles and/or pedestrians, the developer shall be responsible for all or a portion installation.

At intersections of local streets, formal traffic control is not required if volumes speed and accident potential are at acceptable levels. In these instances, clear sight distance must be maintained in accordance with Section 4.7.6(c).

4.12.3 Mailboxes

Mailboxes shall be located within road rights-of-way so as not to obstruct vehicular or pedestrian traffic. On rural roads mailboxes shall be located at least eight feet from the travel way and adequate shoulder areas shall be provided. In high density areas and on roads with curbwalks, gang mailboxes may be required. Mailboxes shall not be permitted in sidewalks or within maintained roadside ditches.

4.12.4 Guardrail

Guardrail may reduce accident severity by deflecting vehicles into safer paths or by reducing the rate of deceleration in the case of pending collisions with fixed objects. Guardrail should be considered in the following instances:

a. To protect a fixed object

b. At any location with a high concentration of running off roadway accidents

c. In areas of steep terrain or high embankments

d. On an isolated sharp curve on a road otherwise built to higher standards

e. On curves requiring a reduction in approach speeds where one of the following conditions exist:

1. The height of embankment is more than 10 feet
2. The side slope is steeper than 4:1
3. Substandard pavement and shoulder widths
4. Other roadside hazards

f. Bridge approaches when the shoulder approach is less than 10 feet

The Colorado Department of Highways Roadway Design Manual and M-Standards shall be used for design and construction.

4.12.5 Street Lighting

Street lighting on local streets will only be installed where local residents pay for operational costs. Street lighting shall be installed at arterial/collector and arterial/arterial intersections where there is a high accident potential.

4.13 Utility Location and Coordination

Utilities shall be located within road rights-of-way so as to minimize road maintenance costs. All utility construction shall conform to the Boulder County Utility Installation Permit Requirements and Article V - Construction Specifications.

4.14 Survey Monuments

The following minimum Standards for land surveys and plats shall conform to Section 38-51-101 and 102 of the 1973 Colorado Revised Statutes. The additions are required by the Boulder County Zoning Resolution and Subdivision Regulations.

4.14.1 Horizontal Control

Survey monuments for external boundaries of all platted subdivisions shall be set not more than fourteen hundred feet apart along any straight boundary line; at all angle points; at the beginning, end, and points of change of direction or change or radius of any curved boundaries (38-51-101) defined by circular arcs; and at the beginning and end of any spiral curve; and at all public land corners.

Internal subdivision survey monuments shall be established at all road centerline intersections; the center of radius for cul-de-sacs; the road centerline PC's and PT's of curves, or the PI's of curves; and at the end of the centerline for deadend streets.

All monuments shall be solidly embedded in the ground. Affixed securely to the top of each monument shall be a durable cap bearing the Colorado registration number of the land surveyor responsible for the establishment of said monument.

4.14.2 Vertical Control

At least one permanent benchmark shall be established in a new or replatted subdivision. The benchmark shall be a domed brass cap firmly affixed to a permanent structure, i.e., a concrete bridge headwall or wingwall, concrete irrigation structures, or other sizeable concrete masses. The cap can also be set in a solid rock formation or in the ground in a 6" diameter, 36" deep concrete monument. The cap is not to be set in sidewalks, curbs, driveways, streets, utility poles or trees. The benchmark shall be located with at least 2 horizontal ties. The elevation and the datum used to establish the benchmark shall be recorded on the plat or submitted to the

County Engineer. All horizontal and vertical monuments shall be established by a Land Surveyor registered in the State of Colorado.

The elevation datum of the benchmark shall be surveyed from United States Geological Survey, Bureau of Land Management, or Boulder County floodplain monuments.

ARTICLE V

CONSTRUCTION SPECIFICATIONS

ARTICLE V - CONSTRUCTION SPECIFICATIONS

5.1 General Policies

5.1.1 Boulder County and Colorado Division of Highways Transportation Construction Specifications.

During the prosecution of work all materials, performance, and quality of work shall conform to the requirements of these Standards and Specifications and the most current edition of the Division of Highways, State of Colorado, Standard Specifications for Road and Bridge Construction.

If these Standard and Specifications or the Division of Highways Standards Specifications do not cover a specific situation during the course of work, applicable specifications must be approved or obtained from the County Engineer. The County Engineer shall be the final authority on the meaning or interpretation of all specifications.

5.1.2 Control of Work

All work done within County road right-of-way and applicable work done on private property shall be inspected and documented by Boulder County or by an approved Colorado Register Professional Engineer, to ensure compliance to these Standards and Specifications, approved plans, and subdivision agreement. The Boulder County Public Works Department shall have the authority to control work as determined by these Construction Specifications, decide all questions which may arise as to the quality and acceptability of materials furnished to the work performed or as to the rate of progress of the work, and questions as to the interpretation of the plans and specifications.

The Public Works Department shall, in writing, suspend the work wholly or in part due to the failure of the contractor to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of these Construction Specifications and approved Plans; for failure to carry out written or verbal orders as a result of unsatisfactory work found during inspections, for periods of time due to unsuitable weather conditions; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

5.1.3 Authority of the Inspector

The Public Works Department shall be represented by the Construction Inspector who is authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of materials to be used. The inspector shall not be authorized to waive the provisions of these Standards and Specifications. The inspector shall not be authorized to issue instructions contrary to the approved plans and specifications or to act as foreman for the contractor.

5.1.4 The Project Engineer

The Project Engineer shall be the duly authorized agent of the developer and/or the contractor and has immediate charge of the engineering details of the work. It shall be the responsibility of the Project Engineer:

a. To provide to the Construction Inspector any engineering details, documentation, or any

other information regarding the prosecution of the work.

b. To provide to the Public Works Department, for written approval, any proposed alterations to the approved plans and specifications.

c. To provide "as-built" plans and specifications to the Public Works Department upon completion of all work to be performed on the project as a condition of final approval of the work.

d. To furnish and set construction stakes and marks establishing all lines, grades and measurements necessary to the proper prosecution of the work in its final location as shown on the approved plans and specifications.

5.1.5 Inspection and Testing

To ensure compliance with these Standards and Specifications and approved plans, adequate in-progress inspection and testing is required.

All materials and each part or detail of the work shall be subject to the inspection of the Construction Inspector. The Construction Inspector shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Project Engineer and contractor as required to make a complete and detailed inspection.

Any work done or materials used without inspection may be ordered removed or replaced by the Construction Inspector. The Construction Inspector may, at any time before acceptance of the work, direct the Contractor to remove or uncover any such portion of the finished work. After examination, and after approval of the work by the Construction Inspector, the Contractor shall restore the portions of work disturbed to the standard required by the specification.

When the Construction Specifications of other jurisdictions are used to govern involved in the work, written approval shall be provided by the other jurisdictions and made available to the Construction Inspector prior to final acceptance of the work. Regular in-progress materials testing shall be provided to the Construction Inspector in a timely manner during the course of work, and shall be a requirement of final acceptance. The interval of in-progress materials testing shall conform to the most current testing schedule established by the Colorado Division of Highways, Materials Testing Section. The number of tests and their location shall be approved by the Construction Inspector.

All materials testing shall be performed by an independent laboratory, under the supervision of a Colorado registered professional engineer at the expense of the developer, the Project Engineer or the Contractor.

5.1.6 Removal of Unacceptable or Unauthorized Work

All work which does not conform to these Construction Specifications or approved plans shall be considered an unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause found to exist prior to final acceptance of the work. Unacceptable work shall be removed and replaced according to these Construction Specifications prior notice to acceptance of the work.

Work shall not be done without lines and grades as per Section 5.1.4. Any work done contrary to the instructions of the Project Engineer or Construction Inspector shall be considered unauthorized and may be ordered removed.

5.1.7 The Use of Approved Plans and Specifications

Any work performed without approved plans and specifications shall be considered unauthorized and may be ordered removed and the existing conditions restored.

The approved plans, specifications, supplementary specifications, standards, supplementary standards and any special provision required or approved by the Public Works Department shall be considered complementary to describe and provide for complete work.

The contractor shall not take advantage of any error or omission in the approved plans, standards, and specifications. In the event an apparent error or omission is discovered, the Project Engineer and the Construction Inspector shall be notified. The Project Engineer shall make any corrections required, subject to approval by the County Engineer.

5.1.8 Acceptance of Work

a. Partial Acceptance. If during the course of work an element of the work such as a completed section of subgrade, structures, etc., is completed satisfactorily by the Contractor, acceptance of that element may be required prior to proceeding with the next element. An example would be acceptance of subgrade prior to the placement of subbase. If, after partial acceptance of an element of work, conditions change, the Construction Inspector may require a reinspection and acceptance as per Section 5.1.5.

b. Final Acceptance. Upon written notice from the developer, Project Engineer, or contractor of the completion of all work, the Construction Inspector will make a final inspection.

   If all construction provided for in the approved plans, performance guarantee, or subdivision agreement is found by the County Engineer to be satisfactory, the procedure for acceptance by the Board of County Commissioners for maintenance or release of the performance guarantee may be initiated. If, however, the inspection discloses any work, in whole or part as being unsatisfactory or uncompleted, the County Engineer will notify the developer, Project Engineer or contractor of the deficient items. In the event the work is not done, the developer is responsible for maintenance of the work until such time as all such items are completed or corrected and a reinspection has been made.

5.1.9 Cooperation with Utilities

The Developer, Project Engineer or contractor shall be responsible for coordinating the location, relocation, installation or removal of all utilities involved with the construction of the project.

The construction plans for the proposed project shall be submitted to the affected utilities as soon as possible after final approval of the plans by the County Engineer. Adequate notice shall be given to utilities for utility locations required for the work to avoid damage to existing utilities and conflicts in the work.

5.2 Legal Responsibilities

The most current edition of the Division of Highways, State of Colorado, Standard Specifications for Road and Bridge Construction; Section 107 - Legal relations and responsibilities to the Public, shall be considered Supplemental Specifications to these Standards and Specifications with the following additions, deletions or revisions.

5.2.1 Definitions

State - Shall be redefined as Boulder County, Colorado

Division - The Boulder County Public Works Department

Engineer - Shall be the Project Engineer as defined in Section 5.1.4 when acting as the authorized agent of the developer or contractor or the Construction Inspector as defined ion Section 5.1.3 when acting in behalf of the County Engineer

Contract - Shall be redefined as these Standards and Specifications.

5.2.2 Additions, Deletions or Revisions

Payment - Delete any reference to payment for the use of these specifications.

107.02 - Delete paragraph two.

107.03 - Delete subsection.

107.04 - Delete the last sentence beginning at "and such necessary work".

107.05 - Delete subsection.

107.07 - Delete "as specified under subsection 104.04".

107.08 - Delete subsection.

107.09 - Delete subsection.

107.16 - Paragraph one, line eight, revise to read the following: "...the Contractor or Developer shall be required to assume any expenses entailed in maintaining traffic."

Delete last sentence.

Delete paragraph two, three and four.

107.17 - Delete subsection.

107.19 - Delete subsection.

107.20 - Is hereby revised as follows:

Paragraph one - "In carrying out any of the provisions of these Standards and Specifications; or in exercising nay power or authority granted to them by Boulder County; or performing their duties within the scope of their employment, there shall be no personal liability upon the Board of County Commissioners, Public Works Director, County Engineer or their authorized representatives due to injuries sustained from an act or omission of such employee, except as may be provided by law.

107.22 - Delete subsection.

107.23 - Delete subsection.

107.25 - Delete (c) Measurement and Payment.

5.3 Exceptions, Additions, Deletions or Revisions to the Colorado Division of Highways Standard Specifications.

The most current edition of the Division of Highways, State of Colorado, Standard Specifications for Road and Bridge Construction; Sections 200 through 700 shall be considered Supplemental Specifications to Standards and Specifications with the following additions, deletions or

revisions:

5.3.1 Definitions

State - Shall be redefined as Boulder County, Colorado

Division –The Boulder County Public Works Department

Engineer - Shall be the Project Engineer as defined Section 5.1.4 when acting as the authorized agent of the developer or contractor or the Construction Inspector as defined ion Section 5.1.3 when acting in behalf of the County Engineer

Contract - Shall be redefined as these Standards and Specifications.

5.3.2 Sections 200-500, Construction Details

Payment - Delete any reference of Payment for the use of these specifications.

Section 202.02 - Paragraph one, delete the last two sentences.

Paragraph eight, delete sentence two.

Section 203-08 - Paragraph three, delete the last sentence.

Paragraph four, delete the last sentence.

Section 203.10 - Page 126, Paragraph one, delete the last sentence.

Section 204 - Delete section.

Section 206.03 - Paragraph one, sentence one, Delete: "...and paid for as structure excavation."

Delete sentence two.

Section 212.06 - Paragraph seven, delete the last sentence.

Section 215.03 - Page 194, Paragraph one, delete "...which will be paid for in accordance with subsection 109.04."

Section 407.06 - Delete paragraph two.

Section 501.06 - Delete the last two paragraphs.

5.3.3 Section 600, Incidental Construction

Payment - Delete any reference of Payment for the use of these specifications.

Section 602.03 - Paragraph one, revise sentence one to read the following: "Two copies of a list of all reinforcing steel and bending diagrams shall be furnished to the Engineers at the site of the work and two copies to the Public Works Department at least one week before the placing of reinforcing steel is begun."

Section 614.20 - Paragraph one, sentence three, revise "Engineer" to Public Works Department. The last sentence, revise "Engineer" to Public Works Department.

Delete the past paragraph.

Section 614.21 - Paragraph one, revise "Engineer" to Public Works Department. Delete (a) and (b) and add the following: "The contractor shall be responsible for installing

and maintaining all traffic control devices as per the plan approved by the Public Works Department to protect the comfort and safety of the traveling public. Traffic control shall be maintained on a 24-hour per day basis for as long as determined necessary by the "Public Works Department."

Section 614.22(b) - Revise the first sentence to read the following: "(b) Requirement for flagging shall be described by the following areas."

(b), 2., Revise "Engineer" to Public Works Department.

(b), 3., Revise "Engineer" Public Works Department.

(d) Delete.

Section 619.01 - Paragraph one, revise to the following: "One latest revision of the American Water Works Association Standards, or the standards of the jurisdiction assuming maintenance of the facility,..."

Section 620 - Delete.

Section 622 - Delete.

Section 623.17 - Revise "Engineer" to Public Works Department.

5.3.4 Section 700, Materials Detail

Payment - Delete any reference to payment for the use of these specifications.

Section 701.02 - Revise "Engineer" to Public Works Department.

Paragraph four, sentence one, add the following: "...at the Contractor's expense."

Section 703.07 - Delete the past paragraph.

Section 703.09 - Delete the past paragraph.

Section 717 - Delete.

ARTICLE VI

DEFINITIONS

ARTICLE VI - DEFINITIONS

6.1 Abbreviations of Official Names

AASHTO - American Association of State Highway and Transportation Officials

ASCE - American Society of Civil Engineer

ASTM - American Society for Testing and Materials

AWWA - American Water Works Association

DRCOG - Denver Regional Council of Governments

FHWA - Federal Highway Administration

ITE - Institute of Traffic Engineers

6.2 Definitions

ACCELERATION LANE - A speed-change lane for the purpose of:

a. Enabling a vehicle entering a roadway to increase its speed to a rate at which it can more safely merge with through traffic.

b. Providing the necessary merging distance.

c. Giving the main roadway traffic the necessary time and distance to make appropriate adjustments.

ACCESS OPENINGS - Openings in the right-of-way line which serve abutting land ownerships whose remaining access rights have been acquired by the State.

ALLOWABLE HEAD - The highest headwater caused by the constriction which can be tolerated without damage to roadway structure or adjacent property.

AVERAGE DAILY TRAFFIC - The average 24-hour volume, of all lanes in both directions being further defined as the total number during a stated period, divided by the number of days in that period. Unless otherwise stated, the period is a year. The term is commonly abbreviated as ADT.

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 part shall be considered as a single axle.

BACKFILL - Material used to replace or the act of replacing material removed during construction; also may denote material placed or the act of placing material adjacent to structures.

BARRIER - Crash, dead-end highway, headlight glare, traffic guidance. Trees, shrubs or other objects intended to impede, stop or affect a vehicular action or movement.

BARRIER CURB - A curb that is designed with a near vertical face to prevent or discourage vehicles from leaving the pavement.

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.

BERM - A raised and elongated area of earth intended to direct the flow of water, screen

headlight glare, or redirect out-of-control vehicles.

BRIDGE - A structure including walls or abutments erected over a depression or an obstruction, as water, highway or railway, and having a track or passageway for carrying traffic or other moving loads.

CEMENT TREATED BASE - A base consisting of a mixture of mineral aggregate (or soil) and portland cement, mixed and spread on a prepared surface, to support a surface course.

CHANNELIZED INTERSECTION - An at-grade intersection in which pavement traffic is directed into definite paths by islands.

CHIPSEAL - Alternate layers of bituminous binder material and stone chips.

CLEARING - The removal of vegetation, structures or other objects as an item of highway construction.

COHESIOMETER - An instrument used to measure the tensile strength (cohesive strength) of an emulsified asphalt treated base course or a bituminous pavement.

CONSTRUCTION JOINT - A joint made necessary by a prolonged interruption in placing of concrete.

CONTOUR GRADING PLAN - A drawing showing an arrangement of contours intended to integrate construction and topography, improve appearance, retard erosion and improve drainage.

CONTOUR LINE - A line (as on a map) that connects points of equal elevation on a land surface.

CONTROL OF ACCESS - The condition where the right of owners or occupants of abutting land or other persons to access, light, air or view in connection with a highway is fully or partially controlled by public authority.

CRITICAL DEPTH - The depth of water flowing in an open channel or a conduit partially filled, for which the velocity head equals one-half the hydraulic mean depth.

CRITICAL FLOW - A condition which exists at the critical depth; under this condition, the sum of the velocity head and static head is a minimum.

CRITICAL SLOPE - The slope of a channel that sustains a given discharge at a uniform and critical depth. A slope less than critical is called a mild slope whereas a steeper than critical slope is called steep slope.

CRITICAL VELOCITY - The velocity in an open channel or a conduit partially filled for which the velocity head equals one-half the hydraulic mean depth.

CROSS SLOPE (ROADWAY) - On divided highways each one-way pavement may be crowned separately as on 2 lane highways, or it may have a unidirectional slope across the entire width of pavement, almost always downward to the outer edge.

CUL-DE-SAC STREET - A local street open at one end only, and with special provisions for turning around.

CULVERT - A closed conduit, other than a bridge, which conveys water carried by a natural channel or waterway transversely under the roadway.

CURVILINEAR ALIGNMENT - A design concept whereby the centerline projection has been developed in accordance with topographic and man-made controls and influences using a minimum of tangent sections.

DEBRIS - Scattered fragments, limbs, ruins, rubbish, mass of stones or fragments of rocks.

DECELERATION LANE - A speed-change lane for the purpose of enabling a vehicle that is to make an exit turn from a roadway to slow to the safe speed on the curve after it has left the main stream of faster-moving traffic.

DELINEATORS - To define the roadbed and used as an aid to alert drivers of day and night hazard conditions.

DESIGN CAPACITY - The practical capacity or lesser value determined for use in designing the highway to accommodate the design volume.

DESIGN LOAD - The loads that must be supported by a structure -in terms of live and dead weight loads.

DESIGN PERIOD - Geometric design generally based on estimated traffic requirements 20 years after construction.

DESIGN SPEED - A speed determined for design and correlation of the physical features of a highway that influence vehicle operation. It is the maximum safe speed that can be maintained over a specific section of highway when conditions are so favorable that the design features of the highway govern.

DESIGN VOLUME - A volume determined for use in design, representing traffic expected to use the highway. Unless otherwise stated, is an hourly volume, commonly abbreviated as DHV.

DHV - Future design hourly volume, two-way, unless otherwise specified.

DISCHARGE FREQUENCY - The runoff that can be expected to occur during the life of highway. Designed on 10, 25 and 100-year flood.

DITCH CHECK - Checks are usually constructed of riprap, metal, concrete, timber or wire enclosed riprap, and should be used only as a last resort because they are a hazard to vehicles driving off the road, hamper the use of power-mowing equipment, are unsightly, and are subject to damage at time of unusual runoffs.

DIVIDED HIGHWAY - A highway with separated roadways for traffic in opposite directions.

DRIVEWAYS - Minor roadway connections that fall into three categories: private, commercial and public.

EASEMENTS - A right to use or control the property of another for designated purposes.

18k EDLA - 18,000 pound single axle Equivalent Daily Load Applications (See 'Axle Load" and "Equivalence Factor.")

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.

EQUIVALENCE FACTOR - A numerical factor that expresses the relationship of a given axle load to another axle load in terms of their effect of the 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.

EROSION - The wearing away of a land surface by detachment and transporting of soil and rock particles by the action of water, wind, or other agents.

EXPANSION JOINT - A joint located to provide for expansion of a rigid slab, without damage to itself, adjacent slabs, or structures.

FLARED INTERSECTION - An unchannelized intersection, or a divided highway intersection

without islands other than medians, where the traveled way of any intersection leg is widened or an auxiliary lane added.

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

FLOOD FREQUENCY - The average interval of time, based on the period of record, between floods equal to or greater than a specified discharge or height. It is generally expressed in years.

FOUR-LEG INTERSECTION - A roadway intersection with four intersection legs. If two of the intersection legs are approximate prolongations of the other two legs, and the angle of intersection of these prolongations is 75 degrees or more, but less than 105 degrees, it is classed as a four-way right-angled intersection. If two of the intersection legs are approximate prolongations of the directions of approach of the other two, and the angle of intersections of these two prolongations is less than 75 degrees or more than 105 degrees, it is classed as a four-way oblique intersection.

FULL CONTROL OF ACCESS - The authority to control access is exercised to give preference to through traffic by providing access connection with selected public roads only and by prohibiting crossing at grade or direct private driveway connections.

GEOMETRIC DESIGN - The arrangement of the visible elements of a road, such as alignment, grades, sight distances, widths, slopes, etc.

GRADE - The rate expressed in terms of percent, ascent or descent divided by length.

GRADE SEPARATION - A crossing of two highways, or a highway and a railroad, at different levels.

GRUBBING - The process of removing roots, stumps and low-growing vegetation.

GUARDRAIL - A protective device intended to make highways safer by reducing accident severity.

HIGHWAY, STREET, OR ROAD - These are general terms, denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way. In rural areas, or in urban areas, where there is comparatively little access and egress, a way between prominent termini is usually called a highway or a road. A way in an urban area with or without provisions made for curbs, sidewalks and paved gutters, is ordinarily called a street.

HORIZONTAL ALIGNMENT - Horizontal geometrics for safe and continuous operation at a uniform design speed for substational lengths of highway and must afford at least the minimum stopping distance of the design speed at all points on the highway.

HOT BITUMINOUS PAVEMENT - a combination of mineral aggregate and bituminous material mixed in a central plant, laid and compacted while hot.

HVEEM STABILIMETER - The measurement of the lateral pressure transmitted by a soil or aggregate being subjected to a vertical load. The pressure obtained is used to compute "R" Value. The internal resistance or the internal friction property of bituminous pavement or a base course. Data obtained is used to compute the Relative Stability.

INTERSECTION - The area embraced within the prolongation or connection of the lateral curb lines, or, if none, then the lateral boundary lines of the roadways of two highways which joint one another at, or approximately at, right angles, or the area within which vehicles traveling on different highways jointing at any other angle may come in conflict.

INTERSECTION ANGLE - The angle between two intersection legs.

INTERSECTION LEG - That part of any one of the roadways radiating from an intersection which is outside the area of the intersection proper.

a. Approach - That portion of a leg which is used by traffic approaching the intersection.

b. Exit - That portion of a leg which is used by leaving an intersection.

INVERT - The floor, bottom, or lowest portion of the internal cross-section of a closed conduit or improved channel.

ISLAND - A defined area between traffic lanes for control of vehicle movements or for pedestrian refuge. Within an intersection a median or an outer separation is considered an island.

LEFT-TURN LANE - A traffic lane within the normal surface width of a roadway, or an auxiliary lane adjacent to or within a median, reserved for left-turning vehicles at an intersection.

LIME TREATED BASE - A base consisting of a mixture of soil, hydrated lime, and water, usually mixed in place and placed to support a pavement structure, or the components thereof.

LONGITUDINAL JOINT - a joint normally placed between traffic lanes to control longitudinal cracking.

MEDIAN - The portion of a divided highway spearing the traveled ways for traffic in opposite directions.

MEDIAN OPENING - a gap in a median provided for crossing and turning traffic.

MINIMUM COVER - The point of minimum cover shall be the edge of the paved shoulder giving the least cover over the pipe.

MINIMUM TURNING PATH - The path of a designated point on a vehicle making its sharpest turn.

MINIMUM TURNING RADIUS - The radius of a minimum turning path of the outside of the outer front tire.

MOUNTABLE CURB - One that can be readily climbed by a moving vehicle.

MULTI-LANE ROAD - a road having two or more lanes for traffic in each direction, or four or more lanes for traffic in two directions. It may be one-way, or two-way, divided or undivided.

NON-MOTORIZED TRAIL - A hardpack, gravel or paved trail suitable for bicycle, pedestrian and equestrian travel.

PARKING LANE - an auxiliary lane primarily for the parking of vehicles.

PARTIAL CONTROL OF ACCESS - The authority to control access is exercised to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there by be some crossings at grade and some private driveway connections.

PASSING SIGHT DISTANCE - The minimum sight distance on two and three-lane highways 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 should it come into view after the overtaking maneuver is started.

PAVEMENT - That part of a roadway having a constructed surface for the facilitation of vehicular movement.

PAVEMENT JOINT - A designed vertical plan of separation or weakness.

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.

PERMEABILITY - The property of soils which permits the passage of any fluid. Permeability depends on grain size, void ratio, shape and arrangement of pores.

PERMISSIBLE VELOCITY - The greatest velocity that will not cause excessive erosion.

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

PLANT MIXED SEAL - A combination of mineral aggregate and bituminous material mixed in a central plant, laid and compacted while hot. This type seal is usually laid in very thin layers.

PRIME COAT - The application of a low viscosity liquid bituminous material to an absorbent surface, preparatory to any subsequent treatment, for the purpose of hardening or toughening the surface and promoting adhesion between it and the superimposed construction.

R VALUE - The resistance value of the soil while in a state of density and degree of saturation typical of the most adverse conditions to be expected on the road during the service life.

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.

RIGHT-OF-WAY - A general term denoting lane, property, or interest therein, usually in a strip, acquired by public or private entities for or devoted to transportation purposes.

RIGHT-TURN LANE - A traffic lane within the normal surfaced width of a roadway, or an auxiliary lane to the right of and adjacent to the through traffic lanes, reserved for right-turning vehicles at an intersection.

ROADBED - The graded portion of a highway, usually considered as the area between the intersections of top and side-slopes, upon which the subbase, base course, surface course and shoulders are constructed. Divided highways are generally considered to have two roadbeds.

ROADSIDE - A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

ROADWAY - The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.

SCREENING - The use of trees, shrubs, fences or other materials to obscure an objectionable view or action or reduce an objectionable sound.

SERVICEABILITY INDEX - A number which is indicative of the pavement's ability to serve traffic at any specific time.

SHOULDER - The portion of a roadway contiguous with the traveled way for accommodation of bicycle traffic stopped vehicles, for emergency use and for lateral support of base and surface courses.

SIGHT DISTANCE - The distance visible to the driver of a passenger vehicle, measured along the normal travel path of a roadway, to the roadway surface or to a specified height above the roadway, when the view is unobstructed by traffic.

SIGHT LINE EASEMENT - An easement for maintaining or improving the sight distance.

SINGLE-UNIT TRUCK - A freight vehicle of two or three axle and larger than a pickup.

SITE TOPOGRAPHY - May be obtained from aerial photographs, ground surveys or

topographic maps, and shall include all improvements and physical controls within the area that may be affected by the design.

SLOPE EASEMENT - An easement for cuts or fills.

SOIL STERILIZATION - Growth reduction of weeds that may emerge through surfaced medians, traffic islands and other areas, soil sterilants may be applied.

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

SPEED-CHANGE LANE - an auxiliary lane including tapered areas, primarily for acceleration or deceleration of vehicles entering or leaving the through traffic lanes.

STABILIZATION - Modification of soils or aggregates be incorporating materials that will increase load bearing capacity, firmness and resistance to weathering or displacement.

STOPPING SIGHT DISTANCE - The distance required by a driver of a vehicle, traveling at a given speed, to bring his / her vehicle to a stop after an object on the roadway becomes visible. It includes the distance traveled during the perception and reaction times and the vehicle braking distance.

STRENGTH COEFFICIENT - A factor used for expressing the relative strength, or substitution value of, layers, one to the other, for conversion purposes in a pavement structure.

STRUCTURAL NUMBER (PAVEMENT) - 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.

SUBBASE - The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

SUBGRADE - The top surface of a roadbed upon which the pavement structure and shoulders including curbs are constructed.

SUPERELEVATION - The raised portion of highway above the normal cross slope to prevent a vehicle from sliding outward, or counteracting all the centrifugal force of a vehicle traveling at an assumed speed.

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 sometimes called "Wearing Course."

SUSTAINED GRADE - A continuous highway grade of appreciable length and consistent or nearly consistent gradient.

T INTERSECTION - A three-leg intersection in the general form of a "T".

TACK COAT - The application of bituminous material to an existing surface to ensure bond between the superimposed construction and the old surface.

TERRAIN - The topography of the profile of a highway, road, or street. As used in this manual, the term generally has one of three modifiers: level, rolling, or mountainous. These three modifiers represent combinations of geometric features in varying degrees which relate primarily to gradients and horizontal and vertical alignment. They reflect the effect on capacity of the operating characteristics of trucks in terms of their passenger car equivalent under the difference geometric conditions.

THREE-LEG INTERSECTIONS - A roadway intersection with three intersection legs. If one of these intersection legs is an approximate prolongation of the direction of approach of another and, if the third leg intersects this prolongation at an angle between 75 degrees and 105 degrees, the three-way intersection is classed as a T intersection. If one leg is an approximate prolongation of the approach of another, and the third leg intersects this prolongation at an angle less than 75 degrees or greater than 105 degrees, it is classed as a Y intersection.

TIME OF CONCENTRATION - The time required for storm runoff to flow from the most remote point, timewise, of a drainage area to the point under consideration. It is usually associated with the design storm.

TOPOGRAPHY - The configuration of the earth surface including the shape and position of its natural and manmade features.

TRAFFIC ANALYSIS PERIOD - A common analysis period (usually 20 years) used in geometric design.

TRAFFIC ANALYSIS PERIOD -A common analysis period (usually 20 years) used in geometric design.

TRAFFIC CONTROL - Any sign, signal, marking, or installation placed or erected under public authority, for the purpose of regulating warning or guiding.

TRAFFIC ISLAND - An island provided in the roadway to separate or direct streams of traffic; includes both divisional and channelizing islands.

TRAFFIC LANE - A strip of roadway intended to accommodate a single line of moving vehicles.

TRAFFIC MARKING - A traffic control device consisting of lines, patterns or colors on the pavement, or other objects within or adjacent to the roadway, or words or symbols on the pavement.

TRAFFIC SIGN - a traffic control device mounted on a support above the level of the roadway that conveys a specific message by means of unchanging words or symbols.

TRAVELED WAY - The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

TRUCK COMBINATION - A truck tractor and a semi-trailer, either with or without full trailer, or a truck with one or more full trailers.

TURNING MOVEMENT - The traffic making a designated turn at an intersection.

TURNING PATH - The path of a designated point on a vehicle making a specified turn.

TWO-WAY ROAD - a road on which traffic may move in opposing directions simultaneously. It may be either divided or undivided.

UNCONTROLLED ACCESS - The authority having jurisdiction over a highway, street or road, does not limit the number of points of ingress or egress except through the exercise of control over the placement and the geometrics of connections as necessary for the safety of the traveling public.

VERTICAL ALIGNMENT - Properly designed, should provide adequate sight distance, safety, comfortable driving, good drainage, pleasing appearance. Minimum lengths of crest vertical curves are controlled by stopping sight distance requirements.

ARTICLE VII

APPENDICES

ARTICLE VII - APPENDICES

7.1 Guidelines for Traffic Studies

Traffic Engineering consultants are invited to discuss projects with the Public Works Department prior to initiation of the study. This should provide a firm base of cooperation and communication between the County, The Owner/Developer and the consultant in creating traffic characteristics that are in the best interest of the total community.

All traffic studies shall contain, as a minimum, the following information:

1. A summary table listing each type of land use, the number and characteristics of the units involved, the generation rates used, (daily and AM/PM peaks), and the resultant trip generation. Trip generation shall be calculated from the latest data contained with the Institute of Transportation Engineers' Trip Generation Report. In the event that data is not available for the proposed land use, the Public Works Department shall approve any estimated rates for approval.

2. A site map that shows the location within the site of each land use and a network map that shows all existing and proposed road facilities.

3. A traffic volume map that shows the most up-to-date traffic volumes and 20 year projected traffic volumes, both daily and peak hour, on the existing road system. Existing and future traffic volumes should be obtained from the Public Works Department, the State Highway Department or any nearby municipality.

4. A trip distribution and assignment analysis which loads trips from the new development onto the road network. The Public Works Department shall approve the assignment percentages used in the analysis and approve when acceptable. Internal trips shall not exceed ten percent of total trips. Nongenerated passerby traffic reductions in generation volumes may be considered if applicable. A modal split of two percent for public transit shall be assumed unless the development is located in a high transit corridor.

5. Traffic Graphics should show:

   a. Peak hour site traffic (in and out and on adjacent facilities)

   b. Peak hour total traffic (current traffic plus site traffic in and out and on adjacent facilities)

   c. Peak hour total traffic (20 year projection) in and out and on adjacent facilities

   d. Total daily traffic (with site traffic shown in parenthesis) both existing and 20 year projected.

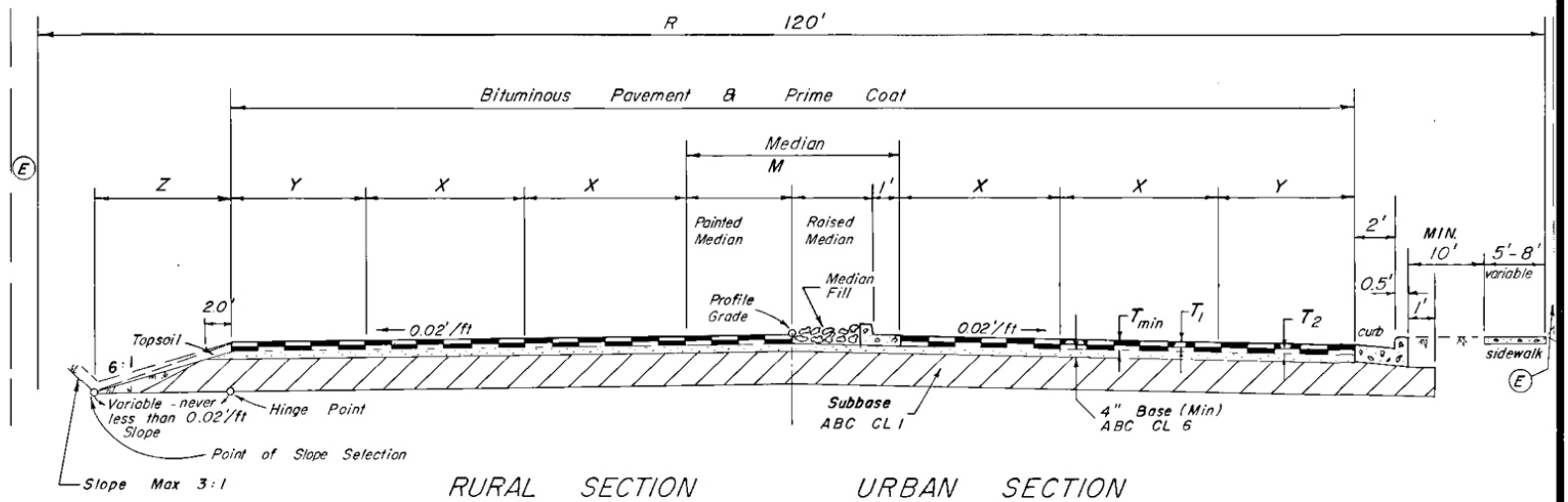
   In the absence of any meaningful peak hour data, peak hour trips shall be assumed to be 20 percent of total daily trips.

6. A peak hour existing and 20 year projected capacity analysis should be conducted for all adjacent facilities, for all adjacent arterial-arterial, arterial-collector, collector-collector intersections, and for all major driveways that intersect arterial or collector streets. Level of service "C" shall be the design objective and under no conditions will less than level of service "D" be accepted for site and non-site traffic. Pedestrian movements should also be considered in the analysis.

7. All required improvements, including roadway widening, channelization, signalized intersections should be identified.
8. Traffic progression is of paramount importance and should be considered in the location of all potential signalized intersections.
9. Traffic accident data for affected street corridors shall be obtained for the study area. Estimates of increased or decreased accident potential shall be evaluated for the development.

ARTICLE VIII

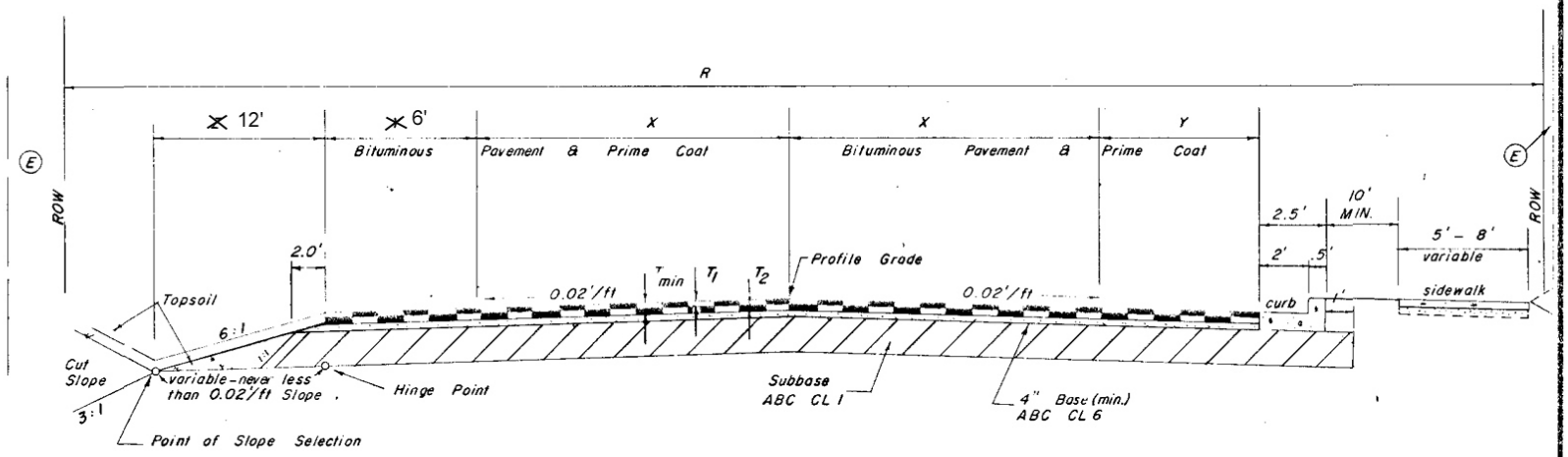
STANDARD DRAWINGS



(E) SLOPE EASEMENT AS REQUIRED

CLASS	X	Y	Z	T_{min}	T_1	T_2	R	M
PRINCIPAL ARTERIAL	12'	10'	12'	3"	1 1/2"	1 1/2"	120'	16'
MINOR ARTERIAL	12'	8'	12'	3"	1 1/2"	1 1/2"	120'	14'

PRINCIPAL AND MINOR ARTERIAL (FOUR LANE) STANDARD DRAWING NO. 1



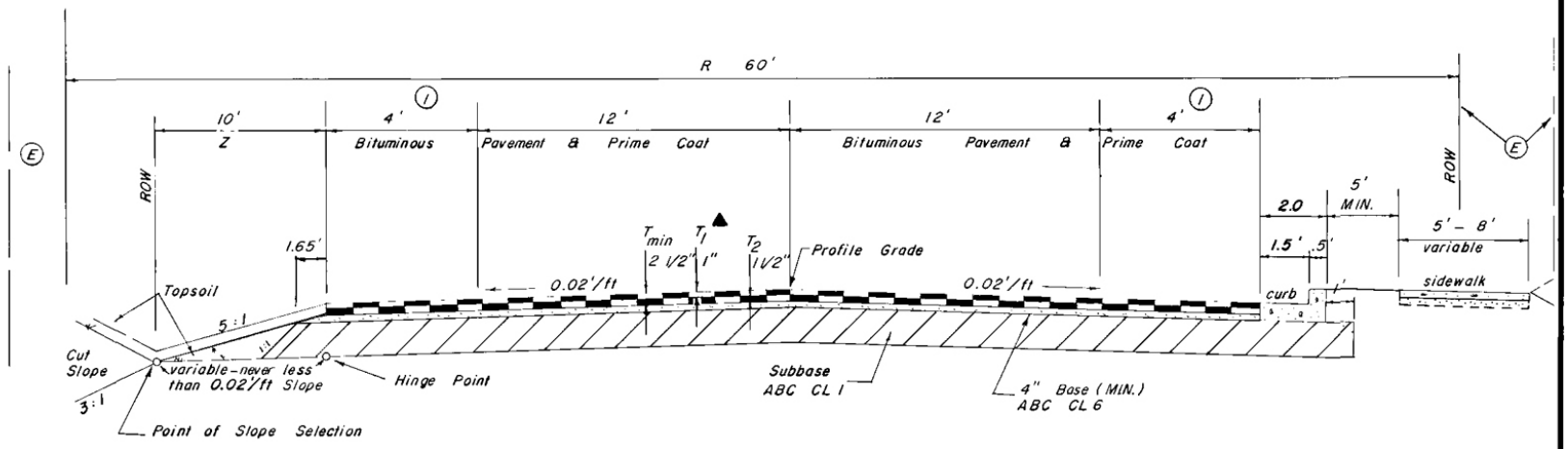
RURAL SECTION URBAN SECTION

(E) SLOPE EASEMENT AS REQUIRED

▲ HOT BITUMINOUS PAVING GRADING EX WILL BE REQUIRED WHEN T_1 = 1"

CLASS	X	Y	Z	T_{min}	T_1	T_2	R
MINOR ARTERIAL	12'	12'	6'	3"	1 1/2"	1 1/2"	120'
MAJOR COLLECTOR	12'	12'	6'	2 1/2"	1"▲	1 1/2"	80'

MINOR ARTERIAL AND MAJOR COLLECTOR (TWO LANE)
STANDARD DRAWING NO. 2



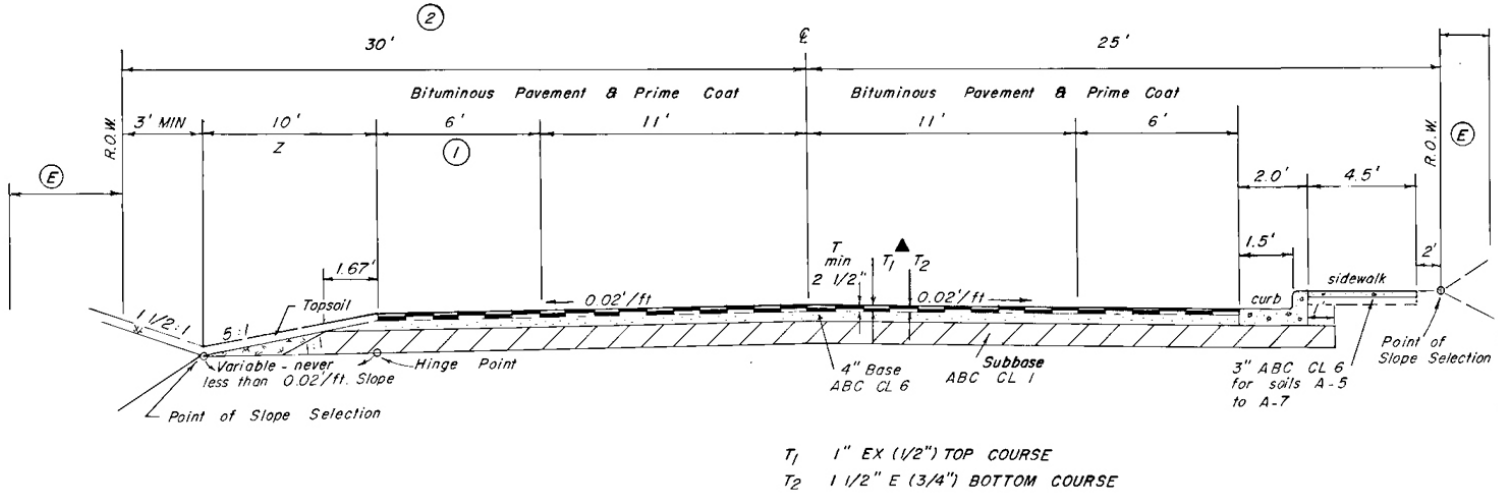
RURAL SECTION URBAN SECTION

(E) SLOPE EASEMENT AS REQUIRED

(I) NO PARKING

▲ HOT BITUMINOUS PAVING GRADING EX WILL BE REQUIRED WHEN T_1 = 1"

RESIDENTIAL COLLECTOR STANDARD DRAWING NO. 3



T_1 1" EX (1/2") TOP COURSE

T_2 1 1/2" E (3/4") BOTTOM COURSE

RURAL SECTION URBAN SECTION

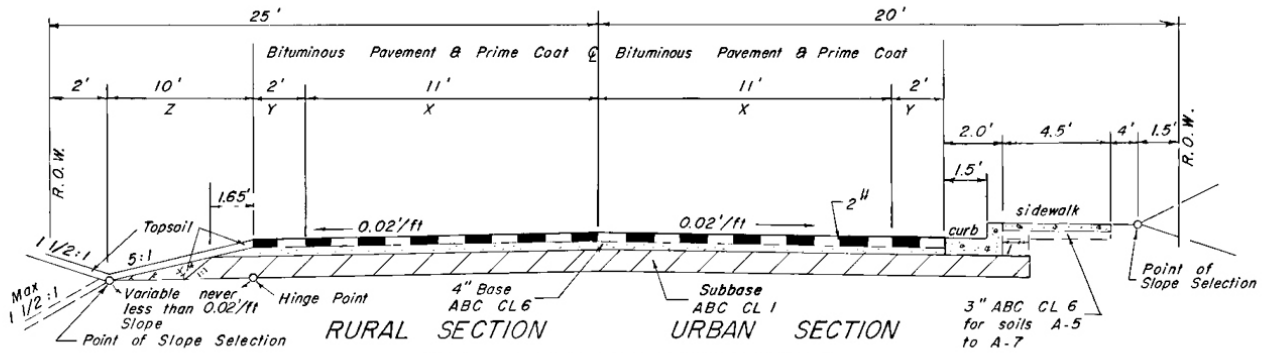
(E) SLOPE EASEMENT AS REQUIRED

(1) SHOULDER MAY BE REDUCED TO 2' IF OFF STREET PARKING IS PROVIDED

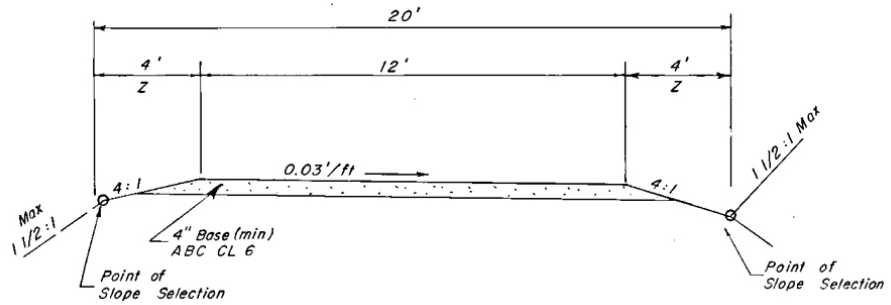
(2) RIGHT OF WAY MAY BE REDUCED TO 50' IF SHOULDER IS REDUCED TO 2'.

▲ HOT BITUMINOUS PAVING GRADING EX WILL BE REQUIRED WHEN T_1 = 1"

LOCAL ACCESS STANDARD DRAWING NO. 4

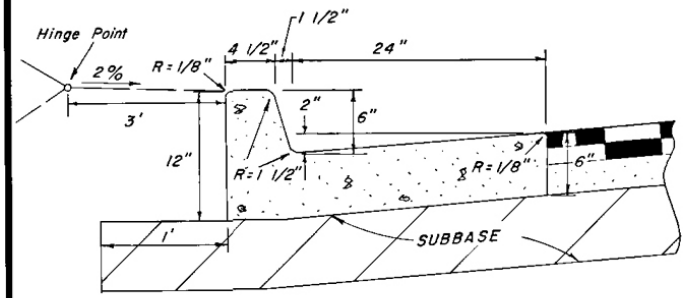


TWO LANE SECTION (PRIVATE)



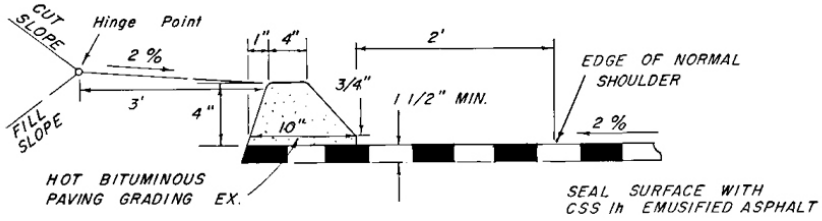
PRIVATE DRIVEWAY SECTION

PRIVATE ROADS
STANDARD DRAWING NO. 5

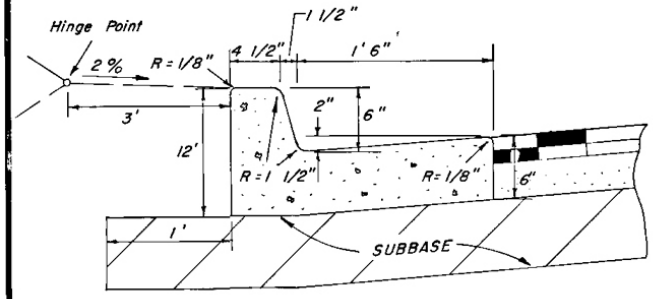


6" BARRIER 2' GUTTER

(PRINCIPAL ARTERIAL , MINOR ARTERIAL AND MAJOR COLLECTOR)



ASPHALT DIKE AND CURB

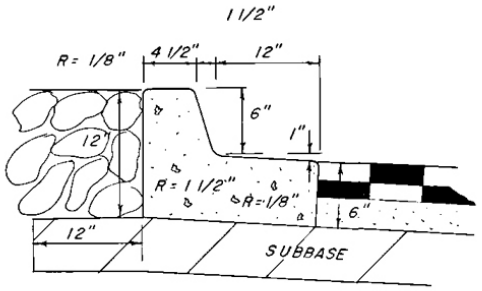


6" BARRIER 1'6" GUTTER

(RESIDENTIAL COLLECTOR AND LOCAL ACCESS)

ALL CONCRETE SHALL BE CLASS A.

FOR CONTRACTION AND EXPANSION JOINT DETAILS SEE DRAWING NO. 8.

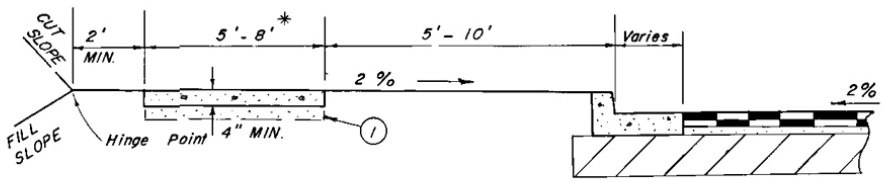


MEDIAN CURB

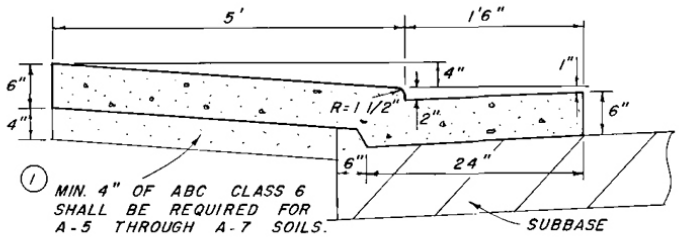
6" BARRIER 1'0" GUTTER

CURBS AND GUTTERS
STANDARD DRAWING NO. 6

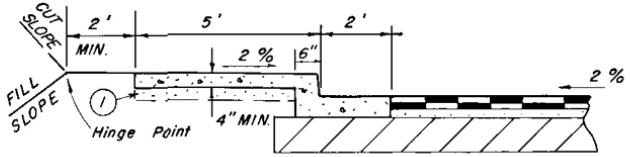
* BIKE AND PEDESTRIAN USE.



CURB AND WALK FOR COLLECTOR ROADS



MODIFIED CURBWALK



CURB AND WALK FOR LOCAL ACCESS ROADS

ALL CONCRETE SHALL BE CLASS A.

FOR CONTRACTION AND EXPANSION JOINT DETAILS SEE DRAWING NO. 8.

ALL CURBWALKS SHALL BE CONSTRUCTED AS A MONOLITHIC POUR.

SIDEWALKS AND CURBWALKS
STANDARD DRAWING NO. 7

NOTES :

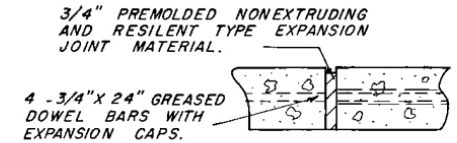
E = EXPANSION JOINT.

C = CONTRACTION JOINT.

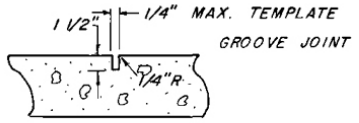
CONTRACTION JOINTS SPACED AT MAX. OF 10'.

EXPANSION JOINTS SPACED AT MAX. OF 500' OR AT THE END OF CURB RETURNS AND DROP INLETS.

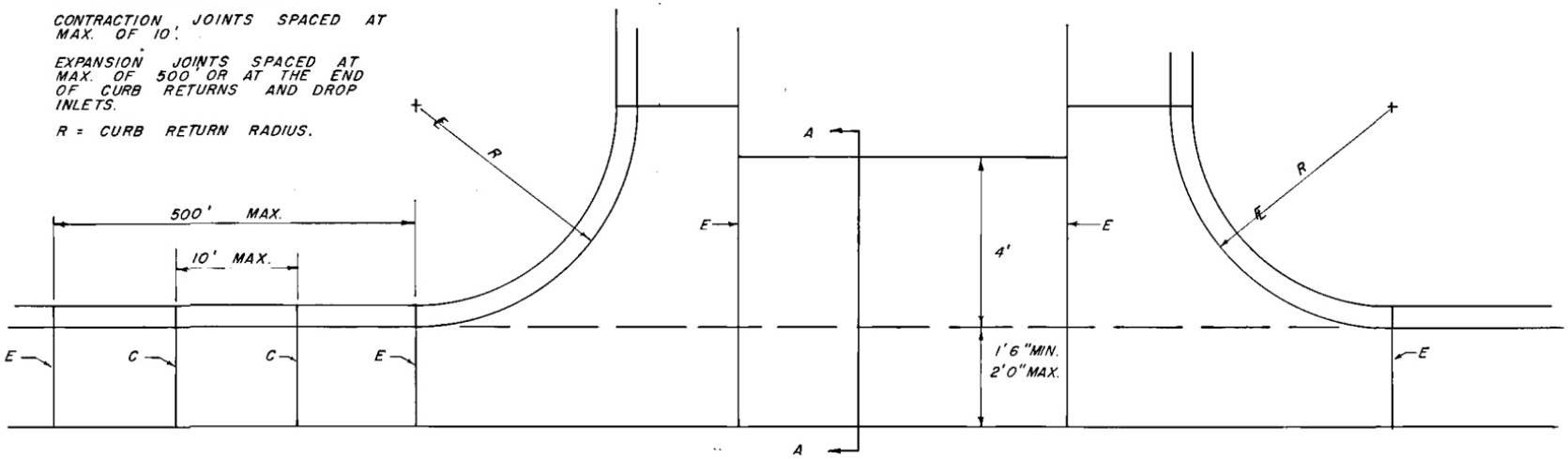
R = CURB RETURN RADIUS.



EXPANSION JOINT



CONTRACTION JOINT

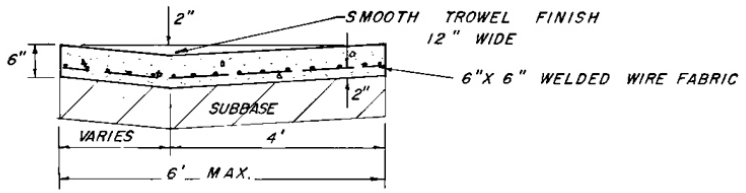


ALL CONCRETE SHALL BE C D H CLASS A.

EXPANSION JOINT MATERIALS SHALL MEET ASTM SPECIFICATIONS D 1751 OR D 1752.

ALL SURFACES SHALL HAVE A BROOM FINISH.

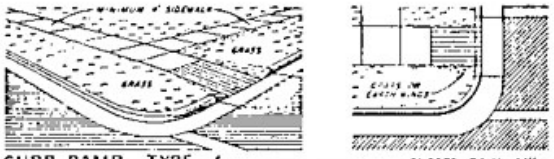
SEE STANDARD DRAWING NO. 6 FOR CURB AND GUTTER DETAILS.



SECTION A - A

TYPICAL CROSS PAN

CURB, GUTTER & SIDEWALK CONSTRUCTION DETAILS STANDARD DRAWING NO. 8

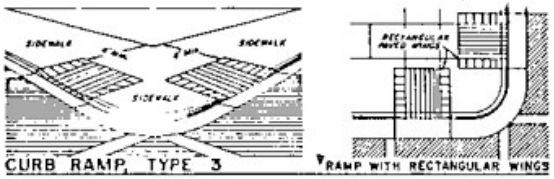


CURB RAMP, TYPE 1 — SLOPED RAMP ONLY

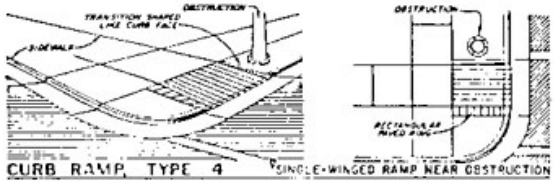
RESIDENTIAL STREET INTERSECTING THRU STREET

CURB RAMP, TYPE 2 — RAMP WITH TRIANGULAR WINGS

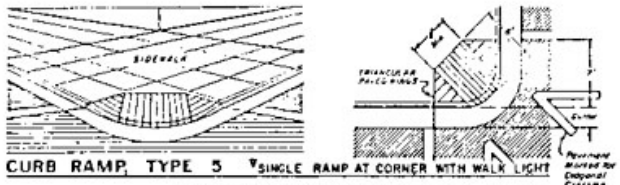
RESIDENTIAL STREET INTERSECTION NEAR BUSINESS AREA



CURB RAMP, TYPE 3 — ▼RAMP WITH RECTANGULAR WINGS



CURB RAMP, TYPE 4 — ▼SINGLE-WINGED RAMP NEAR OBSTRUCTION



CURB RAMP, TYPE 5 — ▼SINGLE RAMP AT CORNER WITH WALK LIGHT

▼ = IN BUSINESS AREA OR NEAR MEDICAL SERVICES

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications applicable to the project.

Minimum width of all Ramps and Sidewalks shall be 5 feet.

Ramp slopes shall not be steeper than 12:1.

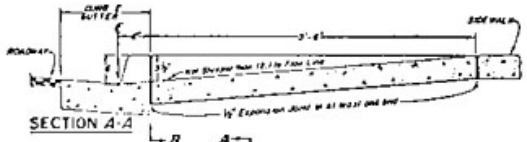
Surface of Ramp slope shall have a coarse broom finish with the striations across the slope.

Concrete for Sidewalk Ramps shall be Class "A"

Normal Gutter flow line and profile shall be maintained through the Ramp area.

A ½" Expansion Joint will be required where the concrete ramp joins any rigid pavement or structure.

NEW Ramp, Curb and Gutter construction may be poured monolithically.

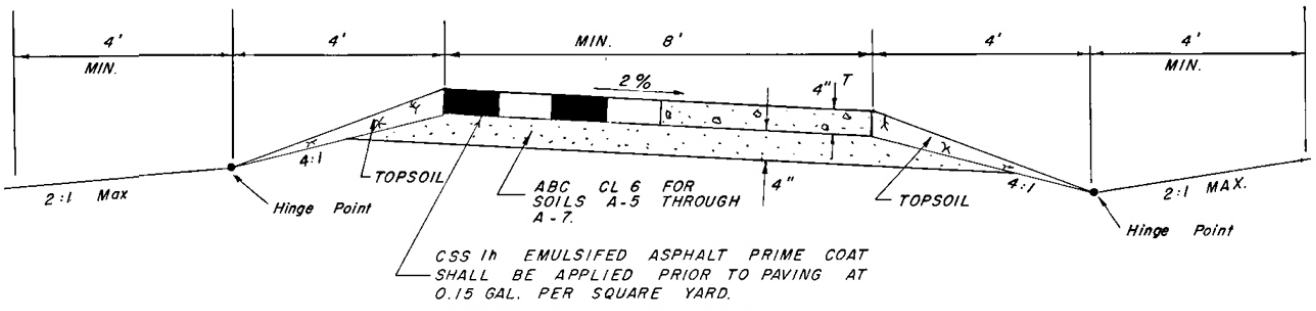


SECTION A-A

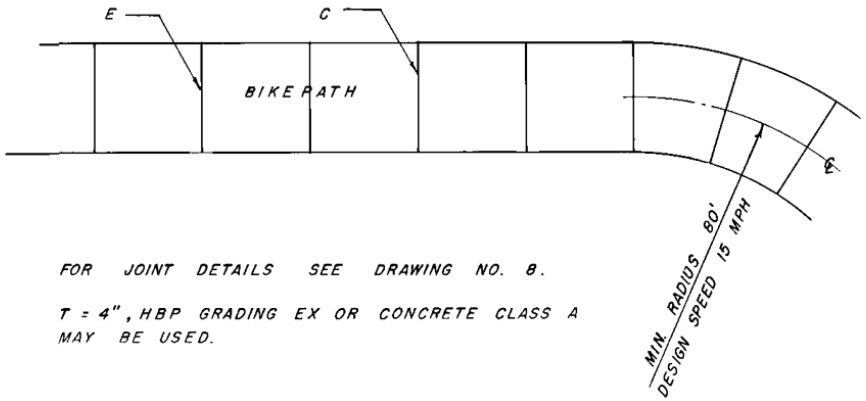
SECTION B-B

TYPICAL CURB RAMP CROSS SECTIONS

HANDICAPPED RAMPS
STANDARD DRAWING NO. 9



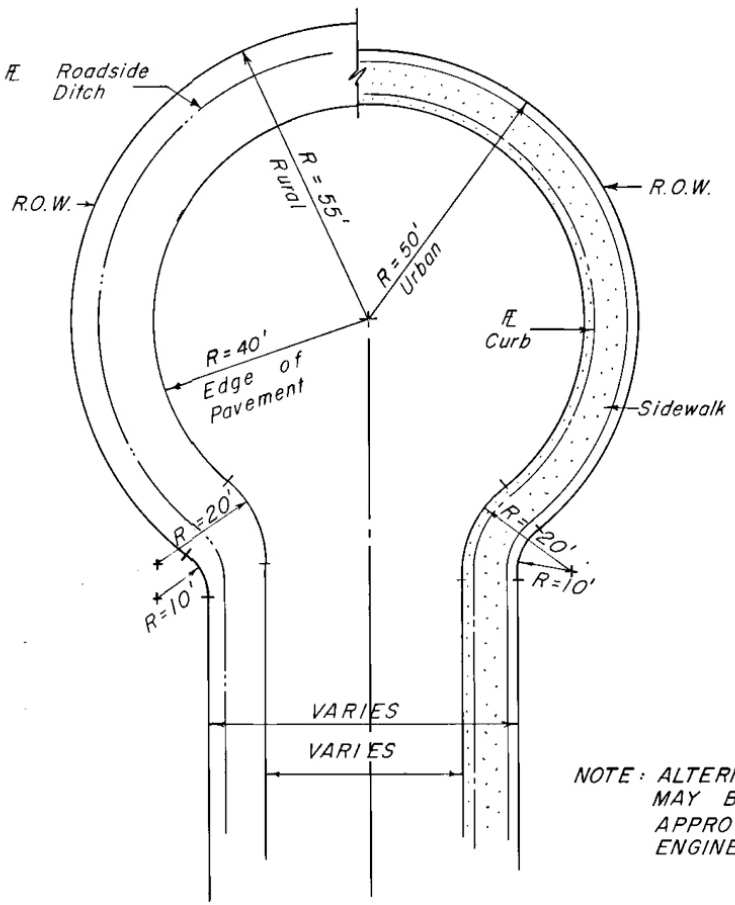
BIKEPATH SECTION

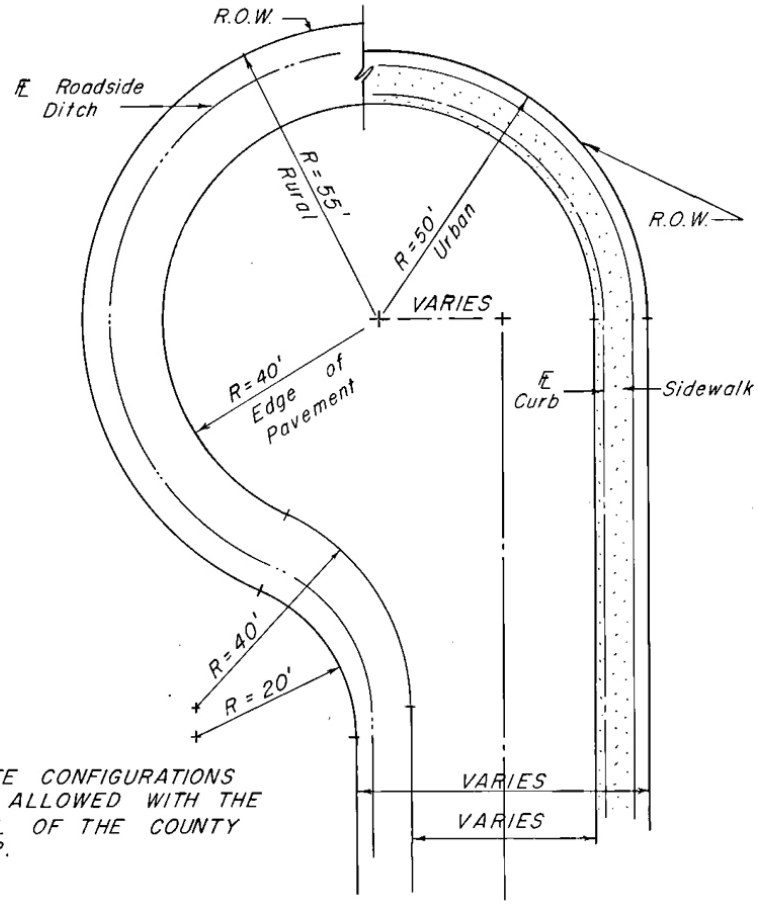


FOR JOINT DETAILS SEE DRAWING NO. 8.

T = 4", HBP GRADING EX OR CONCRETE CLASS A MAY BE USED.

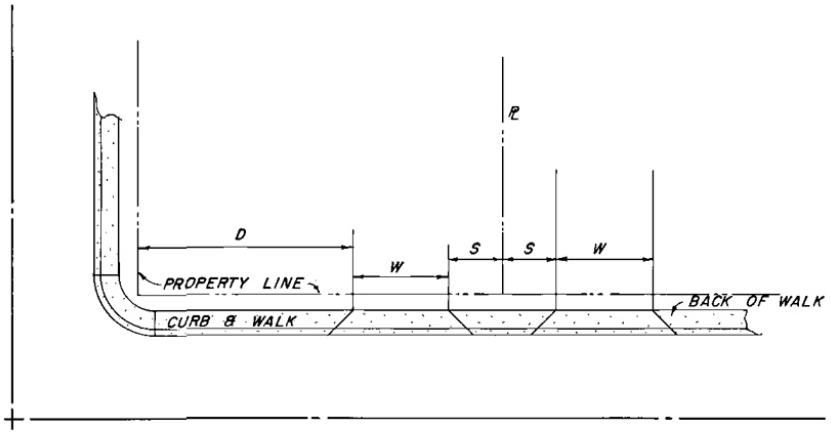
BIKEPATHS
STANDARD DRAWING NO. 10





NOTE: ALTERNATE CONFIGURATIONS MAY BE ALLOWED WITH THE APPROVAL OF THE COUNTY ENGINEER.

CUL DE SAC DETAILS
STANDARD DRAWING NO. 11

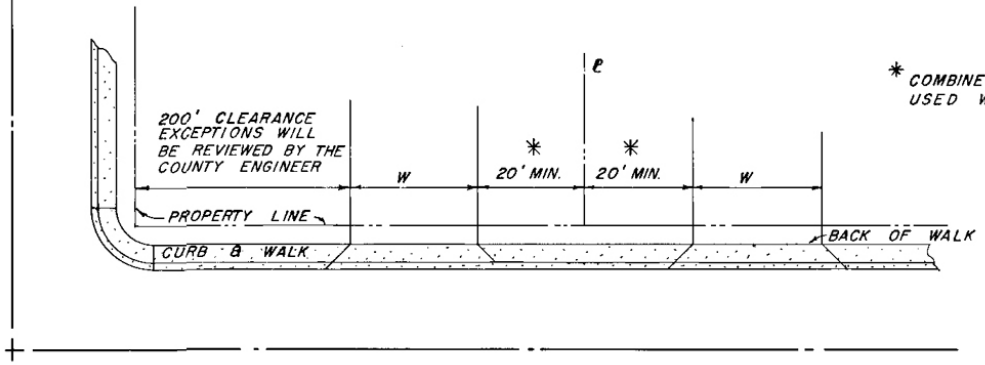


W - FOR MIN. AND MAX. WIDTHS SEE STANDARD DRAWING NO. 12 AND 13.

S - MIN. SIDE YARD AS PER ZONING CLASS

D DISTANCE TABLE	
LOCAL ACCESS	50'
COLLECTORS	100'

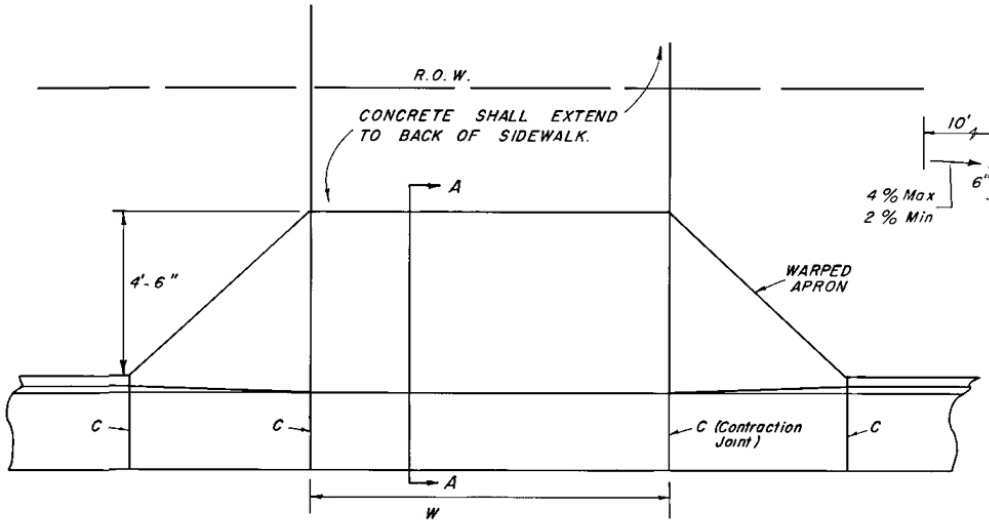
DRIVES ONTO LOCAL AND COLLECTOR STREETS



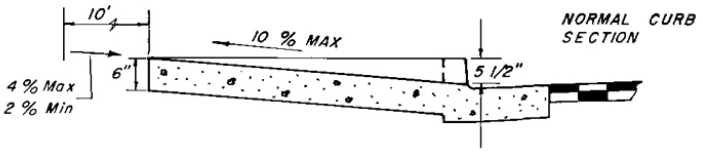
* COMBINED ACCESS SHALL BE USED WHEREVER POSSIBLE.

DRIVES ONTO ARTERIAL STREETS

DRIVEWAY LOCATION AND SPACING STANDARD DRAWING NO. 12



PLAN

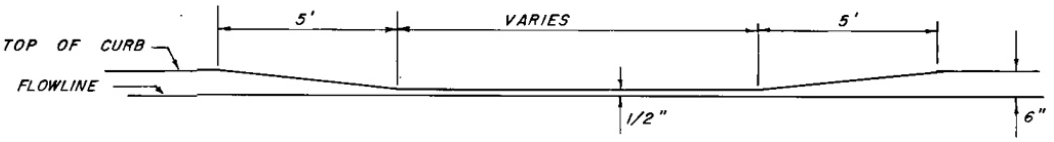


SECTION A - A

URBAN DRIVEWAY WIDTHS		
	MIN.	MAX.
RESIDENTIAL	10'	20'
COMMERCIAL	20'	30'*

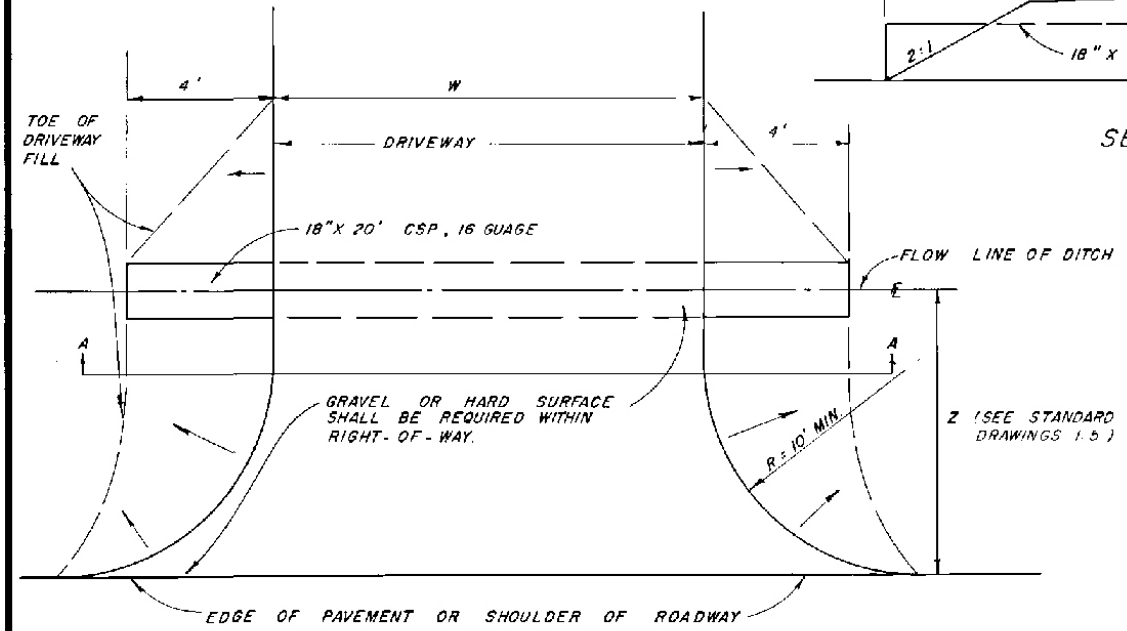
* DRIVES OVER 30' MAY REQUIRE CONSTRUCTION AS A ROAD APPROACH WITH CURB RETURNS AND CROSS PAN.

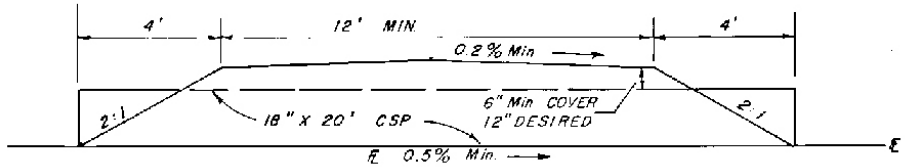
FOR DRIVEWAY SPACING SEE STANDARD DRAWING NO. 11.



TYPICAL CURB CUT SECTION

STANDARD URBAN DRIVEWAYS
STANDARD DRAWING NO. 13





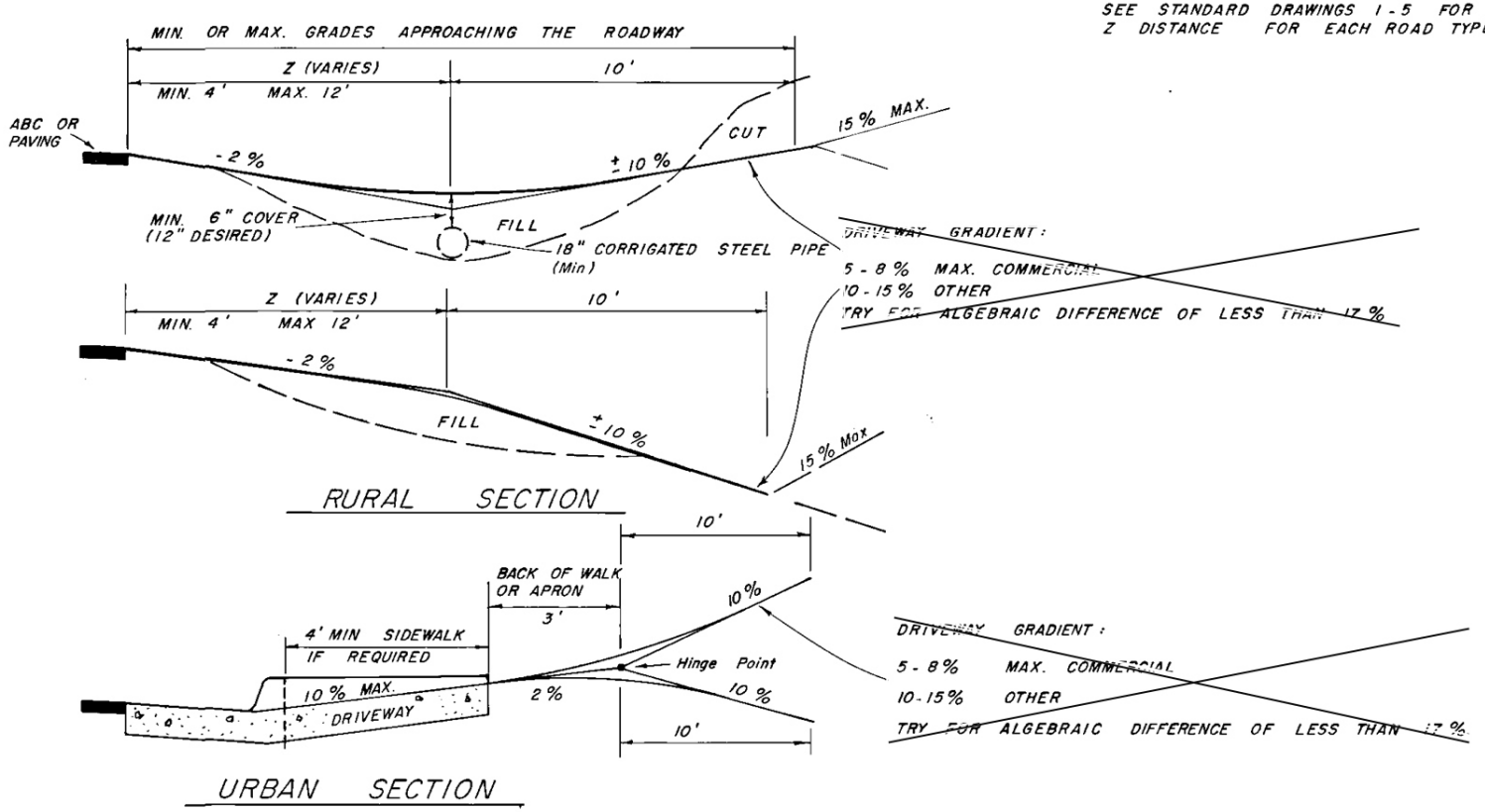
SECTION A - A

RURAL DRIVEWAY WIDTHS		
	MIN.	MAX.
RESIDENTAL	12'	16'
COMMERCIAL	16'	26'
PRIVATE ROAD	16'	26'

ALL CULVERTS SHALL BE CORRUGATED STEEL OR REINFORCED CONCRETE PIPE.

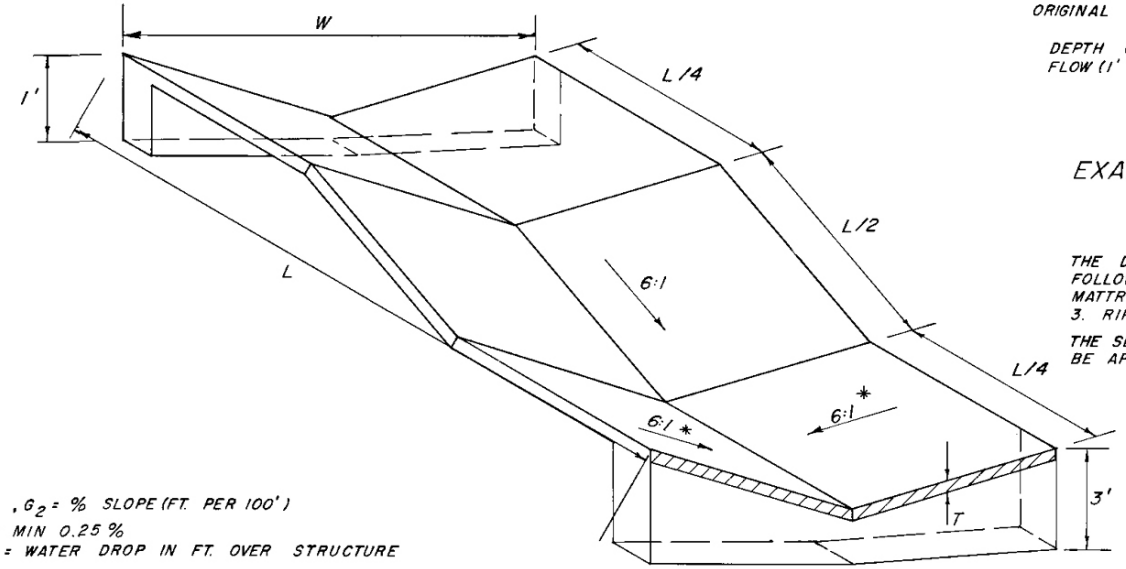
SEE DRIVEWAY PROFILES STANDARD DRAWING NO. 14.

STANDARD RURAL DRIVEWAYS
STANDARD DRAWING NO. 14



SEE STANDARD DRAWINGS 1-5 FOR Z DISTANCE FOR EACH ROAD TYPE.

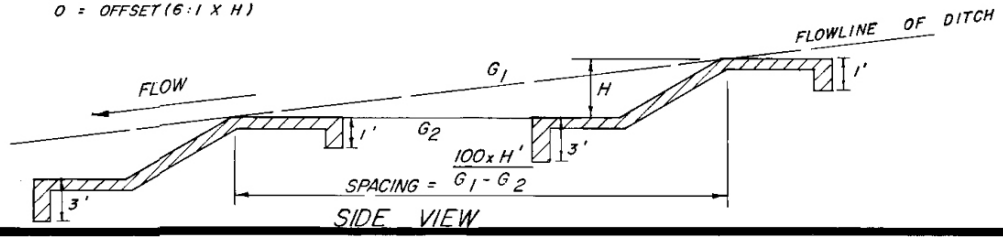
DRIVEWAY PROFILES
STANDARD DRAWING NO. 15



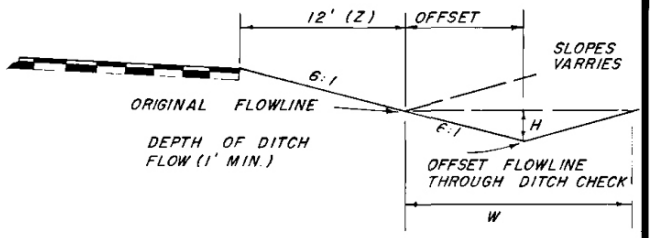
G_1 , G_2 = % SLOPE (FT. PER 100')
G_2 MIN 0.25 %
H = WATER DROP IN FT. OVER STRUCTURE

EROSION DITCH CHECK

T = THICKNESS
W = WIDTH
L = LENGTH
H = HEIGHT
O = OFFSET (6:1 X H)



SIDE VIEW



EXAMPLE SECTION

THE DITCH CHECK MAY BE CONSTRUCTED OF THE FOLLOWING MATERIALS : 1. GABION SLOPE MATTRESS. 2. GROUTED RIP - RAP (8" - 12"). 3. RIP - RAP (8" - 12") OVER FILTER CLOTH.

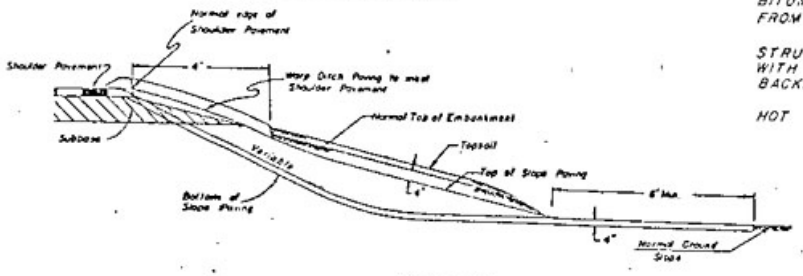
THE SELECTION OF THE ABOVE MATERIALS MUST BE APPROVED BY THE COUNTY ENGINEER.

* SLOPE MAY BE ADJUSTED TO MATCH EXISTING OR DESIGNED SIDESLOPE OR BACKSLOPE.

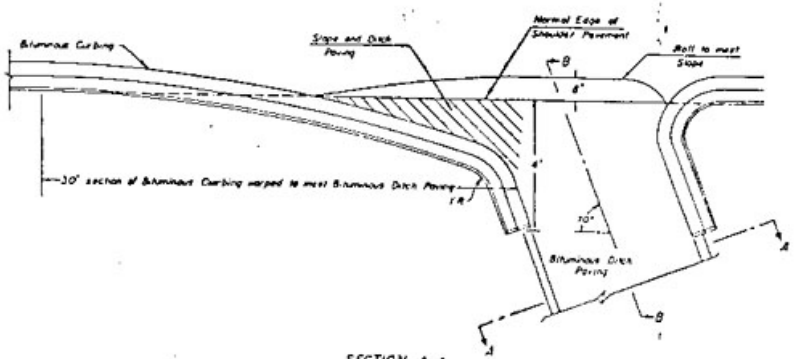
EROSION CONTROL DITCH CHECK STANDARD DRAWING NO. 16

DETAILS OF EMBANKMENT PROTECTOR

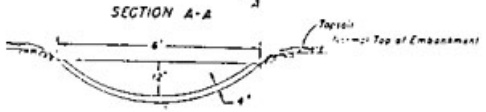
PLANT MIXED BITUMINOUS DITCH PAVING



SECTION B-B



SECTION A-A



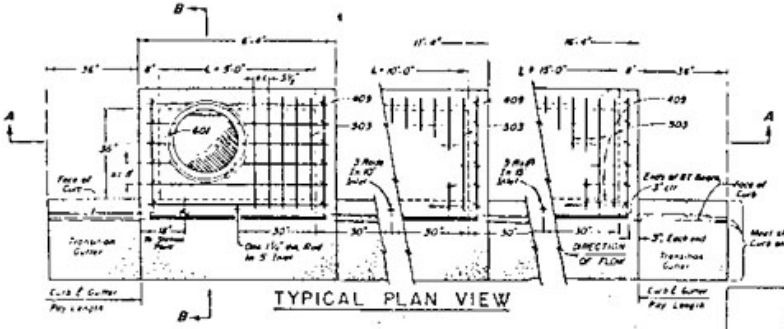
NOTE :

IF PROTECTOR IS LOCATED IN THE BOTTOM OF A VERTICAL CURVE, FLARE BITUMINOUS CURB ON EACH SIDE OF INLET TO ALLOW FOR FLOW FROM BOTH DIRECTIONS.

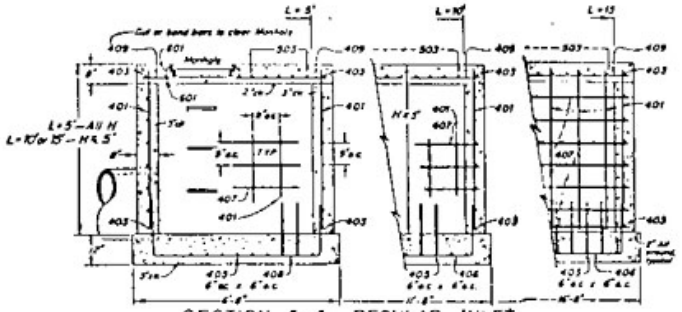
STRUCTURE BACKFILL MATERIAL IS NOT TO BE USED IN CONNECTION WITH THESE STRUCTURES. EMBANKMENT MATERIAL SHALL BE USED FOR BACKFILLING.

HOT BITUMINOUS PAVING GRADING EX SHALL BE REQUIRED.

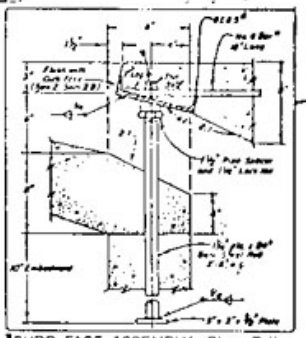
EMBANKMENT PROTECTOR
STANDARD DRAWING NO. 17



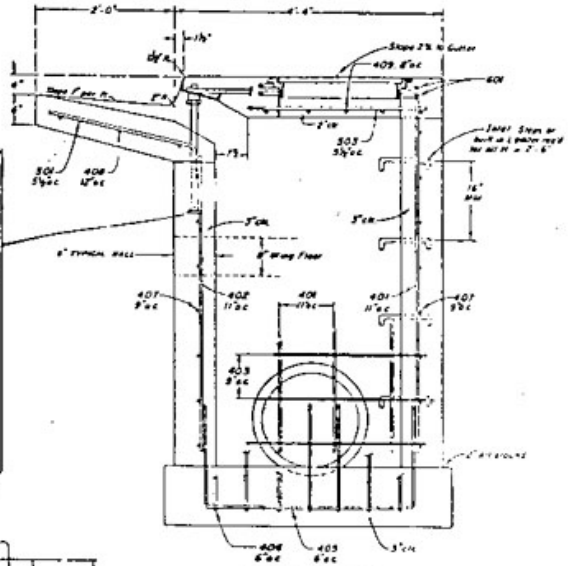
TYPICAL PLAN VIEW



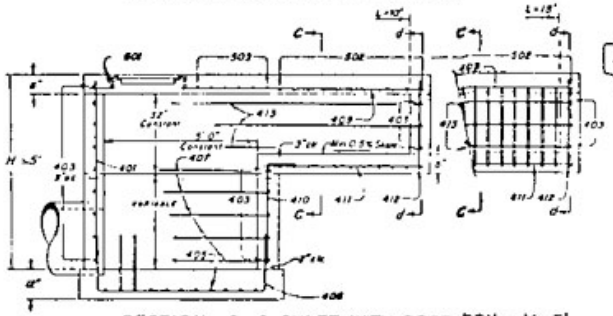
SECTION A-A REGULAR INLET



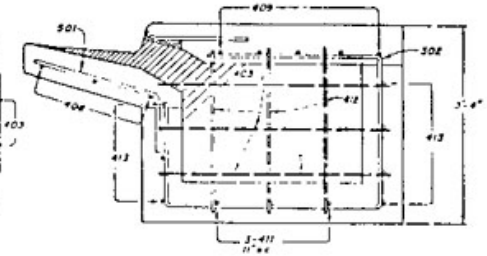
*CURB FACE ASSEMBLY. Place Entire Assembly Before Pouring Concrete.



SECTION B-B
TYPICAL END VIEW



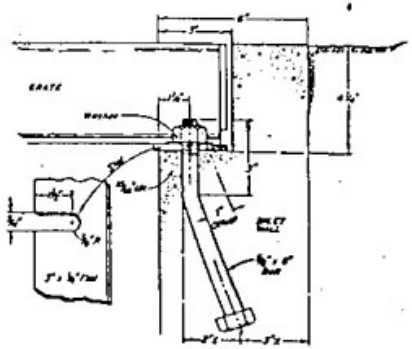
SECTION A-A INLET WITH DROP BOX — H>5'



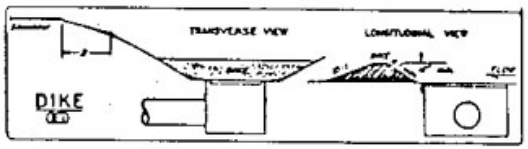
(Dotted Bars are in Section d-d)

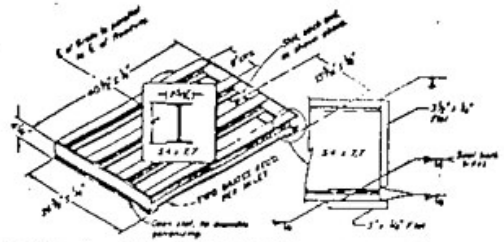
SECTIONS C-C & d-d

TYPICAL CURB INLET TYPE R STANDARD DRAWING NO. 18



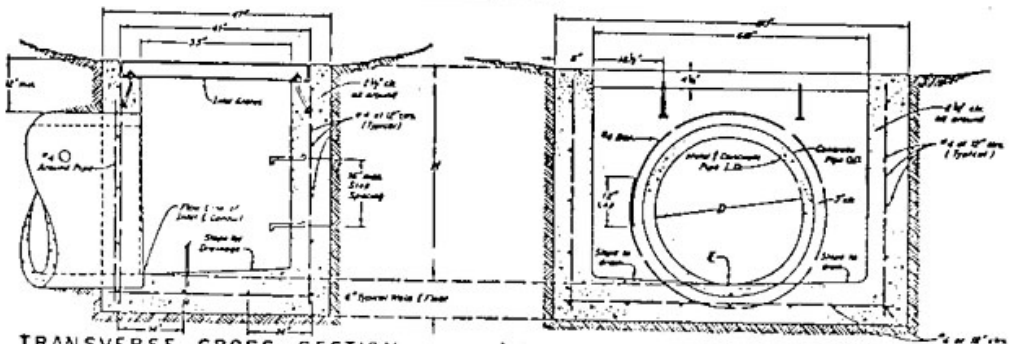
GRATE INSTALLATION DETAIL





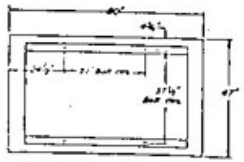
TYPE 'C' INLET GRATE

INLET, TYPE D



TRANSVERSE CROSS SECTION

LONGITUDINAL CROSS SECTION



PLAN VIEW

SHOWING ANCHOR BOLT LAYOUT

NOTES:

CONCRETE SHALL BE CLASS A.

INLET GRATING SHALL BE GALVANIZED

ALL EXPOSED CONCRETE SHALL RECIEVE CLASS 1 FINISH.

FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.

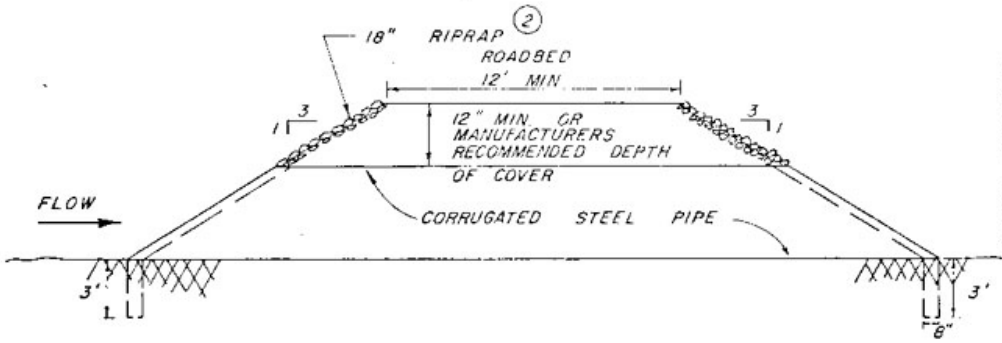
INLETS MAY BE CAST - IN - PLACE OR PRECAST.

STEPS WILL BE REQUIRED WHEN H EXCEEDS 3'6".

DROP INLET
TYPE D
STANDARD DRAWING NO. 19

STANDARD DRAWING NO. 20

LOW WATER CROSSING



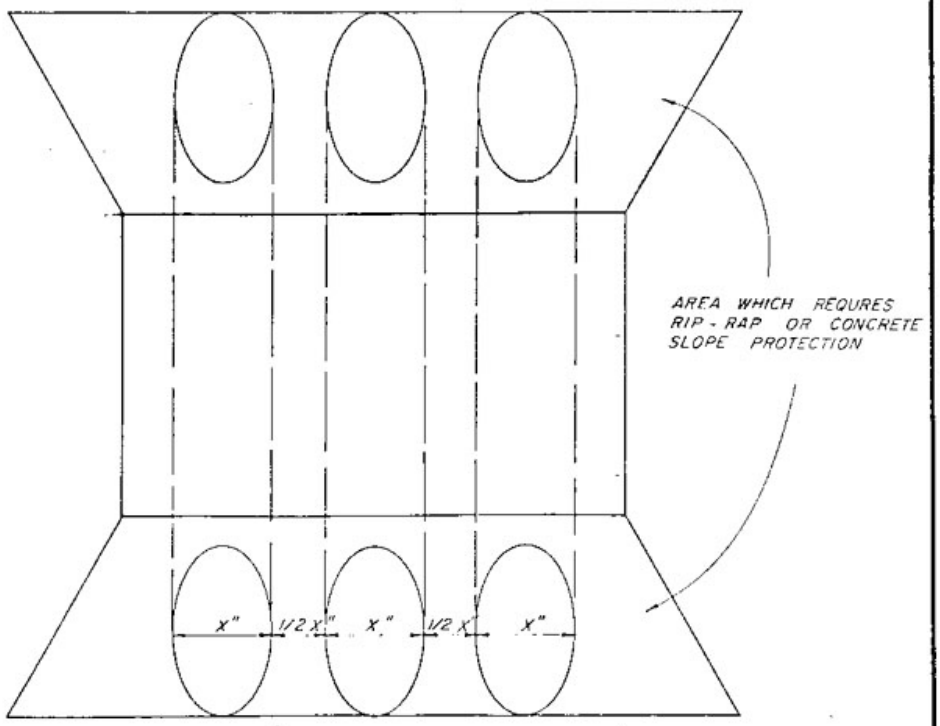
LOW WATER CROSSING TYPICAL SECTION

NO SCALE

(1) TOE WALL MIN. 8" IF CONC. IS USED, 18" IF RIP-RAP IS USED. TOE WALL SHALL BE MIN. 3' DEEP OR TO BEDROCK.

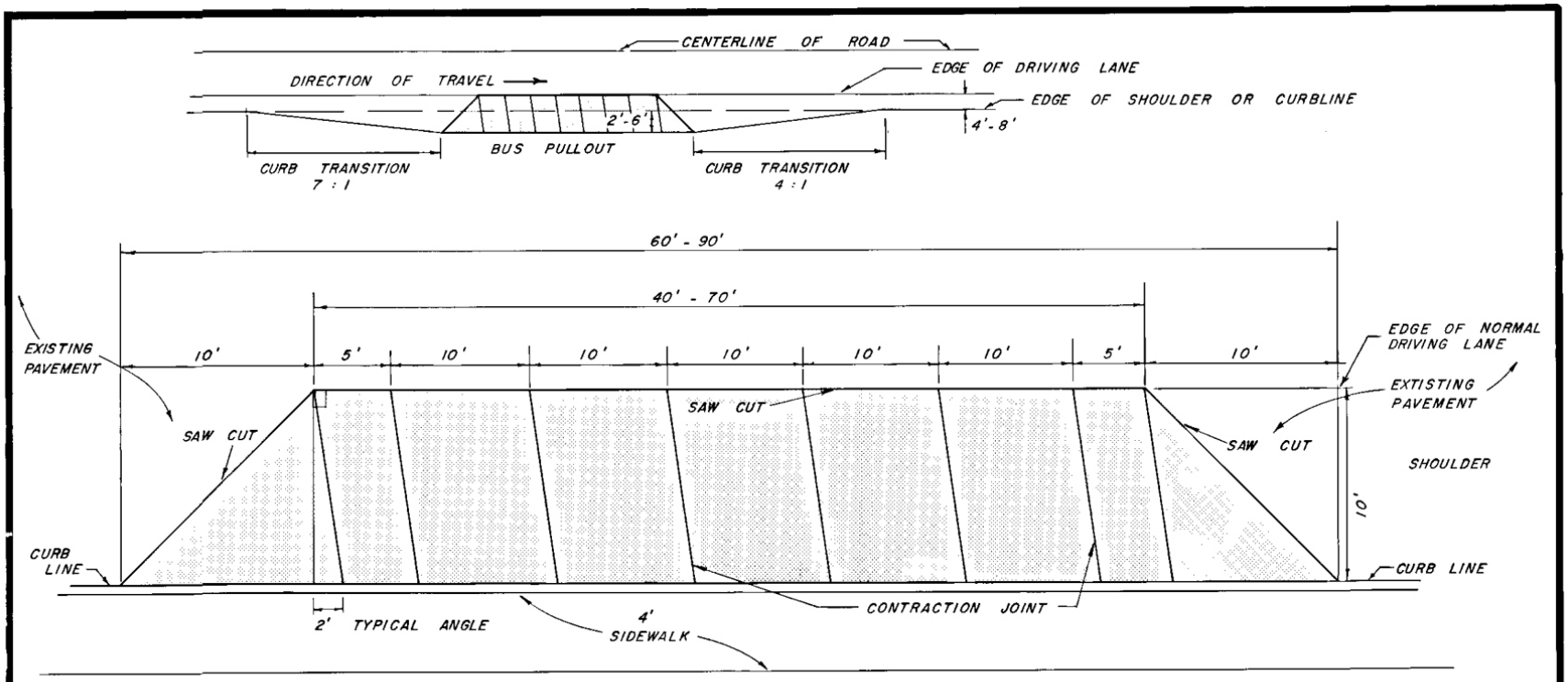
(1) SEE COLORADO DEPT. OF HIGHWAYS M-STANDARD 601-KA FOR DETAILS OF CONCRETE APRON.

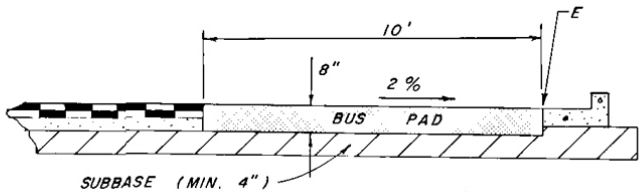
(2) SEE COLORADO DEPT. OF HIGHWAYS STANDARD SPECS., SECTION 506 FOR MATERIAL AND CONSTRUCTION REQUIREMENTS.



PLAN VIEW

NO SCALE





SECTION

SEE DRAWING NO. 8 FOR JOINT DETAILS IF CURB IS NOT MONOLITHIC WITH PAD.

NOTES:

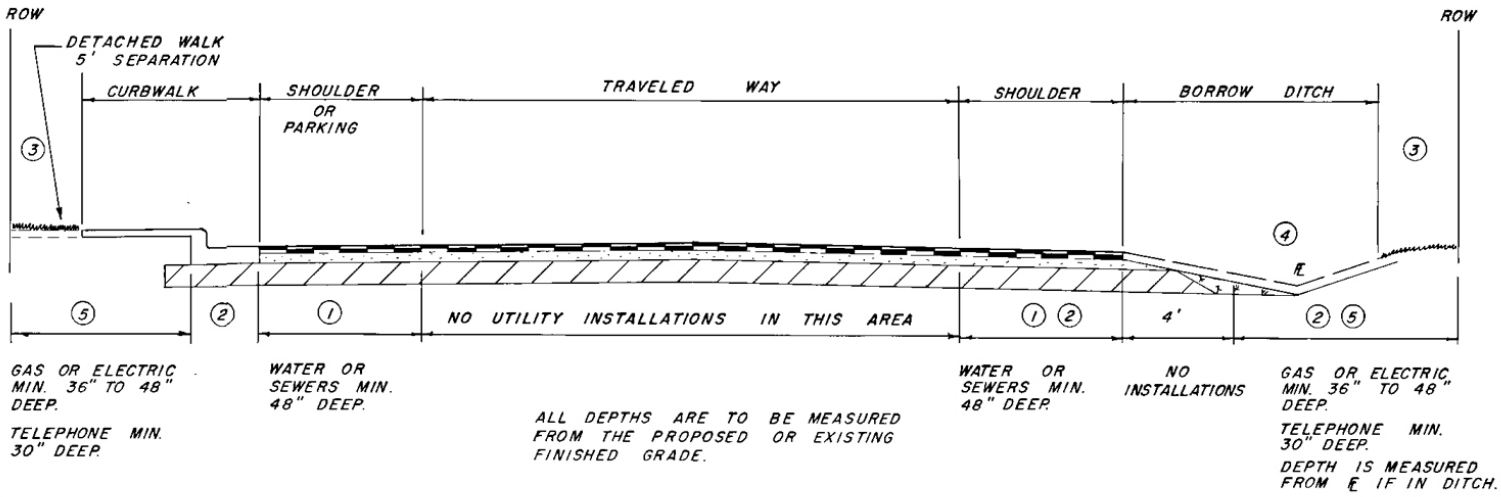
BUS PAD SURFACE SHALL MATCH THE GRADE OF THE ADJACENT PAVEMENT.

EXISTING PAVEMENT SHALL BE SAW CUT TO PROVIDE A UNIFORM VERTICAL FACE.

CONCRETE SHALL BE POURED AGAINST THE EXISTING PAVEMENT WHERE POSSIBLE.

CLASS A CONCRETE SHALL BE REQUIRED.

BUS PAD
STANDARD DRAWING NO. 21



(1) NO WATER VALVES OR SEWER MANHOLES WILL BE PERMITTED IN GRAVEL SHOULDERS.

(2) CORRIDORS MAY BE ADJUSTED BY THE COUNTY ENGINEER IF THERE IS A CONFLICT WITH AN EXISTING UTILITY.

(3) NO METER VAULTS ARE TO BE INSTALLED WITHIN THE ROW.

(4) NO VALVES OR MANHOLES WILL BE PERMITTED IN AREAS WHERE ROAD MAINTENANCE REQUIRES GRADING.

(5) IN SUBDIVISIONS WHERE 50' FEET OF ROW IS PROPOSED, UTILITY EASEMENTS OUTSIDE THE ROW MAY BE REQUIRED.

UTILITY LOCATION CORRIDORS
STANDARD DRAWING NO. 22

ARTICLE IX

REFERENCED REPORTS

ARTICLE IX - REFERENCED REPORTS

The following Regulation, Requirements, Standards and Specifications are hereby adopted as Supplemental Standards and Specifications differ, the Boulder County Road Standards and Specifications shall govern.

1. Manual on Uniform Traffic Control Devices, U.S. Department of Transportation, Federal Highway, Admin. 1988 Latest Rev.
2. Roadway Design Manual,State of Colorado, Department of Transportation
3. Trip Generation, Institute of Transportation Engineers, P.O. Box 9234, Arlington Virginia
4. Boulder County Storm Drainage Criteria Manual, WRC Eng. 1984
5. Concrete Pipe Design Manual, ACPA Vienna, Virginia. November 1992
6. Handbook of Steel Drainage and Highway Construction Products, A151, Washington D.C., 1983
7. Standard Specifications for Highway Bridges, AASHTO, 1973
8. Standard Specifications for Road and Bridge Construction, State of Department of Transportation, Division of Highways, State of Colorado, Latest Rev.
9. Colorado Department of Transportation M and S Standards, Latest Rev.
10. AASHTO Green Book, Latest Rev.
11. Americans with Disabilities Act Tech Sheet #55, June 1993

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