# ROAD DESIGN MANUAL

VIRGINIA DEPARTMENT OF TRANSPORTATION

# LOCATION AND DESIGN DIVISION

## VOLUME 1

# PREFACE

## PURPOSE

This manual has been prepared to promote uniformity in design procedures for all designers and technicians involved in the development of plans for Virginia's highways. It is intended to serve as an informational and procedural guide and to be used in conjunction with specifications, standards, policy directives (State and Federal) and design policy manuals published by the American Association of State Highway and Transportation Officials (AASHTO). It is neither a textbook nor a substitute for engineering knowledge, experience or judgment. Tables and figures are included as aids in the solution of office and field problems.

## MEANINGS OF "SHALL" OR "WILL", "SHOULD" AND "MAY".

To clarify the meanings intended in this manual by the use of these words, the following definitions apply:

- SHALL or WILL
  A mandatory condition. When certain design criteria is described in a procedure or design of a street or highway, it is mandatory that this condition be met.

- SHOULD
  An advisory condition. Where the word "should" is used, it is considered to be advisable usage, recommended but not mandatory.

- MAY
  A permissive condition. Design or application is optional.

# VIRGINIA DEPARTMENTATION OF TRANSPORTATION
# ROAD DESIGN MANUAL
# VOLUME I



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### ORGANIZATIONAL CHART

Organizational charts illustrating the Virginia Department of Transportation are available on the VirginiaDOT.org web site. The following link to the Department's organizational chart is provided for your information:
http://www.virginiadot.org/infoservice/resources/vdotchartwnames.pdf.

## SECTION 1A-2 – LOCATION AND DESIGN DIVISION

### DIRECTORY

A directory listing the Location and Design Division's personnel is available on the VirginiaDOT.org web site. The following link to the Location and Design Division's directory is provided for your information:
http://www.virginiadot.org/business/locdes/phonedirectory.asp.

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# CHAPTER 1B – NOMENCLATURE

## SECTION 1B – 1 - PRINCIPAL ABBREVIATIONS

### ABBREVIATIONS

The following abbreviations may be found in this manual as well as in other design reference materials:

| | |
|---|---|
| AASHTO | - American Association of State Highway and Transportation Officials. |
| ABC | - Alcohol Beverage Control |
| ACOE | - Army Corps of Engineers |
| ADT | - Annual Average Daily Traffic |
| AFS | - Automated Fuel System |
| AHS | - Automated Highway Systems |
| APS | - Automated Purchasing System |
| ARTS | - Advanced Rural Transportation System |
| ASAP | - Alcohol Safety Action Program |
| ASCE | - American Society of Civil Engineers |
| ASTM | - American Society for Testing and Materials |
| ATIS | - Advanced Traveler Information System |
| ATMS | - Advanced Traffic Management Systems |
| BAMS | - Bid Analysis Management System |
| BMS | - Bridge Management System |
| BPR | - Business Process Reengineering |
| BOCA | - Building Officials and Code Administration |
| CA | - Certification Acceptance |
| CADD | - Computer Aided Drafting and Design |
| CBLAD | - Chesapeake Bay Local Assistance Department |
| CBR | - California Bearing Ratio |
| CE | - Categorical Exclusion |
| CEQ | - Council on Environmental Quality |
| CERCLA | - Comprehensive Environmental Response Compensation and Liability Act |
| CFS | - Cubic feet per second |
| CMAQ | - Congestion Mitigation and Air Quality |
| CMS | - Congestion Management Study |
| COE | - Corps of Engineers |
| CSIP | - Corridor Safety Improvement Program |
| CRSI | - Concrete Reinforcing Steel Institute |
| CVO | - Commercial Vehicle Operations |
| CZM | - Coastal Zone Management |
| DCR | - Department of Conservation and Recreation |

| | |
|---|---|
| DDHV | - Directional Design Hourly Volume |
| DEIS | - Draft Environmental Impact Statement |
| DEQ | - Department of Environmental Quality |
| DHR | - Department of Historic Resources |
| DHV | - Design Hourly Volume |
| DMME | - Department of Mines, Minerals and Energy |
| DMV | - Department of Motor Vehicles |
| DNH | - Division of Natural Heritage |
| DOC | - Department of Commerce |
| DOE | - Department of Education |
| DOI | - Department of the Interior |
| DSP | - Department of State Police |
| DWM | - Department of Waste Management |
| EA | - Environmental Assessment |
| EAR | - Expected Accident Rate |
| ED | - Environmental Division |
| EIR | - Environmental Impact Report |
| EIS | - Environmental Impact Statement (DEIS-Draft, FEIS-Final) |
| EMS | - Emergency Medical Services |
| EPA | - Environmental Protection Agency |
| EPMS | - Equipment Preventive Maintenance System |
| E & S | - Erosion and Sediment |
| FA | - Federal-Aid |
| FAI | - Federal-Aid Interstate |
| FAP | - Federal-Aid Primary |
| FAPM | - Federal Aid Program Manual |
| FARS | - Fatal Accident Reporting System |
| FAS | - Federal-Aid Secondary |
| FAU | - Federal-Aid Urban |
| FEA | - Final Environmental Assessment |
| FEIS | - Final Environmental Impact Statement |
| FHWA | - Federal Highway Administration |
| FI | - Field Inspection |
| FIFRA | - Federal Insecticide Fungicide Rodenticide Act |
| FIS | - Flood Insurance Study |
| FMS | - Financial Management System II |
| FONSI | - Finding of No Significant Impact |
| FPS | - Feet Per Second |
| FTA | - Federal Transit Administration |
| FY | - Fiscal Year |
| GDHS | - "A Policy on the Geometric Design of Highways and Streets" |
| GIS | - Geographic Information System |
| GPS | - Global Positioning System |
| GSA | - General Services Administration |

| | |
|---|---|
| HPMS | - Highway Performance Monitoring System |
| HTRIS | - Highway and Traffic Records Information System |
| HOV | - High-Occupancy Vehicle |
| IACM | - Interagency Coordination Meeting |
| IDMS | - Integrated Document Management System |
| IECC | - Interagency Environmental Coordination Meeting |
| IIM | - Instructional and Informational Memoranda (L & D) |
| IGRDS | - Interactive Graphic Roadway Design System |
| IMMS | - Integrated Maintenance Management System |
| ITD | - Information Technology Division |
| ISO | - International Standardization Organization |
| ISTEA | - Intermodal Surface Transportation Efficiency Act of 1991 |
| ITE | - Institute of Traffic Engineers |
| IVHS | - Intelligent Vehicle Highway System |
| L & D | - Location and Design (Division) |
| LOP-1 | - Letter of Permission #1 |
| MATS | - Materials Test System |
| MHW | - Mean High Water |
| MIS | - Major Investment Study |
| MOA | - Memorandum of Agreement |
| MPO | - Metropolitan Planning Organization |
| MTRS | - Micro Traffic Records System |
| MUTCD | - Manual of Uniform Traffic Control Devices |
| NAAQS | - National Ambient Air Quality Standards |
| NCHRP | - International Cooperative Highway Research Program |
| NCTRP | - National Cooperative Transit Research and Development |
| NEPA | - National Environmental Policy Act |
| NGS | - National Geodetic Survey (Formerly USC & GS) |
| NHS | - National Highway System |
| NHTSA | - National Highway Traffic Safety Administration |
| NIST | - National Institute of Standards and Technology |
| NMFS | - National Marine Fisheries Service |
| NPDES | - National Pollution Discharge Elimination System |
| NPS | - National Park Service |
| NWR | - National Wildlife Refuge |
| OA | - Outdoor Advertising |
| OEMS | - Office of Emergency Medical Services |
| PCE | - Programmatic Categorical Exclusion |
| PDC | - Planning District Commission |
| PE | - Preliminary Engineering |
| PH | - Public Hearing |
| PMS | - Pavement Management System |
| PPMS | - Program Project Management System |
| PPMS/E | - Program Project Management System/Environmental Subsystem |

| | |
|---|---|
| PPMS/T | - Program Project Management System/Traffic Subsystem |
| PPR | - Preliminary Plan Review |
| PS & E | - Plans, Specifications and Estimates |
| PTMS | - Public Transportation Management System |
| PVC | - Polyvinylchloride |
| RCRA | - Resource Conservation and Recovery Act |
| RDM | - Road Design Manual (L & D) |
| ROD | - Record of Decision |
| RRR | - Resurfacing, Restoration, and Rehabilitation |
| R/W | - Right of Way |
| SAAP | - Special Advertisement and Award Process |
| SAE | - Society of Automotive Engineers |
| SARA | - Superfund Amendments and Reauthorization Act |
| SCS | - Soil Conservation Service |
| SDSD | - Special Design Section Drawing |
| SERP | - State Environmental Review Process |
| SI | - International System of Units |
| SIP | - State Implementation Program |
| SMS | - Safety Management System |
| SR | - State Route |
| SUE | - Subsurface Utility Engineering |
| SWM | - Storm Water Management |
| SYP | - Six Year Plan |
| TED | - Traffic Engineering Division |
| TIP | - Transportation Improvement Program |
| TMS | - Traffic Monitoring System |
| TPD | - Transportation Planning Division |
| TRB | - Transportation Research Board |
| TSCA | - Toxic Substances Control Act |
| TSTC | - Transportation Safety Training Center |
| TVA | - Tennessee Valley Authority |
| USCE | - United States Corps of Engineers |
| USCG | - United States Coast Guard |
| USFWS | - United States Fish and Wildlife Service |
| USGS | - United States Geological Survey |
| UVA | - University of Virginia |
| VASAP | - Virginia Alcohol Safety Action Program |
| VCU | - Virginia Commonwealth University |
| VDACS | - Virginia Department of Agriculture and Consumer Services |
| VDGIF | - Virginia Department of Game and Inland Fisheries |
| VDH | - Virginia Department of Health |
| VDOT | - Virginia Department of Transportation |
| VGP-1 | - Virginia General Permit #1 |
| VIMS | - Virginia Institute of Marine Science |

| | |
|---|---|
| VMRC | - Virginia Marine Resources Commission |
| VOF | - Virginia Outdoors Foundation |
| VPDES | - Virginia Pollution Discharge Elimination System |
| VSP | - Virginia State Police |
| VTRC | - Virginia Transportation Research Council |
| VTTTC | - Virginia Transportation Technology Transfer Center |
| VWPP | - Virginia Water Protection Permit |

## SECTION 1B – 2 - HIGHWAY TERMS

### DEFINITIONS

The definitions of highway terms that follow have been approved by the Department or adopted by AASHTO and are by no means a complete listing. However, it is felt that this list embraces the range of definitions applicable to design requirements.

### A

**ABANDONMENT** - The relinquishment of the public interest in right of way or activity thereon with no intention to reclaim or use again for highway purposes.

**ACCELERATION** - The rate of change of velocity with respect to time.

**ACCESS MANAGEMENT** - The process that provides (or manages) access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity and speed.

**ACQUISITION OR TAKING** - The process of obtaining right of way.

**ASPHALT COATING**

Prime coat - An application of a low viscosity liquid asphalt material to coat and bind mineral particles preparatory to placing a base or surface course.

Seal coat - A thin treatment consisting of asphalt material, usually with cover aggregate, applied to a surface course. The term includes but is not limited to sand-seal, chip seal, slurry seal, contrast seal, fog seal, and blot seal.

**AVERAGE RUNNING SPEED** - The summation of distance divided by the summation of running times.

**AXLE LOAD** - The total load transmitted by all wheels, the centers of which may be included between two parallel transverse vertical planes 1 meter (40 inches) apart, extending across the full width of the vehicle.

### B

**BACKFILL** - Material used to replace or the act of replacing material removed during construction.

**BASELINE** - Alignment on which the proposed right of way and construction is based.

**BINDER COURSE** - A plant mix of graded aggregate (generally open graded) and asphalt material which constitutes the lower layer of the surface course.

**BOARD** - Commonwealth Transportation Board of Virginia.

**BORROW** - Suitable material from sources outside the roadway prism used primarily for embankments.

**BRIDGE** - A structure, including supports, erected over a depression or an obstruction such as water, highway or railway and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 6 meters (twenty feet) between inner faces of abutments.

> **Bridge length** - The greater dimension of a structure measured along the baseline of the roadway between backs of abutment backwalls or between ends of bridge floor.
>
> **Bridge roadway width** - The clear width of structure measured at right angles to the center of the roadway between the bottom of curbs or, if curbs are not used, between the base of the inner faces of parapets or railings at the edge of shoulder.

## C

**CAPACITY** (Traffic) - The maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or a roadway in one direction or in both directions for a multi-lane highway, during a given time period under prevailing roadway and traffic conditions.

**CERTIFICATION ACCEPTANCE** - Form of documentation by VDOT for FHWA (on all Federal-Aid projects except Interstate) showing that all Federal requirements have been met.

**CHORD** - Segment whose endpoints (chord points) lie on a circle or curve.

**CLEAR ZONE** - The roadside border area, starting at the edge of the through traveled way (edge of pavement), available for safe use by errant vehicles.

**COMMISSIONER** - Commonwealth Transportation Commissioner of Virginia and Vice-Chairman of the Commonwealth Transportation Board.

**CONDEMNATION** - The process by which property is acquired for public purposes through legal proceedings under power of eminent domain.

**CORRIDOR** - A strip of land between two termini within which traffic, topography, environment and other characteristics are evaluated for transportation purposes.

**CULVERT** - A conduit which provides a passage for water, vehicles, animals, or people through highway or railroad embankment (For detailed definition refer to VDOT's Drainage Manual).

## D

**DESIGN SPEED** - A speed determined for design and correlation on the physical features of a highway that influence vehicle operation: the maximum safe speed maintainable over a specified section of highway when conditions permit design features to govern.

**DISPOSABLE MATERIAL** - Material that is not adequate for use on the project and must be disposed of off the project.

## E

**EASEMENT** - A grant of the right to use property for a specific use.

**EMBANKMENT** - A structure of soil, soil-aggregate or broken rock between the existing ground and the subgrade.

**EXPRESSWAY** - A divided arterial highway for through traffic with limited access and generally with grade separations at major intersections.

**EXTRA WORK** - An item of work not provided for in the contract as awarded but found by the engineer to be essential for the satisfactory fulfillment of the contract within its intended scope.

## F

**FEE SIMPLE** - Full ownership of property (Right of way).

**FLEXIBLE PAVEMENT** - A pavement structure comprised of aggregates, as opposed to rigid portland cement concrete pavement.

**FORCE ACCOUNT WORK** - Prescribed work paid for on the basis of actual costs and appropriate additions.

**FREEWAY** - An expressway with full control of access.

**G**

**GORE** - The area immediately beyond the divergence or before the convergence of two roadways bound by the edges of those roadways.

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

> **Overpass** - A grade separation where the subject highway passes over a highway or railroad.
>
> **Underpass** - A grade separation where the subject highway passes under a highway or railroad.

**GREENWAY** - Linear Corridor of private or public recreation lands and waters, providing access to open space and recreational activities and linking rural and urban spaces (e.g. bicycle facilities, utility corridors, scenic roads and highways, abandoned railroad rights-of-way, etc.)

**H**

**HARD CONVERSION** - Conversion from one measurement system to another using the numerical conversion factor to calculate quantities in a new system and then, rounding to a convenient dimension.

**HECTARE** - The derived unit of area equal to 10,000 $m^2$.

**HIGHWAY, STREET OR ROAD** - A general term denoting a public way for purposes of vehicular travel.

**HISTORIC SITE** - A building, monument, park, cemetery or other site having public interest and National, regional or State significance, which should be considered in the location and design of a highway.

**HYDROPLANING** - A condition where one or more tires of a moving vehicle are separated from the pavement by a film of water; usually due to a combination of depth of water, pavement surface texture, vehicle speed, tread pattern, tire condition and other factors.

**INTERCHANGE** - A system of interconnecting roadways usually in conjunction with one or more grade separations, providing for the movement of traffic between two or more roadways on different levels.

**INTERCHANGE ELEMENTS**

**Direct connection** - A one-way turning roadway which does not deviate greatly from the intended direction of travel.

**Ramp** - A turning roadway at an interchange for travel between intersection legs.

**Loop** - A one-way turning section of roadway that curves to the right to accommodate a left-turning movement.

**Outer connection** - A one-way turning roadway primarily for the right-turning movement, outside of a loop.

**Two-way ramp** - A ramp for traveling in two directions.

**INTERCHANGE TYPES**

**Cloverleaf** - A 4-leg interchange with loops for left turn movements and outer connections for right turns or two-way ramps for these turns.

**Diamond interchange** - A 4-leg interchange with a single one-way ramp in each quadrant. All left turns are made directly on the minor highway.

**Directional interchange** - An interchange, generally having more than one highway grade separation, with direct connections for the major left-turning movement(s).

**INTERSECTION** - The general area where two or more highways join or cross, within which are included the roadway and roadside facilities for traffic movements in that area.

**INVERT** - The lowest point in the internal cross section of a pipe or other drainage structure.

## L

**LAND DEVELOPMENT PROJECT** - A manmade change to the land surface that potentially changes its runoff characteristics as a permanent condition.

**LANE**

**Auxiliary lane** - The portion of the roadway adjoining the traveled way for parking, speed change, storage for turning, weaving, truck climbing or for other purposes supplementary to through traffic movement.

**Turn Lane** - An auxiliary lane to accommodate turning vehicles.

**Parking Lane** - An auxiliary lane primarily for the parking of vehicles.

**Speed-change lane** - An auxiliary lane, primarily for the acceleration or deceleration of vehicles entering or leaving the through traffic lanes.

**LEVEL OF SERVICE** - A qualitative rating of the effectiveness of a highway in serving traffic, measured in terms of operating conditions. Note: The Highway Capacity Manual identifies operating conditions ranging from "A" for best operation (low volume, high speed) to "F" for poor operation where volumes are below capacity.

General Operating Conditions for Level of Service:

A - Free flow, with low volumes and high speeds

B - Stable flow, but speeds beginning to be restricted by traffic conditions

C - In stable flow zone but most drivers restricted in freedom to select their own speeds

D - Approaches unstable flow; drivers have little freedom to maneuver

E - At or near capacity of highway, flow is unstable, may be short delays

F - Forced flow at low speeds, many delays, volumes are below capacity

(A Guide for Selection of Design Levels of Service may be found in AASHTO's A Policy on Geometric Design of Highways and Streets.)

**LIMITED ACCESS** - The regulated limitation of public access rights to and from properties abutting a highway facility. This limited access can be either "full", providing access to selected public roads and prohibiting crossings at grade and direct driveway connections, or "partial", providing access to selected public roads, crossings at grade, and some private driveway connections.

**LINEAGE (PPMS-ID)** – Any other applicable PPMS-ID numbers.

**LOGICAL TERMINI** - Overall limits of project (all connected "C" projects)

## M

**MEDIAN** - The portion of a divided highway separating the traveled ways for traffic.

**MINIMUM TURNING RADIUS** - The radius of the minimum turning path of the outside of the outer front tire. (Vehicle manufacturers' data books give minimum turning radius to the centerline of the outer front tire.)

## O

**OPERATING SPEED** - The highest overall speed at which a driver can travel on a given highway under favorable weather conditions and under prevailing traffic conditions without exceeding the safe speed as determined by the design speed on a section-by-section basis.

**OUTER SEPARATION** - The portion of a highway between the traveled ways of a roadway for through traffic and a frontage street or road.

## P

**PARKWAY** - An arterial highway for non-commercial traffic, with full or partial control of access and usually located within a park or a ribbon of park-like developments.

**PLANS** - The contract drawings which show a location, character and dimensions of the prescribed work, including layouts, profiles, cross sections and other details.

**PPMS-ID LINEAGE** – Any other applicable PPMS-ID numbers.

**PROFFER** - Land offered for dedication to the Department/Municipality/County by a property owner or developer for the purpose of making road improvements.

**PROPOSED** - The term "proposed" is to be used for roadways, lanes, interchanges and items that are not construction items in the contract (e.g. - Prop. ℄ Prop. W.B.L., Prop. R/W, etc.).

**R**

**RADIAN** - The supplementary unit of plane angles with its vertex at the center of a circle that is subtended by an arc equal in length to the radius.

**REQUIRED** - The term "required" is to be used to apply to items to be constructed by the contractor for which payment will be made (e.g. - St'd. CG-6 Req'd., St'd. DI-3B Req'd., St'd. GR-8 Req'd., etc.).

**RIGHT OF WAY** - A general term denoting land, property or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

**RIGID PAVEMENT** - A pavement structure having as one course a portland cement concrete slab.

**ROADBED** - The graded portion of a highway, within top and side slopes, prepared as a foundation for the pavement structure and shoulders.

**ROADWAY** - The portion of a highway, within the limits of construction, and all structures, ditches, channels, waterways, etc. necessary for the correct drainage thereof. A divided highway has two or more roadways.

**ROOTMAT** - Stumps, roots, and other perishable plant material located in the area to be graded or in areas of clearing and grubbing.

**S**

**SELECT MATERIAL** - Suitable native material obtained from roadway cuts or borrow areas or other similar material used for subbase roadbed material, shoulder surfacing, slope cover or other specific purposes.

**SHY LINE OFFSET** - A distance beyond which a roadside object will not be perceived as a threat by a driver.

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

**SLIP RAMP** - An angular connection between an expressway and a parallel road.

**SOFT CONVERSION** - Conversion from one measurement system to another using the numerical conversion factor to calculate quantities in a new system.

**SPECIAL PROVISIONS** - Additions and revisions to the standard and supplemental specifications applicable to an individual project.

**SPECIFICATIONS** - The compilation of provisions and requirements for the performance of prescribed work.

> **Standard specifications** - A book of specifications approved for general application and repetitive use.
>
> **Supplemental specifications** - Approved additions and revisions to the standard specifications for general use.

**SPEED** - The rate of vehicular movement, generally expressed in miles per hour.

> **Average highway speed** - The weighted average of the design speeds within a highway section.
>
> **Average running speed** - For all traffic, or component thereof, the summation of distances divided by the summation of running time.
>
> **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 specified section of highway when conditions are so favorable that the design features of the highway govern.
>
> **Running speed** - The speed over a specified section of highway, being the distance divided by running time.

**STORM SEWER SYSTEM** - Drainage system installed to carry storm water runoff, consisting of two or more pipes in a series connected by one or more drop inlets.

**SUBSTRUCTURE** - That part of a bridge structure below the bearings of simple and continuous spans, skewbacks of arches and top of footings of rigid frames; including backwalls, wingwalls and wing protection railings.

**SUPERSTRUCTURE** - That part of a bridge structure above the bearings of simple and continuous spans, skewbacks of arches and top of footings of rigid frames; excluding backwalls, wingwalls and wing protection railings.

## U

**UNSUITABLE MATERIAL** - Material that is not adequate for use in the normal roadway prism, but may be used in other areas on the project.

## V

**VEHICLE** -

**Bus** - A motor vehicle designed for the transportation of more than 10 persons.

**Design vehicle** - A selected motor vehicle, the weight, dimensions and operating characteristics of which are used in highway design.

**House trailer** - A trailer or semitrailer which is designed, constructed and equipped as a dwelling place, living abode or sleeping place either permanently or temporarily and is equipped for use as a conveyance on streets and highways.

**Light delivery truck** - A single unit truck, such as a panel or pick-up truck, with size and operating characteristics similar to those of a passenger car and commonly used for short-haul light delivery service. For capacity analysis purposes it is considered to be a passenger car.

**Parked vehicle** - A vehicle stopped for temporary storage.

**Passenger Car** - A motor vehicle, except motorcycles, designed for carrying 10 passengers or less and used for the transportation of persons.

**Semitrailer** - A vehicle designed for carrying persons or property and for being drawn by a motor vehicle and so constructed that some part of its weight and that of its load rests upon or is carried by another vehicle.

**Standing vehicle** - A vehicle stopped for a brief interval as when loading or unloading.

**Trailer** - A vehicle designed for carrying persons or property and drawn by a motor vehicle which carries no part of the weight of the vehicle and load of the trailer.

**Truck tractor** - A motor vehicle designed for drawing other vehicles but not for a load other than a part of the weight of the vehicle and load drawn.

**VOLUME** (Traffic) - The number of vehicles passing a given point during a specified period of time.

**Average daily traffic** - The average 24-hour volume, being the total volume during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year.

**Design volume** - A volume determined for use in design, representing traffic expected to use the highway. Unless otherwise stated, it is an hourly volume.

**Thirtieth highest hourly volume** - The hourly volume that is exceeded by 29 hourly volumes during a designated year.

# SECTION 1B – 3 - PLAN ABBREVIATIONS

## ABBREVIATIONS

Abbreviations should be avoided on plans where possible. Certain abbreviations are, of course, helpful and often necessary. The following is a list of abbreviations allowable for use on plans. Undoubtedly there are other acceptable abbreviations but this list should serve as a guide for standardization of our road plans.

| | |
|---|---|
| Ac. | - Acre |
| Aban. | - Abandon or Abandoned |
| Abut. | - Abutment |
| Accel. | - Acceleration |
| ADT | - Average Daily Traffic |
| Aggr. | - Aggregate |
| Ahd. | - Ahead |
| Approx. | - Approximate |
| Asph. | - Asphalt |
| Avg. | - Average |
| Base. | - Basement |
| Beg. | - Beginning or Begin |
| Bk. | - Back |
| BL | - Baseline |
| Bl. | - Block |
| Bldg. | - Building |
| Blvd. | - Boulevard |
| BM | - Bench Mark |
| Br. | - Brick |
| C | - Cut |
| CATV | - Cable Television |
| C.B. | - Cinder Block |
| CBR | - California Bearing Ratio |
| C-C | - Center to Center, Curb to Curb |
| Cem. | - Cement or Cemetery |
| CG | - Change of Grade |
| C&G | - Curb & Gutter |
| Ch. | - Chord |
| Chan. Ch. | - Channel Change |
| Cl. | - Class, Clearance |
| C.L., Corp. Lim. | - Corporate Limits |
| Cl. & Gr. | - Clearing & Grubbing |
| ℄ | - Centerline |

| | |
|---|---|
| CM | - Corrugated Metal |
| CS | - Circular Curve to Spiral |
| Co. | - County, Company |
| Conc. | - Concrete |
| Cond. | - Condition |
| Conn. | - Connection |
| Constr. | - Construction |
| Cont. | - Continuous, Continuously |
| Corp. | - Corporate or Corporation |
| Cu. Yds., CY | - Cubic Yards |
| Culv. | - Culvert |
| D= | - Degree of Curve (Curve Data) |
| DB | - Deed Book |
| Dbl. | - Double |
| DE= | - Spiral Angle |
| Decel. | - Deceleration |
| Dept. | - Department |
| Des. | - Design |
| DHV | - Design Hourly Volume |
| DI | - Drop Inlet |
| Dia. | - Diameter |
| Dispos. | - Disposable |
| Dist. | - Distance |
| Distr. | - District |
| Dr. | - Drive, Drainage |
| Dwl. | - Dwelling |
| D= | - "Delta" Deflection Angle Between Tangents (Central Angle) |
| Dc= | - Central Angle between S.C. & C.S. |
| DS= | - Spiral Angle |
| E | - Electric |
| E= | - Superelevation Rate |
| Ease. | - Easement |
| EBL | - East Bound Lane |
| Elev. | - Elevation |
| EW | - Endwall |
| ES | - End Section |
| ES= | - External Distance |
| Engr. | - Engineer, Engineering |
| Entr. | - Entrance |
| EP | - Edge of Pavement |
| Eq. | - Equality |
| Est. | - Estimate or Estate |
| Excav. | - Excavation |

| | |
|---|---|
| Exist. | - Existing |
| F | - Fill |
| Fr. | - Frame or From |
| G | - Gas |
| Gal., Gals. | - Gallon (s) |
| Galv. | - Galvanized |
| Gar. | - Garage |
| Gr. | - Gravel |
| GV | - Gas Valve |
| HEC | - Horizontal Elliptical Conc. |
| Hor. | - Horizontal |
| Hydr. | - Hydraulic |
| Hwy. | - Highway |
| Incl. | - Included, Including |
| Int. | - Intersection |
| In Pl. | - In Place |
| Inv. | - Invert |
| I.P. | - Iron Pin |
| Jct. | - Junction |
| k= | - Simple Curve Coordinate (Abscissa) |
| kg | - Kilogram |
| km/h | - Kilometers Per Hour |
| L= | - Length of Circular Curve (Curve Data) |
| Lb(s) | - Pound(s) |
| LC= | - Length of Circular Curve |
| LF | - Linear Feet |
| LH= | - Long Chord |
| Lim. Acc.,L/A | - Limited Access |
| Liq. | - Liquid |
| Ln. | - Lane |
| Loc. | - Location |
| LS | - Lump Sum |
| Ls= | - Length of Spiral |
| LT= | - Long Tangent |
| Lt. | - Left |
| m | - Meter |
| Maint. | - Maintenance |
| Matl. | - Material |
| Max. | - Maximum |
| Med. | - Median |
| MH | - Manhole (Storm Water) |
| Mi. | - Mile |
| Min. | - Minimum |
| mm | - Millimeter |

| | |
|---|---|
| Mod. | - Modified |
| Mon. | - Monument |
| N | - North |
| NBL | - North Bound Lane |
| N&C | - Nail & Cap |
| NGS | - National Geodetic Survey |
| No. | - Number |
| Off. | - Office |
| Ohd., O.H., Ovhd. | - Overhead |
| Orig. | - Original |
| p= | - Simple Curve Coordinate (Ordinate) |
| Pave. | - Pavement |
| PB | - Plat book |
| PC | - Point of Curvature |
| PCC | - Point of Compound Curvature |
| Perm. | - Permanent |
| Pg. | - Page |
| Pkwy. | - Parkway |
| Pl. | - Place |
| PI | - Point of Intersection |
| ⅊ | - Property Line |
| POC | - Point on Curve |
| POST | - Point on Sub Tangent |
| POT | - Point on Tangent |
| PRC | - Point of Reverse Curvature |
| Prel. | - Preliminary |
| Proj. | - Project |
| Prop. | - Proposed |
| PSY | - Per Square Yard |
| PT | - Point of Tangency |
| PTP | - Permanent Turning Point |
| PVC | - Polyvinyl Chloride |
| Pvt. | - Private |
| Quan. | - Quantity |
| R= | - Radius of Circular Curve (Curve Data) |
| RC= | - Radius of Circular Curve |
| Rd. | - Road |
| Ref. | - Reference |
| Reinf. | - Reinforced |
| Reloc. | - Relocated |
| Req’d. | - Required |
| Ret. | - Retaining |
| Rev. | - Revision - Revised |
| Rt. | - Right |

| | |
|---|---|
| Rte. | - Route |
| R/W | - Right of way |
| RR | - Railroad |
| Rwy. | - Railway |
| SBL | - South Bound Lane |
| SC= | - Spiral to Circular Curve |
| S.D.S.D. | - Special Design Standard Drawing |
| SFM | - Sanitary Force Main |
| SSMH | - Sanitary Sewer Manhole |
| Sect. | - Section |
| Spec. Des. | - Special Design |
| Sq. Yd., SY | - Square Yard |
| Sty. | - Story |
| St. | - Street |
| Sta. | - Station |
| ST | - Short Tangent |
| S.T.= | - Spiral to Tangent |
| Stab. | - Stabilized |
| St'd. | - Standard |
| SS | - Storm Sewer |
| Str. | - Stream |
| Struct. | - Structure |
| SU | - Single Unit (Trucks) |
| Subgr. | - Subgrade |
| Super. | - Superelevation |
| Sur. | - Survey |
| Surf. | - Surface |
| Surf. Tr. | - Surface Treated |
| SW | - Sidewalk |
| T= | - Tangent Distance (Curve Data) |
| TC= | - Tangent of Circular Curve |
| Tel. Ped. | - Telephone Pedestal |
| Temp. | - Temporary |
| fc= | - Deflection Angle of Spiral Curve |
| Topo. | - Topography, Topographic |
| TP | - Turning Point |
| Trans. | - Transition |
| Trav. | - Traverse |
| TS= | - Tangent to Spiral Distance |
| Typ. | - Typical |
| U= | - Long Tangent |
| Ult. | - Ultimate |
| Unsuit. | - Unsuitable |
| USC & GS | - United States Coast & Geodetic |

| | |
|---|---|
| | Survey (Now National Geodetic Survey) |
| USGS | - United States Geological Survey |
| V= | - Velocity |
| v= | - Short Tangent |
| Var. | - Variable |
| VC | - Vertical Curve |
| Vert. | - Vertical |
| VDOT | - Virginia Department of Transportation |
| Vol. | - Volume |
| VPD | - Vehicles Per Day |
| VSD | - Vertical Sight Distance |
| Va. | - Virginia |
| W | - Water |
| W/ | - With |
| W/O | - Without |
| WB | - Will Book |
| WBL | - West Bound Lane |
| WV | - Water Valve |
| WM | - Water Meter |
| X= | - Tangent Distance for SC |
| XS= | - Tangent Distance for S.C. |
| X-Sect. | - Cross Section |
| X-over | - Crossover |
| Y= | - Tangent Offset for SC |
| YS= | - Tangent offset of the S.C. |

# RAILROADS IN VIRGINIA

| FORMER NAMES | FORMER NAMES | FORMER NAMES | CURRENT NAMES |
|---|---|---|---|
| B & O - BALTIMORE & OHIO<br>C & O - CHESAPEAKE & OHIO<br>W & P - WINCHESTER & POTOMAC<br>W & S - WINCHESTER & STRASBURG | *CHESSIE SYSTEM | CSX TRANSPORTATION | CSX TRANSPORTATION |
| CC & O - CAROLINA, CLINCHFIELD & OHIO<br>CLINCHFIELD<br>HAYSI<br>L & N - LOUISVILLE & NASHVILLE<br>SCL - SEABOARD COASTLINE | SBD - SEABOARD SYSTEM | | |
| | | RF & P - RICHMOND, FREDERICKSBURG,<br>& POTOMAC RAILWAY COMPANY | |
| | | [ *NS CORPORATION - NORFOLK SOUTHERN ] | NORFOLK SOUTHERN<br>RAILWAY |
| | NF & D -NORFOLK, FRANKLIN<br>& DANVILLE | N & W - NORFOLK & WESTERN | |
| | NS - NORFOLK SOUTHERN | CNW - CAROLINA NORTHWESTERN | |
| | SOU - SOUTHERN | NS - NORFOLK SOUTHERN RAILWAY COMPANY | |
| | | D & W - DANVILLE & WESTERN<br>INTER - INTERSTATE RAILROAD COMPANY<br>V & S - VIRGINIA & SOUTHWESTERN | |
| | | CW - CHESAPEAKE WESTERN | CW - CHESAPEAKE WESTERN |
| | | [ *CSXT & *NS COMBINED ]<br>N & PBL - NORFOLK & PORTSMOUTH<br>BELT LINE RAILROAD | N & PBL - NORFOLK & PORTSMOUTH<br>BELT LINE RAILROAD |
| | | | [ INDEPENDENT RAILROADS ]<br><br>AMTRAK - NATIONAL RAILROAD<br>PASSENGER CORPORATION<br>W & W- WINCHESTER & WESTERN<br>RAILROAD<br>ESHR - EASTERN SHORE RAILROAD |
| | | | [ OTHER RAILROADS ]<br><br>COMMONWEALTH RAILWAY COMPANY<br>SALTVILLE RAILROAD - MUNICIPAL<br>OWNED<br>NORTH CAROLINA & VIRGINIA R.R. CO.<br>METRO - WASHINGTON METROPOLITAN<br>AUTHORITY<br>CHESAPEAKE AND ALBEMARLE RAILROAD<br>CO.<br>BUCKINGHAM BRANCH RAILROAD CO.<br>VIRGINIA SOUTHERN RAILROAD<br>SHENANDOAH VALLEY RAILROAD |

*HOLDING COMPANIES - NOT RAILROADS

# SECTION 1B - 4 SHALL AND WILL LANGUAGE

## SHALL AND WILL LANGUAGE

The following policy applies to all information included in plan assemblies:

All actions referring to the Contractor will be referenced using the word “shall” and all actions referring to the Department will be referenced using the word “will”. “Shall” indicates the Contractor is contractually bound to performing that task or function and “will” indicates the Department is bound to performing its task or function.

Such terms as “to be”, “is to be”, or “must” will be avoided when referring to actions by the Contractor or the Department.

# CHAPTER 1C - GEOGRAPHIC LOCATIONS

## SECTION 1C-1 - CONSTRUCTION AREAS

**Page**



## LIST OF FIGURES

**Page**

# CHAPTER 1C - GEOGRAPHIC LOCATIONS

## SECTION 1C-1 - CONSTRUCTION AREAS

### DISTRICTS AND RESIDENCIES

There are four or more residency offices in eight of the nine construction districts in Virginia. The Northern Virginia District, which administers activities of the counties of Arlington, Fairfax, Loudoun and Prince William and the municipalities within their outer boundaries, has three residency offices and receives technical assistance in certain areas from the Culpeper District. District Administrators and Resident Engineers are charged with the administration and supervision of all highway activities within their designated geographical area. Figure 1C-1 shows the statewide construction district locations and their respective district numbers.

### COUNTIES AND MUNICIPALITIES

County numbers are listed in Figure 1C-3 along with corresponding residency and district codes for quick location. A tabulation for municipalities (Figures 1C-4 and 1C-5) identifies the county, residency and district for each and separates (for Urban Project Funding) the cities and towns into three population breakdowns - over 5000, 3500-5000, and less than 3500. By matching corresponding numbers to the "District and Residency" tabulation, (Figure 1C-6), all construction areas in Virginia can be easily identified.

# COMMONWEALTH OF VIRGINIA

## DEPARTMENT OF TRANSPORTATION

### OFFICE OF PUBLIC AFFAIRS DIVISION

### CONSTRUCTION DISTRICTS

| DISTRICT | NUMBERS |
|---|---|
| BRISTOL | 1 |
| SALEM | 2 |
| LYNCHBURG | 3 |
| RICHMOND | 4 |
| HAMPTON ROADS | 5 |
| FREDERICKSBURG | 6 |
| CULPEPER | 7 |
| STAUNTON | 8 |
| NORTHERN VIRGINIA | 9 |

O LEGEND

DISTRICT ADMINISTRATOR'S OFFICE

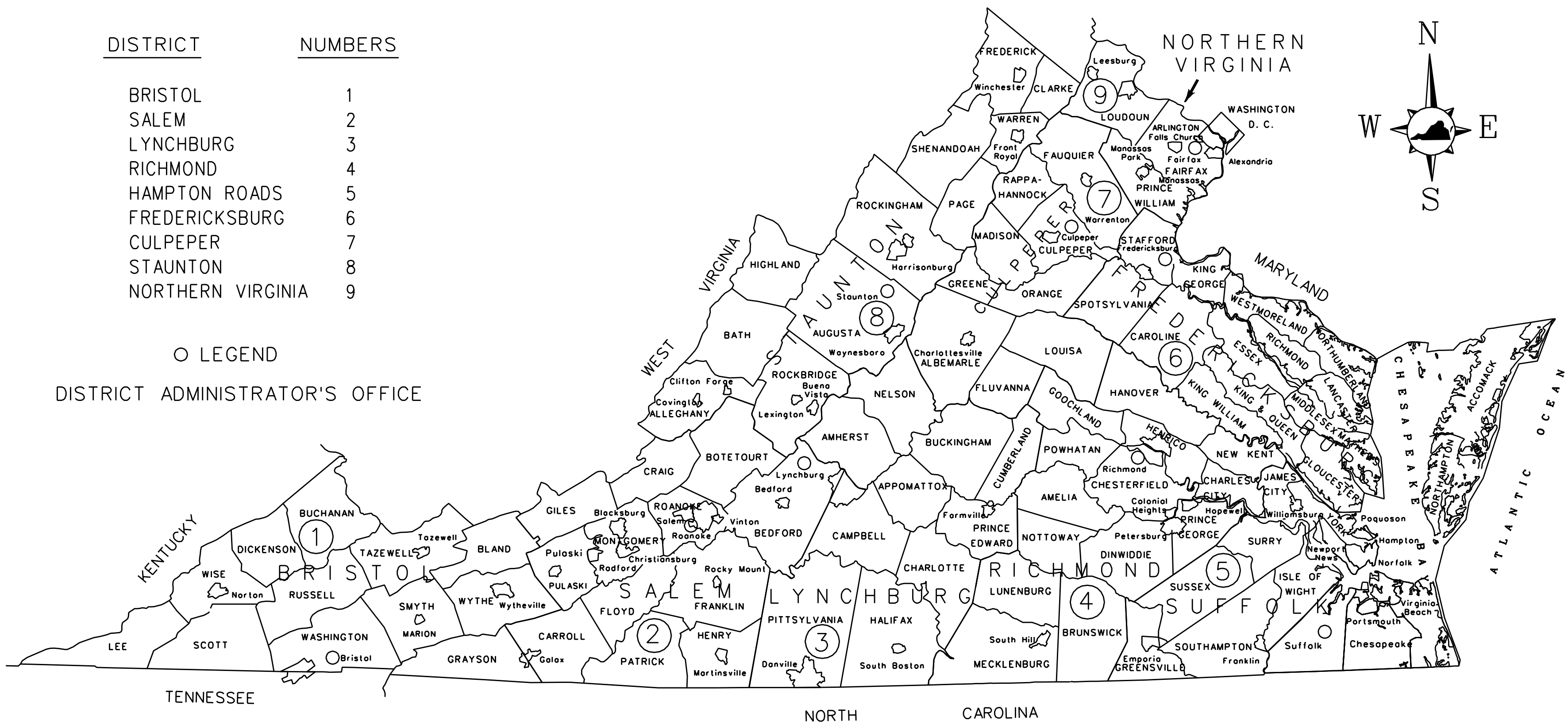


**FIGURE 1C-1 CONSTRUCTION DISTRICTS**

# VIRGINIA PLANNING DISTRICTS

| PLANNING DISTRICTS | |
|---|---|
| (1) LENOWISCO | (12) WEST PIEDMONT |
| (2) CUMBERLAND PLATEAU | (13) SOUTHSIDE |
| (3) MOUNT ROGERS | (14) PIEDMONT |
| (4) NEW RIVER VALLEY | (15) RICHMOND REGIONAL |
| (5) FIFTH | (16) RADCO |
| (6) CENTRAL SHENANDOAH | (17) NORTHERN NECK |
| (7) LORD FAIRFAX | (18) MIDDLE PENINSULA |
| (8) NORTHERN VIRGINIA | (19) CARTER |
| (9) RAPPAHANNOCK-RAPIDAN | (22) ACCOMAC-NORTHAMPTON |
| (10 THOMAS JEFFERSON | (23) HAMPTON ROADS |
| (11) CENTRAL VIRGINIA | |

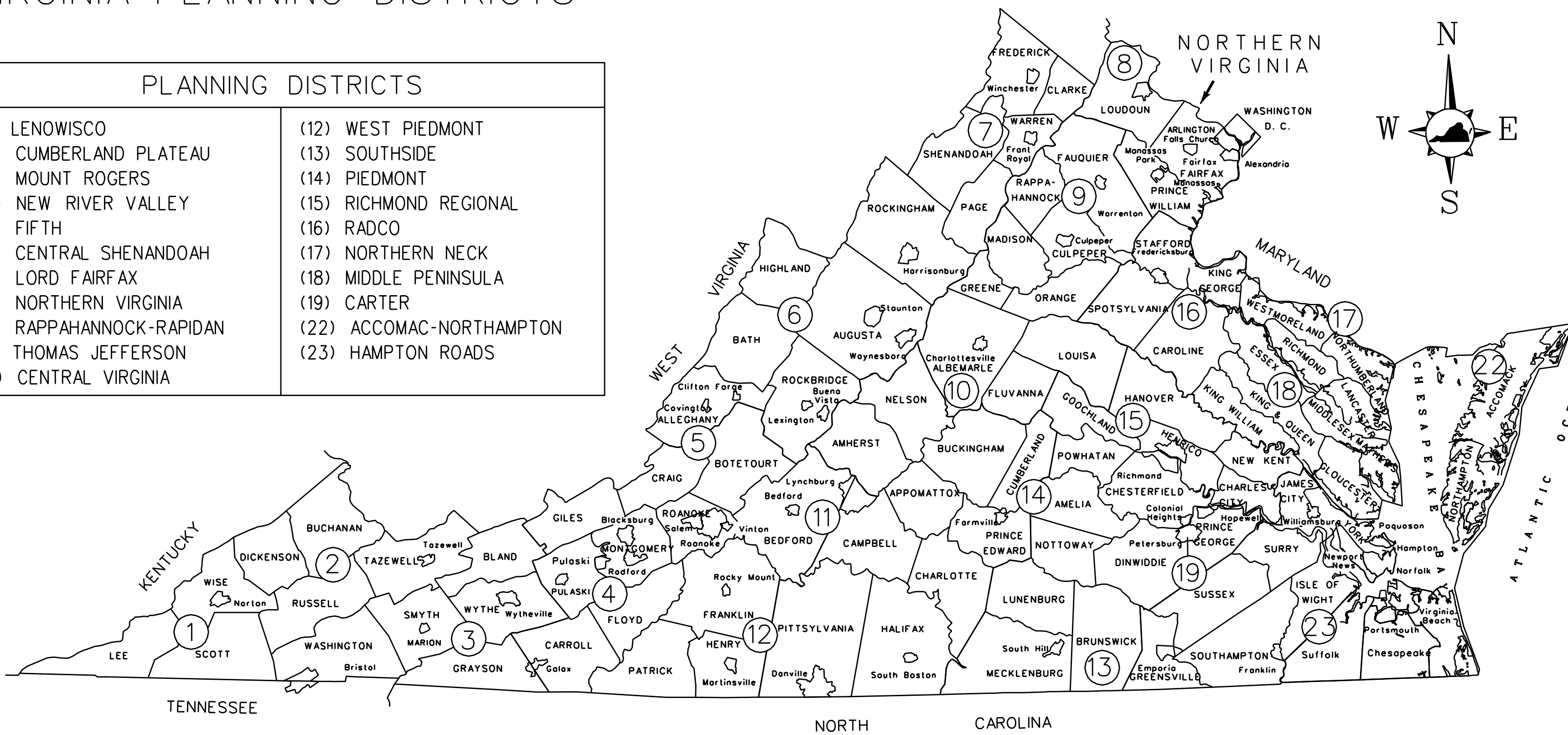


**FIGURE 1C-2 PLANNING DISTRICTS**

| County | County No. | Residency | District | County | County No. | Residency | District | County | County No. | Residency | District |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arlington | 00 | 47 | 9 | Franklin | 33 | 13 | 2 | Nottoway | 67 | 24 | 4 |
| Accomack | 01 | 36 | 5 | Frederick | 34 | 55 | 8 | Orange | 68 | 45 | 7 |
| Albemarle | 02 | 43 | 7 | Giles | 35 | 11 | 2 | Page | 69 | 56 | 8 |
| Alleghany | 03 | 50 | 8 | Gloucester | 36 | 37 | 6 | Patrick | 70 | 12 | 2 |
| Amelia | 04 | 24 | 4 | Goochland | 37 | 28 | 4 | Pittsylvania | 71 | 17 | 3 |
| Amherst | 05 | 22 | 3 | Grayson | 38 | 8 | 1 | Powhatan | 72 | 26 | 4 |
| Appomattox | 06 | 20 | 3 | Greene | 39 | 43 | 7 | Prince Edward | 73 | 19 | 3 |
| Augusta | 07 | 53 | 8 | Greensville | 40 | 31 | 5 | Prince George | 74 | 25 | 4 |
| Bath | 08 | 50 | 8 | Halifax | 41 | 18 | 3 | Prince William | 76 | 48 | 9 |
| Bedford | 09 | 16 | 2 | Hanover | 42 | 28 | 4 | Pulaski | 77 | 11 | 2 |
| Bland | 10 | 6 | 1 | Henrico | 43 | 27 | 4 | Rappahannock | 78 | 46 | 7 |
| Botetourt | 11 | 14 | 2 | Henry | 44 | 12 | 2 | Richmond | 79 | 39 | 6 |
| Brunswick | 12 | 23 | 4 | Highland | 45 | 53 | 8 | Roanoke | 80 | 14 | 2 |
| Buchanan | 13 | 4 | 1 | Isle of Wight | 46 | 33 | 5 | Rockbridge | 81 | 50 | 8 |
| Buckingham | 14 | 19 | 3 | James City | 47 | 35 | 5 | Rockingham | 82 | 54 | 8 |
| Campbell | 15 | 20 | 3 | King George | 48 | 40 | 6 | Russell | 83 | 4 | 1 |
| Caroline | 16 | 41 | 6 | King & Queen | 49 | 37 | 6 | Scott | 84 | 58 | 1 |
| Carroll | 17 | 9 | 2 | King William | 50 | 41 | 6 | Shenandoah | 85 | 55 | 8 |
| Charles City | 18 | 27 | 4 | Lancaster | 51 | 39 | 6 | Smyth | 86 | 3 | 1 |
| Charlotte | 19 | 18 | 3 | Lee | 52 | 58 | 1 | Southhampton | 87 | 31 | 5 |
| Chesterfield | 20 | 26 | 4 | Loudoun | 53 | 49 | 9 | Spotsylvania | 88 | 40 | 6 |
| Clarke | 21 | 56 | 8 | Louisa | 54 | 42 | 7 | Stafford | 89 | 40 | 6 |
| Craig | 22 | 14 | 2 | Lunenburg | 55 | 24 | 4 | Surry | 90 | 32 | 5 |
| Culpeper | 23 | 45 | 7 | Madison | 56 | 45 | 7 | Sussex | 91 | 32 | 5 |
| Cumberland | 24 | 19 | 3 | Mathews | 57 | 37 | 6 | Tazewell | 92 | 6 | 1 |
| Dickenson | 25 | 1 | 1 | Mecklenburg | 58 | 23 | 4 | Warren | 93 | 56 | 8 |
| Dinwiddie | 26 | 25 | 4 | Middlesex | 59 | 37 | 6 | Washington | 95 | 3 | 1 |
| Essex | 28 | 41 | 6 | Montgomery | 60 | 11 | 2 | Westmoreland | 96 | 39 | 6 |
| Fairfax | 29 | 47 | 9 | Nelson | 62 | 22 | 3 | Wise | 97 | 1 | 1 |
| Fauquier | 30 | 46 | 7 | New Kent | 63 | 27 | 4 | Wythe | 98 | 8 | 1 |
| Floyd | 31 | 9 | 2 | Northampton | 65 | 36 | 5 | York | 99 | 35 | 5 |
| Fluvanna | 32 | 42 | 7 | Northumberland | 66 | 39 | 6 | | | | |

**FIGURE 1C-3 COUNTIES**

**OVER 5,000 POPULATION**

| | City/Town | City/Town Number | County | Residency | District | City/Town | City/Town Number | County | Residency | District | City/Town | City/Town Number | County | Residency | District |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cities** | Alexandria | 100 | 00 | 47 | 9 | Fredericksburg | 111 | 88 | 40 | 6 | Poquoson | 147 | 99 | 35 | 5 |
| | Bedford | 141 | 09 | 16 | 2 | Galax | 113 | 17 | 9 | 2 | Portsmouth | 124 | 64 | 34 | 5 |
| | Bristol | 102 | 95 | 3 | 1 | Hampton | 114 | 27 | 35 | 5 | Radford | 126 | 60 | 11 | 2 |
| | Buena Vista | 103 | 81 | 50 | 8 | Harrisonburg | 115 | 82 | 54 | 8 | Richmond | 127 | 20 | 27 | 4 |
| | Charlottesville | 104 | 02 | 43 | 7 | Hopewell | 116 | 74 | 25 | 4 | Roanoke | 128 | 80 | 14 | 2 |
| | Chesapeake | 131 | 64 | 34 | 5 | Lexington | 117 | 81 | 50 | 8 | Salem | 129 | 80 | 14 | 2 |
| | Colonial Heights | 106 | 20 | 26 | 4 | Lynchburg | 118 | 15 | 20 | 3 | South Boston | 130 | 41 | 18 | 3 |
| | Covington | 107 | 03 | 50 | 8 | Manassas | 155 | 76 | 48 | 9 | Staunton | 132 | 07 | 53 | 8 |
| | Danville | 108 | 71 | 17 | 3 | Manassas Park | 152 | 76 | 48 | 9 | Suffolk | 133 | 61 | 33 | 5 |
| | Emporia | 109 | 40 | 31 | 5 | Martinsville | 120 | 44 | 12 | 2 | Virginia Beach | 134 | 75 | 34 | 5 |
| | Fairfax | 151 | 29 | 47 | 9 | Newport News | 121 | 94 | 35 | 5 | Waynesboro | 136 | 07 | 53 | 8 |
| **Towns** | Falls Church | 110 | 29 | 47 | 9 | Norfolk | 122 | 64 | 34 | 5 | Williamsburg | 137 | 47 | 35 | 5 |
| | Franklin | 145 | 87 | 31 | 5 | Petersburg | 123 | 26 | 25 | 4 | Winchester | 138 | 34 | 55 | 8 |
| | Abingdon | 140 | 95 | 3 | 1 | Farmville | 144 | 73 | 19 | 3 | Pulaski | 125 | 77 | 11 | 2 |
| | Ashland | 166 | 42 | 28 | 4 | Front Royal | 112 | 93 | 56 | 8 | Vienna | 153 | 29 | 47 | 9 |
| | Blacksburg | 150 | 60 | 11 | 2 | Herndon | 235 | 29 | 47 | 9 | Vinton | 149 | 80 | 14 | 2 |
| | Bluefield | 143 | 92 | 6 | 1 | Leesburg | 253 | 53 | 49 | 9 | Wytheville | 139 | 98 | 8 | 1 |
| | Christiansburg | 154 | 60 | 11 | 2 | Marion | 119 | 86 | 3 | 1 | | | | | |
| | Culpeper | 204 | 23 | 45 | 7 | | | | | | | | | | |

**FIGURE 1C-4 CITIES AND TOWNS**

| 3,500 - 5,000 POPULATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| City/Town | | City/Town Number | County | Residency | District | City/Town | City/Town Number | County | Residency | District |
| **Cities** | Norton | 146 | 97 | 1 | 1 | | | | | |
| **Towns** | Altavista | 162 | 15 | 20 | 3 | Richlands | 148 | 92 | 6 | 1 |
| | Big Stone Gap | 101 | 97 | 1 | 1 | Rocky Mount | 157 | 33 | 13 | 2 |
| | Bridgewater | 176 | 82 | 54 | 8 | Smithfield | 300 | 46 | 33 | 5 |
| | Chincoteague | 190 | 1 | 36 | 5 | South Hill | 301 | 58 | 23 | 4 |
| | Clifton Forge | 105 | 3 | 50 | 8 | Strasburg | 306 | 85 | 55 | 8 |
| | Dumfries | 212 | 76 | 48 | 9 | Tazewell | 158 | 92 | 6 | 1 |
| | Luray | 159 | 69 | 56 | 8 | Warrenton | 156 | 30 | 46 | 7 |

| TOWNS WITH POPULATION < 3500 | | | | |
|---|---|---|---|---|
| TOWN | TOWN NUMBER | COUNTY | RESIDENCY | DISTRICT |
| Blackstone | 142 | 67 | 24 | 4 |
| Chase City | 186 | 58 | 23 | 4 |
| Elkton | 216 | 82 | 54 | 8 |
| Grottoes | 228 | 07/82 | 54 | 8 |
| Lebanon | 252 | 83 | 4 | 1 |
| Narrows | 266 | 35 | 11 | 2 |
| Orange | 275 | 68 | 45 | 7 |
| Pearisburg | 279 | 35 | 11 | 2 |
| Saltville | 295 | 86 | 3 | 1 |
| Wise | 329 | 97 | 1 | 1 |
| Woodstock | 330 | 85 | 55 | 8 |

**FIGURE 1C-5 CITIES AND TOWNS**

| BRISTOL DISTRICT | (1) | SALEM DISTRICT | (2) | LYNCHBURG DISTRICT | (3) |
|---|---|---|---|---|---|
| **RESIDENCY** | **No.** | **RESIDENCY** | **No.** | **RESIDENCY** | **No.** |
| WISE | 1 | HILLSVILLE | 9 | CHATHAM | 17 |
| ABINGDON | 3 | CHRISTIANSBURG | 11 | HALIFAX | 18 |
| LEBANON | 4 | MARTINSVILLE | 12 | DILLWYN | 19 |
| TAZEWELL | 6 | ROCKY MOUNT | 13 | APPOMATTOX | 20 |
| WYTHEVILLE | 8 | SALEM | 14 | AMHERST | 22 |
| JONESVILLE | 58 | BEDFORD | 16 | | |
| **RICHMOND DISTRICT** | **(4)** | **HAMPTON ROADS DISTRICT** | **(5)** | **FREDERICKSBURG DISTRICT** | **(6)** |
| **RESIDENCY** | **No.** | **RESIDENCY** | **No.** | **RESIDENCY** | **No.** |
| SOUTH HILL | 23 | FRANKLIN | 31 | SALUDA | 37 |
| AMELIA | 24 | WAVERLY | 32 | WARSAW | 39 |
| PETERSBURG | 25 | SUFFOLK | 33 | FREDERICKSBURG | 40 |
| CHESTERFIELD | 26 | NORFOLK | 34 | BOWLING GREEN | 41 |
| SANDSTON | 27 | WILLIAMSBURG | 35 | | |
| ASHLAND | 28 | ACCOMAC | 36 | | |
| **CULPEPER DISTRICT** | **(7)** | **STAUNTON DISTRICT** | **(8)** | **NORTHERN VIRGINIA DISTRICT** | **(9)** |
| **RESIDENCY** | **No.** | **RESIDENCY** | **No.** | **RESIDENCY** | **No.** |
| LOUISA | 42 | LEXINGTON | 50 | FAIRFAX | 47 |
| CHARLOTTESVILLE | 43 | VERONA | 53 | MANASSAS | 48 |
| CULPEPER | 45 | HARRISONBURG | 54 | LEESBURG | 49 |
| WARRENTON | 46 | EDINBURG | 55 | | |
| | | LURAY | 56 | | |

**FIGURE 1C-6 DISTRICTS AND RESIDENCIES**

# CHAPTER 1D - PROJECT DEVELOPMENT

## CHAPTER 1D-1 - INTRODUCTION

**Page**

# CHAPTER 1D - PROJECT DEVELOPMENT

## CHAPTER 1D-1 - INTRODUCTION

### INTRODUCTION

Projects that are determined to be essential are included in the Virginia Transportation Six-Year Improvement Program (SYIP). The Project Development Process begins after Preliminary Engineering Funds have been authorized. The wide range of road plan types developed by the Department provides significant flexibility in the Project Development Process for the Project Manager who is responsible for the project design, compilation of the plan assembly and meeting the PPMS schedule. The Project Manager decides when to proceed with reviews or submissions. All reviews or submissions may not be applicable for every project and the Project Manager is encouraged to take advantage of opportunities, using sound judgment, to expedite the process by omitting unnecessary reviews or submissions. During the project development process there are many correspondence files and other records, which are important to retain. Guidelines concerning records retention are available in Chapter 2G. Major steps in the Project Development Process are:

### LOCATION STAGE

Public Information Meetings
Location Public Hearing

### FINAL DESIGN STAGE

Initial Field Review
Scoping
Value Engineering Review (if applicable)
Preliminary Field Inspection
Preliminary Utility Field Inspection
Post Willingness or Public Hearing (Design or Combined L&D)
Constructability Review
Field Inspection
R/W Submission
Pre-Advertisement Conference & Biddability Review
Plan Submission to Construction Division

PROJECT DEVELOPMENT FLOW CHARTS are available that explain the steps listed above. These charts are from the Management Services Division and are on the VirginiaDOT.org web site. A link is provided for your information http://www.virginiadot.org/projects/Resources/CE-CEP11x17.pdf .

# CHAPTER 1E - QUALITY CONTROL

## SECTION 1E-1-INTRODUCTION

## SECTION 1E-2-PROCESS



## SECTION 1E-3-CHECKLIST

# CHAPTER 1E - QUALITY CONTROL

## SECTION 1E-1-INTRODUCTION

A primary emphasis must be placed on providing high quality in the development of roadway plans. In the design process, the Project Manager is responsible for the project design and compilation of the plan assembly and also decides when plans have been developed to the point that Quality Reviews are to be made. The Program Manager is both responsible and accountable for the quality of all of the projects under his/her management.

Section 1E-3 of this Chapter includes a Quality Control Checklist to be used as a "tool" to facilitate the process of maintaining high quality plans during the design process. The appropriate Section Manager and Program Manager will complete the checklist review at various stages. It is required that the Project Manager maintain a current copy of this checklist in each project file for checking appropriate stages in the project development process. This checklist is available as form LD-436.

## SECTION 1E-2-PROCESS

### PROJECT SELECTION

Quality Control Reviews will be conducted on all projects.

### PROCESS

The current process for quality control is to review the project via the quality checklist at the various stages of project development. The checklist insures that we are following the current project development recommendations and completing task at the proper stages.

## SECTION 1E-3-CHECKLIST

Five columns are available for the five different time frames during which an overall review of the plan assembly should be conducted: Preliminary Field Inspection, Public Hearing, Field Inspection, Right of Way, and Advertisement.

The items that have an asterisk beside them indicate items to be reviewed to check the constructability adequacy of the plans. Not all items have a line to check for all five time frames. That indicates that the information would not typically be available for review at that stage of development. As the Project Manager approaches a particular targeted review, he/she should check off the items on the checklist as they are completed.

In order for this checklist to serve as a "useful tool" to make your job easier, it also includes references to sections in the Road Design Manual and the Instructional and Informational Memoranda where supportive instructions on developing the particular item in the checklist may be found. These references should not be considered "all-inclusive", since there are always various references within Department directives relative to similar guidelines and instructions (i.e. reference may be to a particular IIM, when in fact you could also find information in the Road and Bridge Specifications as well as in the Drainage Manual).

The Checklist has been divided into different categories of sheets, which reference sections in the Road Design Manual and/or Instructional and Informational Memoranda. For the individual items listed under those particular categories of sheets, you will find specific page references for the Road Design Manual, when appropriate.

You will receive updates to this checklist from time to time. Use the checklist to your best advantage by making sure that you have the most current version of the checklist at each appropriate time frame by checking the revision date on the current sheets in your Road Design Manual with the copy you have been working on in your project file. As new instructions are issued, you may want to add to the checklist until the Engineering Services Section can update the checklist (probably on an annual basis).

The following link **HTTP://WWW.EXTRANET.VDOT.STATE.VA.US/FORMS/** will open the Quality Control Checklist (form LD-436). Copies should be made directly from the most current revisions of these sheets and kept in the project file for completion at various stages of project development.

## CHAPTER 2A - LOCATION STUDY

### SECTION 2A - 1 - PROJECT INITIATION



### SECTION 2A - 2 - ADMINISTRATIVE APPROVAL



### SECTION 2A - 3 - REVIEWING WORK LOAD AND ASSEMBLING DATA



### SECTION 2A - 4 - REQUESTING AND ASSEMBLING ADDITIONAL DATA



### SECTION 2A - 5 - FIELD REVIEW

**SECTION 2A - 6 - STUDY OF ALTERNATES**



**SECTION 2A - 7 - PROJECT SCOPING**

# CHAPTER 2A - LOCATION STUDY

## SECTION 2A - 1 - PROJECT INITIATION

### PRELIMINARY ENGINEERING AUTHORIZATION

Projects are initiated and funding requests are submitted according to the system classification. See IIM LD- 183 for the authorization procedure.

### URBAN PROJECTS

Projects within towns and cities with populations of 3,500 or more (and other selected urban areas under 3,500) are initiated by municipal resolution to the Local Assistance Division stating their desire for VDOT to consider the implementation of a project. Upon receipt of a request, and approval by the Local Assistance Division Director, the Local Assistance Division forwards to the Location and Design Division a request for assignment of a project number. Upon determining the project number, FHWA-534 Highway Capital Outlay Code, and Functional Classification, this information is provided to the Director, Local Assistance Division on Form LD-219. Form U-9 will then be prepared by the Local Assistance Division and copies sent to the Fiscal Division, giving authorization to set up the appropriate charges, and to the Location and Design Division.

### INTERSTATE AND PRIMARY PROJECTS

Requests for initiation of projects on the Interstate and Primary Systems originate within VDOT in accordance with established construction schedules, for future planning purposes and in some instances at the request of local governments. Project numbers are assigned using LD-219 according to the Functional Classification and financing. Programming Division authorizes funding using Form PS-14.

### CERTIFICATION ACCEPTANCE

Certification Acceptance (C.A.) is a form of documentation by VDOT for FHWA (on all Federal - Aid projects except Interstate) showing that all Federal Requirements have been met. The Program/Project Management System (P/PMS) should by used to monitor the various stages of project development as well as documenting completion of various stages.

In carrying out operations under certification acceptance (CA), it is imperative that all steps in the project implementation stage be strictly followed. This is particularly the case in transmitting a project at the P.S. & E. stage to the Federal Highway Administration, which cannot be submitted until the environmental document has been cleared. The approval is obtained by the Environmental Division. Environmental documents must receive approval by the FHWA before the work can be authorized. Projects in this category are to be held in this Division until notification from the Environmental Division has been received that the document has been approved by the FHWA.

## EARLY PROJECT NOTIFICATION

Project Early Notification is required as soon as a project has been initiated (PE authorized) in order to provide state environmental resource agencies an opportunity to comment on highway improvements at an early stage of project development. Early Notifications are required on all proposed improvements that disturb previously undisturbed ground (for specifics, see Environmental Division's State Environmental Review Process Manual). Information on SERP is available at http://www.virginiadot.org/projects/environmental-SERP-faq.asp.

Project Early Notification Form EQ-429 shall be completed and submitted with a location map on a section of a U.S.G.S. quadrangle sheet to the applicable District Environmental Manager as follows: Interstate and Primary projects - by the project manager as designated in PPMS; Urban projects - by the Local Assistance Division; Secondary projects - by the Resident Engineer through the Local Assistance Division when submitting Form LD-430. The forms and maps are then forwarded to the sixteen environmental resource agencies for review.

Environmental data identified in this early review process by the resource agencies is returned to the District Environmental Manager within thirty days. The district environmental personnel will utilize this data in their Preliminary Environmental Inventory to determine the significance / non-significance of the project.

## PRELIMINARY SCOPING

All projects are to be scoped in the early stages of development and placed in the Six-Year Improvement Program. (See IIM LD- 210)

## ASSIGNMENT OF PROJECT NUMBERS

Form LD-219 is used to assign project numbers to new projects, delete project numbers, or request additions/revisions to existing project numbers and descriptions.

## REQUESTING STRUCTURE NUMBERS

When a project includes a structure, a “B” or “D” number (See Section 2D-9) and a 5-digit FMSII/HTRIS Number is required. The “B” or “D” number is assigned by Location and Design Division’s Plan Coordination Section (or Local Assistance Division). The Project Manager will then request the FMSII/HTRIS Number by submitting Form LD-219 to Thomas Lester (or John Coleman) of the Structure and Bridge Division prior to requesting a project number from the appropriate division. This request must provide the location of the crossing, denoted on a map, conceptual sketch, or plans, if available.

## REQUESTING A PROJECT NUMBER

Interstate and Primary Projects -
New Projects [prior to inclusion of project in the Six Year Improvement Program (SYIP)] - Programming Division will process Form LD-219.

Existing Projects (projects included in SYIP) - The Project Manager may request that an additional number be assigned to a project (additional PE, R/W, C, B or D number) by submitting Form LD-219 to the Programming Division. Programming Division will forward Form LD-219 to the Location and Design Administrative Support Section upon concurrence with the request.

Urban Projects –
The Project Manager will complete and submit Form LD-219 to the Location and Design Administrative Support Section, copied to the Local Assistance Division.

Secondary Roads Projects –
The Project Manager will complete and submit Form LD-219 to the Local Assistance Division.

## REQUESTING A REVISION TO A PROJECT NUMBER

Interstate and Primary Projects -
To request a revision to a project number (i.e. changing a “C” to an “M”, canceling a project number, etc.) the Project Manager will submit Form LD-219 to the Location and Design Administrative Support Section for processing.

Urban Projects –
The Project Manager will complete and submit Form LD-219 to the Location and Design Division Administrative Support Section, copied to the Local Assistance Division.

Secondary Roads Projects -
The Project Manager will complete and submit Form LD-219 to the Local Assistance Division.

## REQUESTING A REVISION TO A PROJECT DESCRIPTION

Interstate and Primary Projects -
To request a revision to the project description, the Project Manager will submit Form LD-219 to the Programming Division. The Programming Division will process the request, and upon concurrence, forward Form LD-219 to the Location and Design Administrative Support Section. The Form LD-219 will document Programming Division's concurrence in the Remarks Section of the form.

When a revision to the project description dramatically changes the scope, length, schedule and/or cost of the project, the Project Manager must submit a formal request to the Programming Division Administrator along with Form LD-219. This request should provide a detailed summary of the revision (including reason for the scope change, new estimated cost, and any changes in the project schedule) and must be signed by the Location and Design Administrator (or District Administrator). Minor revisions to the project scope may not warrant a formal request. The Project Manager should discuss these situations with the Programming Division.

Urban Projects –
The Project Manager will complete and submit Form LD-219 to the Location and Design Division Administrative Support Section, after coordination with the Local Assistance Division.

Secondary Roads Projects -
The Project Manager will complete and submit Form LD-219 to the Local Assistance Division.

## SECONDARY ROADS (ARTERIAL-COLLECTOR-LOCAL ROADS)

The following procedure is to be adhered to in the preparation of secondary projects for field inspection stage:

1. Secondary projects are initiated by the Resident Engineer in conjunction with a master plan and with approval of appropriate boards of supervisors. He will submit Form LD-430 to the Director, Local Assistance with an assigned project number and the Functional Classification.

2. Upon receipt of the secondary roads Preliminary Field Inspection authorization, the State Location and Design Engineer shall request data in accordance with Section 2A-7 and request historical and archaeological surveys. It is desirable that the information be available to those present at the time of the review. The State Location and Design Engineer shall assist in supplying any mapping or photography which may be required to complete the above.

3. After completion of step No. 2, the District Administrator will schedule an Initial Field Review and notify the Director, Local Assistance, Location and Design Engineer and Right of Way Engineer of the date, time and site. Representatives from the District Environmental, Right of Way, Mobility Management, or any other appropriate section(s) may be requested to attend. A scoping team reviews the design at this time for documentation. (See IIM - LD - 210.)

4. The results of this Initial Field Review are to be forwarded to the Director, Local Division on Form LD-430. The cost estimate of the project is to include construction estimates by the Location and Design Section. The District Right of Way Section will provide right of way and utility estimates as required. Projects with anticipated right of way donations are to have the donations fully resolved at this time.

5. Upon receipt of the Form LD-430, the Director, Local Assistance shall complete his review and should he concur with the proposed scheme of development, he will so notify the State Location and Design Engineer with a copy to the District Administrator. Upon approval by the State Location and Design Engineer, field surveys will be authorized. Field surveys are not to be made prior to this approval.

6. Upon completion of the preliminary design, which will include proposed grades and right of way, prints will be furnished to the District Environmental Manager for preparation of the proper environmental document and for permit determination.

7. Any major deviation from the agreements reached at the Initial Field Review and indicated in step No. 3 must be evaluated considering cost differential. This information is to be transmitted along with the preliminary plans as indicated in step No. 6 so that any change from the original concept can be included in the decision making process. The revised project must satisfy the original objective within a reasonable funding scope. In cooperation with the Resident Engineer, the District Design Engineer will be responsible for determining and updating the project cost so that a project will not be scheduled prior to the Department's ability to finance.

8. For instructions on using the "No Plan" and "Minimum Plan" concept see Appendix A, Section A-7.

**PROJECT PROGRESSION**

The State Location and Design Engineer or his representative for Location will request that the design unit in either the Central Office or the District to which the project has been assigned prepare a preliminary study, if one is warranted. Should a study not be needed, survey will be authorized as noted in Section 2B-1. The Preliminary Engineering Section will participate in any special studies and analyses that may be required by management.

# SECTION 2A - 2 - ADMINISTRATIVE APPROVAL

## AUTHORIZATION FOR LOCATION PUBLIC HEARING

The State Location and Design Engineer will review the project with the appropriate officials to determine if a Location Public Hearing will be required, taking into account the general complexity of the proposed and anticipated public interest (Location Public Hearings are usually held on all projects involving major environmental changes affecting the community.) Should it be found desirable to hold a Location Public Hearing, authorization will be given and those involved will be advised as to the scheduling of the hearing, corridors to be presented and other pertinent information. (A determination should be made at this time as to whether existing photography is adequate for the preparation of an aerial mosaic. If not, the required coverage should be requested.)

In most cases, a notice of willingness will not be posted on a project with one or more of the following characteristics. These characteristics are cause for considerable public concern which necessitate both a Location Public Hearing and a Design Public Hearing:

1. A major highway project of four or more lanes on a new location;

2. Project impacting the area with significant social, economic or environmental effects;

3. Project having two or more feasible solutions under serious consideration;

4. A Federal-Aid project identified as a Class I action.

# SECTION 2A - 3 - REVIEWING WORK LOAD AND ASSEMBLING DATA

## SCHEDULING PROJECT WITH WORK LOAD

When a project is received by either the Preliminary Engineering Section or a Design Section, the Section Head will assign it to one of his/her groups. Care must be taken to review existing and possible future construction schedules to assure that the section being assigned the project has sufficient time and manpower. On Preliminary Engineering projects, consideration must be given to long range commitments to assure that the same section will continue the project through the Preliminary Field Inspection stage.

## SETTING UP CORRESPONDENCE FILES

The initiation and constant maintenance of correspondence files cannot be over-emphasized. A properly maintained file will provide a continuing history of the project and will permit documentation of the various stages of activities. When a project is received by the Engineer to whom it is assigned, every effort should be made to assemble all correspondence relative to this particular project. This will involve a search of the main file, a review of the files of other divisions, and possibly a review of the files of District personnel. All original correspondence is to go to the central files after copies are made. When all available correspondence is assembled, consideration is to be given to the number of files needed and their content. On large projects or those expected to continue for several years, this is very important, as a separation of certain items will provide optimum access.

When a project has been authorized by the Programming Division, the project designer (or coordinator is to set up a file folder labeled "PRELIMINARY ENGINEERING COST" and the file is to only contain data such as the authorization(s), PE cost expenditures, request for additional funds, and backup data for additional PE cost and cost overruns (e.g., reason - for design of a section; additional study for Environmental considerations; etc.).

## SETTING UP ROUTE FILES

Route files will contain all rolls, mosaics, old plans, photographs, USGS quadrangle sheets and other available data. Consideration must be given to the size and expected time frame of the project and sufficient space provided for the anticipated accumulation. Items in the route file are to be identified by some method for easy access. As the project progresses, care must be taken to keep only essential items, as an accumulation of unneeded material will waste valuable space.

# SECTION 2A - 4 - REQUESTING AND ASSEMBLING ADDITIONAL DATA

## PRELIMINARY PLAN DEVELOPMENT

Preliminary Plan Development is intended to provide the basis for scoping, and the guiding document for the development of Field Inspection plans. It is essential that various alternatives be assessed in sufficient detail in order to preclude major modifications during the latter stages of project development.

The following outline is a guide in the development process to assure that adequate control is applied in the early stage of projects:

1. As early as possible, at the inception of a project, photographic coverage is essential. The location of the project determines the coverage required. Rural projects with sparse development and without extremes in topography and development can generally be addressed at a ratio of 1:2000 Metric (1" = 200' Imperial). A ratio of 1:1000 Metric (1" = 100' Imperial) is preferable, but may limit the band width when relocations or various new alignments are being considered.

   Other projects in congested areas may require photography at a ratio of 1:500 Metric (1"= 50' Imperial). It is the designer's responsibility to obtain photography at an appropriate ratio (scale).

2. If traffic data has not been secured, a request should be submitted at this time on Form LD-104, including the date the information is needed.

3. From the photo coverage in step No. 1, a temporary plan base, either in the form of sheets or mosaics, is to be secured. The request should note that the material is to be used as temporary plan base, and photographic screening and/or dodging will be employed to produce a base on which line work will easily be visible.

   Studies have shown that these plan bases provide a clearer drawing when the final version is completed. Other annotations can be made more legible by removing the image to provide a "clean" space for descriptions, etc.

4. Depending upon the complexity of the project, the use of title sheets, typical section sheets and other drawings may be used for quantities and details of traffic, intersections, etc. The base photo coverage can be placed on a sheet outline and a set of plans produced.

## ASSEMBLING ADDITIONAL AVAILABLE DATA

Quite often there is available data within the Department and other state agencies which proves valuable in determining the location and design of the project. Land use maps, tax maps, soil studies, etc., are available in many instances and should be included in the route file for future use. Transportation studies are available for cities and towns over 3,500 population, as well as for eight other urban areas under 3,500, and should be used as a guide.

## REQUEST FOR TRAFFIC DATA

Traffic data is requested on Form LD-104, except for low volume Local Roads and Rural Collectors with a Current ADT (Current ADT being defined as latest available traffic counts) less than 400 VPD. The designer is to check the appropriate blocks to obtain traffic data required for a particular situation. The design year and speed is to be indicated on the form when submitted by the designer. The design year traffic data being requested is to be based on the advertisement date plus the normal 11 years for secondaries and 22 years for all other systems.

Normal traffic data requests on Form LD-104 will be required on Local Roads and Rural Collectors requiring a detailed traffic analysis, such as roads experiencing a higher than normal growth rate or for other reasons that would require some type of traffic forecast. Careful consideration must be given to environmentally sensitive locations which would require possible air or noise studies. Where schools, churches, historical structures, playgrounds, etc., are in close proximity to the proposed project, the District Environmentalist should be contacted to determine the extent of traffic analysis required.

## REQUESTING PHOTOGRAPHIC COVERAGE/TOPOGRAPHIC MAPPING

On most new locations, it is desirable to request topographic mapping. A review of available data in most cases allows the Engineer to determine the approximate area to be mapped. In some instances it may be necessary to review the area to be mapped in the field. This area can then be shown accurately on a quadrangle sheet. After determining the area to be mapped, the ratio (scale) of mapping is to be determined. Most mapping is prepared at a 1:2000 ratio (1" = 200' scale); however, it is also available at other ratios (scales). When the proper ratio (scale) is determined, the Assistant Location and Design Engineer for Location will advise the Photogrammetric Engineer who will proceed in the preparation of the mapping. Immediate action on requests for mapping may not always be possible as the flying time necessary for good aerial photography is limited.

## ASSEMBLING PHOTOGRAPHS AND MAPPING

After the photographs are secured, mapping is completed. Prints can be made and used as individual sheets or combined as rolls at the discretion of the Engineer. A set of individual photographs is also essential for stereo viewing. A mosaic can be ordered through the Photogrammetric Engineers, should this be found desirable.

# SECTION 2A - 5 - FIELD REVIEW

## ARRANGING FIELD REVIEW (ON-SITE)

After all available data is assembled, field review is to be made. Arrangements are to be made with the District Administrator and Resident Engineer (and the Local Assistance Division representative, if applicable) for an on-site review.

## HOLDING ON-SITE REVIEW

On the initial field review there are several situations to be investigated. A determination is to be made, with the assistance of the District Administrator and/or Resident Engineer, as to future development which could influence the selection of a corridor. Relative property values should be noted on the prints. Soils, streams and current land use are to be noted. All applicable environmental areas such as parks, historical sites, hazardous waste sites, wetlands, etc., should also be noted. The probable effect on existing roads and entrances should be reviewed. An on-site review should leave the review party with a better understanding or "feel" of the corridors under consideration.

## PREPARATION OF REPORT

A report is to be written, either to the section supervisor or to the file, outlining the conclusions reached at the on-site review. An appropriate part of this report is a recommendation as to the most desirable manner in which to proceed. This report will also serve as a record of matters considered.

# SECTION 2A - 6 - STUDY OF ALTERNATES

## PROJECTING HORIZONTAL ALIGNMENT

In projecting horizontal alignment at this stage of development, all practical considerations should be tested, subject to information obtained from the initial field reconnaissance. The alignment should be governed by the Geometric Design Standards in Appendix A, Section A-1, based on the design speed for the Functional Classification of the highway system that is being considered. In corridor selection, any deviation from these standards is to be noted for consideration. Additional information may also be obtained from AASHTO's A Policy on Geometric Design of Highways and Streets and other related publications. As corridors are studied, it is suggested that one baseline be projected for each alternate.

## PROJECTING VERTICAL ALIGNMENT

When all horizontal alignments have been selected and shown on the prints, a tentative grade is necessary in order to properly evaluate these alternates. Care must be taken to confirm to applicable standards in regard to gradient and to passing and stopping sight distances on both crest and sag vertical curves. Grades should present a smooth appearance and eliminate the "roller coaster" concept whenever possible.

## EVALUATING ALTERNATIVES

In evaluating alternates at this stage of the project development, it should be kept in mind that this is the initial attempt to define a corridor location and the alignment and grades projected are subject to refinement as shown in Section 2B-2. The basic objective at this time is to eliminate the corridors or alignments which are inferior to others considered within the project area. Ideally, one alignment and grade should appear superior to others considered within a given corridor. The aforementioned items used in considering horizontal and vertical alignment offer the best means of evaluating alternates in addition to any information which was obtained from other sources.

## PREPARATION OF REPORT

After alternates have been reviewed and evaluated, a written report to the section supervisor or file is to be prepared stating the conclusions reached, reasons for retaining or eliminating some corridors or alternates and a recommended procedure to follow as the study progresses. Copies are to be sent to the District Administrator and Resident Engineer and any division, which is affected by the project. In this manner all involved parties will be kept abreast of the progress of the project and the files will contain sufficient documentation.

## EVALUATING PUBLIC INVOLVEMENT PROGRAM

Informing the public about studies in their area in the earliest stages can be very helpful in the later stages of project development. Contact the Public Involvement Section for advice and assistance in setting up a useful public involvement program.

## CONTACTING LOCAL GOVERNMENT AND/OR AGENCIES

Cooperation and information are two key words in working with local officials. At this stage of development, contact with the local governing bodies, planning commissions and other elected and/or appointed officials is both proper and desirable. Being in contact daily with their local situation gives these local officials an insight to the area's problems and/or changing conditions. In addition to exchange of ideas and information, contact at this time will give them an opportunity to make a contribution to the overall project development. Contact and arrangements for meeting with local officials in urban areas are to be made by the Local Assistance Division. In other areas, these arrangements are to be made by the District Administrator or his/her designated representative. Meetings of this type also afford the opportunity to bring District personnel up to date on progress of the project.

# SECTION 2A - 7 - PROJECT SCOPING

## POLICY

All projects are to be scoped in their early stages of development. See Chapter 1D for instructions on appropriate timing.

## SCOPING GROUP

The Scoping Group is determined according to the roadway classification. It is an inter-disciplinary group.

## SCOPING PROCESS

The scoping allows all project participants to define the elements comprising the project, the working budget, schedule for designing and developing the project. The recommended design is presented to the scoping group and after agreement is reached, the appropriate form will document the decisions reached.

Interstate, Primary, Urban and Secondary projects will use Form LD-430.

Copies of these forms are to be sent to all team members.

Prior to the plans being signed for right of way (or construction when no right of way is needed), the coordinator will certify that the project is within the original scope, or provide documentation as to the deviations.

The State Location and Design Engineer will use Form LD-404 for this purpose.

## DESIGN EXCEPTIONS

If there are geometric values agreed to that are below acceptable guidelines, the coordinator shall seek to obtain approval of these design exceptions from the State Location and Design Engineer (all projects) and FHWA approval on Federally Funded Projects.

## CHAPTER 2B - PHASE I, INITIAL ROADWAY INVESTIGATION & PRELIMINARY FIELD INSPECTION

### SECTION 2B – 1 - GROUND SURVEYS



### SECTION 2B – 2 - COORDINATION WITH OTHER DIVISIONS AND AGENCIES



### SECTION 2B – 3 - DETERMINATION OF ROADWAY DESIGN



### SECTION 2B – 4 - REQUEST FOR ENVIRONMENTAL EVALUATION



### SECTION 2B – 5 - COST ESTIMATES

**SECTION 2B – 6 - CONSTRUCTABILITY QUALITY REVIEW**



**SECTION 2B – 7 - THE PRELIMINARY FIELD INSPECTION**



**SECTION 2B – 8 - VALUE ENGINEERING**

# CHAPTER 2B - PHASE I, INITIAL ROADWAY INVESTIGATION & PRELIMINARY FIELD INSPECTION

## SECTION 2B – 1 - GROUND SURVEYS

### SURVEY AUTHORIZATION

There are certain instances in which it is not necessary to hold a Location Public Hearing after the completion of a Location Study. In these instances, surveys will be authorized by the Assistant Location and Design Engineer. All ground surveys are authorized by the State Location and Design Engineer, or a representative, by memorandum to the District Administrator. The Programming Division authorizes funding and notifies the Fiscal Division of this funding. All surveys will be assigned in cooperation with the District Administrator. Assignments are to be made on the basis of available manpower statewide. At this time, a determination is to be made as to the feasibility of utilizing photogrammetric methods for all or selected phases of the survey. Due to the critical timing necessary in securing photography suitable for mapping purposes, the District Administrator should arrange the work schedule to accomplish the ground control work in a timely manner.

Surveys are performed in accordance with the current Survey Manual. The authorization procedure for each roadway classification is described in this section.

Underground utilities are to be designated as instructed in IIM LD- 140.

### INTERSTATE

Interstate projects are authorized for survey after Location Approval has been given by the Commonwealth Transportation Board and the Federal Highway Administration and in accordance with tentative construction schedules.

### PRINCIPAL / MINOR ARTERIAL

Principal and Minor Arterial System projects are authorized for surveys in accordance with established construction or planning schedules. Projects with Federal funding for preliminary engineering require prior approval by the Federal Highway Administration.

### URBAN

Urban projects are authorized for survey upon receipt of Form U-9 from the Local Assistance Division. Projects with Federal funding for preliminary engineering require prior approval by the Federal Highway Administration.

## SECONDARY (ARTERIAL-COLLECTOR-LOCAL ROADS)

Secondary project surveys are requested by the Local Assistance Division in accordance with planning schedules, particularly in the Secondary System Contract Advertisement Schedule.

## DATA REQUIRED

In order to assist the survey party in establishing proper horizontal and vertical controls, certain data must accompany the survey authorization. This data should include, but is not limited to:

(1) prints of adjacent projects in the planning or construction stage,
(2) existing road plans,
(3) National Geodetic Survey controls, both horizontal and vertical,
(4) prints of the proposed alignment and grade (if available),
(5) U.S. Geological Survey topographic quadrangle maps of the area and
(6) photographs of the area.

## COMPLETE SURVEYS

Projects designed in the Districts: When the field work has been completed by the Survey party, the District Survey Party Engineer transmits the electronic data by memorandum to the District Design Unit for the plotting of horizontal and vertical data. The Central Office shall be notified that the survey is complete. Upon receipt of this memorandum the District Coordinator will issue design instructions and contact the District Location and Design Engineer to determine scheduling.

Projects designed in the Central Office, or by Consultants: When the field work has been completed by the Survey Party, the electronic data is to be submitted to the Central Office by memorandum. Plan sheets will be plotted by the Aerial Survey Section or the Consultant assigned the project.

**When the designer receives the survey, it should be checked for utility designations. If none are shown, a request should be made as outlined in IIM LD-140.**

Bridge site plans and data sheets will be plotted by the survey party and transmitted to the Central Office by the District Survey Party Engineer, with the exception of Secondary Projects, which are to be sent to the District Structure and Bridge Division.

## SECTION 2B – 2 - COORDINATION WITH OTHER DIVISIONS AND AGENCIES

### REQUEST FOR SOILS DATA

Soils data is to be requested on Form LD-252. A copy of the tentative alignment and grades is to accompany this form to the Materials Division. It should be noted that this is a very preliminary soils evaluation and is not to be confused with the more detailed soils report furnished at a later date.

### REQUEST FOR HYDRAULIC EVALUATION

In projecting alternates, consideration must be given to hydrology, hydraulics, and the potential effects a given projection will have on flood prone areas, wetlands, navigable waters and water quality. Consequently, the alternates being considered are to be reviewed by the Hydraulics Section during this stage of project development.

### COORDINATION WITH ENVIRONMENTAL DIVISION

Due to the increased emphasis being placed on the effects of a proposed highway on the environment, it is essential that this Division be contacted in the early stages of development on all projects. A memorandum is to be written stating that preliminary development is underway and requesting their evaluation of the corridors under consideration. A copy of these study corridors is to accompany this memorandum. See Appendix C, Section C-2-NOISE ABATEMENT and Section C-4-WATER RELATED PERMITS for further instructions on coordination with the Environmental Division.

### COORDINATION WITH OTHER STATE AGENCIES

Project Early Notification will involve all applicable state environmental resource agencies in the early stages of project development. If, however, a project has not been included in the Project Early Notification Process, requests for review with environmental resource agencies such as Historic Landmarks, State Historian, Commission of Game and Inland Fisheries, etc., are to be coordinated through the Environmental Division. Each project has its own individual characteristics and should be reviewed carefully at an early stage to determine if a possible conflict may arise.

# SECTION 2B – 3 - DETERMINATION OF ROADWAY DESIGN

## CAPACITY ANALYSES

Traffic Data, as described in Section 2A-4, must now be analyzed in relation to the pre-determined Functional Classification.

The basic number of thru lanes required in order for the mainline to operate at a satisfactory level of service shall be determined by capacity analyses. Capacities of connecting and crossing roadways shall also be determined, taking into consideration plans for future improvements to these facilities.

Where at-grade intersections are proposed, a capacity analysis shall be made to determine whether or not the intersection will operate at a satisfactory level of service. If the analysis indicates an unsatisfactory service level, an interchange should be considered.

When interchanges are proposed or are being considered, a capacity analysis should be utilized to determine the type of interchange required.

Peak hour traffic projection to the design year shall be used for all capacity analyses.

All capacity checks shall be reviewed with the Transportation & Mobility Planning Division and shall be documented in project files.

Reference materials available at this time to assist in capacity analysis include:

1. Highway Capacity Manual - 1985 (Transportation Research Board Special Report 209)

2. Design of Urban Streets - January 1980 - FHWA

3. Highway Capacity Software

## INTERCHANGE DESIGN

Because of the wide variety of site conditions, traffic volumes, highway types and interchange layouts, the warrants which justify an interchange may differ at each location. The six major factors to be considered are:

1. Control of access
2. Elimination of bottlenecks or spot congestion
3. Elimination of hazards
4. Site topography
5. Road user benefits
6. Traffic volumes

Other than on a freeway, the inability to provide the necessary capacity with an at-grade intersection is a common warrant for an interchange.

More detailed warrants and general types of interchanges may be found in Chapter X "Grade Separations and Interchanges" of AASHTO's A Policy on Geometric Design of Highways and Streets.

**REFINING HORIZONTAL ALIGNMENT**

Horizontal alignment is to be reviewed at this stage for possible revisions due to information received under Section 2B-1 such as: obvious areas of unsuitable material and/or rock, major utility facility relocations and environmental considerations (such as splitting communities, splitting watersheds, conflicts with National or State Forests and Parks, historical property, archaeological sites, recreational areas, sites affected by noise beyond acceptable limits, etc.). Horizontal alignment must remain within acceptable limits as prescribed in the Geometric Design Standards (See Appendix A, Section A-1) unless an authorized exception is made by the State Location and Design Engineer and, if applicable, the Federal Highway Administration.

**REFINING VERTICAL ALIGNMENT**

Vertical alignment is to be reviewed at this stage for possible revisions resulting from data received under Section 2B-1 such as: soil data (compaction factors, etc.) indicating the need to raise or lower grades for earthwork balances, major utility facilities, hydraulic requirements and considerations such as raising grades to obtain adequate cover for drainage structures and vertical clearances for various grade separations. Vertical alignment must remain within acceptable limits as prescribed in the Geometric Design Standards (See Appendix A, Section A-1) unless an authorized exception is made by the State Location and Design Engineer and, if applicable, the Federal Highway Administration.

## PERMIT DETERMINATION

The designer shall submit Form LD-252 to the Environmental Engineer with appropriate data. The Environmental Division will review the project and determine what type of water related permits may be required. (See Appendix C, Section C-4).

## COORDINATION WITH OTHER DIVISIONS AND AGENCIES

After refinements as outlined in this section are made, the location of the plans is to be furnished to division and agencies that have been involved up to this point. For example, furnishing plan locations allows the Environmental Division to resolve as many problems as possible at this stage (archaeological sites, etc.) and the Local Assistance Division, on applicable projects, to coordinate with city or town representatives.

# SECTION 2B – 4 - REQUEST FOR ENVIRONMENTAL EVALUATION

## REQUEST FOR APPROPRIATE ENVIRONMENTAL DOCUMENT

When preliminary plans are complete, the Environmental Division should be requested (Form LD-252) to prepare an appropriate environmental document. This memorandum should contain a brief description of the corridor or corridors to be presented at the public hearing and the approximate date of the public hearing. Copies of this memorandum should go to the District Administrator and Resident Engineer and other affected divisions within the Department. This is the point at which an official environmental document is requested; however, the Environmental Division is involved in environmental evaluations earlier in the location studies (See Section 2B-1).

## DATA TO BE SUBMITTED

Prints of the corridor/s under consideration and copies of pertinent correspondence for each corridor should accompany the request for the preparation of an environmental document. Costs will be figured after the request, and furnished prior to the completion of the document. In addition, it is desirable that the designer and the Environmental Team leader assigned the project meet in order to review the data submitted and assure a complete understanding of the various aspects of the project. Contact should also be made with the Public Involvement Section to discuss visual aids, statements, brochures and a public involvement program. Traffic data is requested from the Transportation and Mobility Planning Division by Environmental Division.

## SECTION 2B – 5 - COST ESTIMATES

### DETERMINING CONSTRUCTION QUANTITIES

Approximate construction quantities are computed at this stage for use in preparing preliminary cost estimates for the corridor/s remaining under consideration.

Upon receipt of the requested soils data, earthwork quantities (regular excavation, borrow or embankment) are computed by the cross-section average end area method using the recommendations made by the Materials Division in regard to shrinkage, swell, unsuitable materials and side slopes. When the most practical balance of earthwork quantities has been obtained, plans are to be prepared showing construction limits and proposed right of way for requesting right of way and utility estimates. These estimates are to be requested as soon as possible in order to allow sufficient time for their completion while other parts of the estimates are being prepared.

Pavement Quantities are computed from the preliminary design requested in Section 2B-1. Drainage items are estimated after preliminary review of the drainage areas, site conditions and other related factors. The Drainage Manual prepared by the Hydraulics Section is to by utilized. Any suggestions previously made by the Hydraulics Section concerning structure size and location are to be incorporated into the estimates. In some instances, especially on large structures, a request is to be made for study/opinion as to the most satisfactory solution.

Other standard items are to be reviewed and shown, if applicable, in accordance with the Road and Bridge Standards, Instructional and Informational Memoranda, and the Road and Bridge Specifications. In the event that an unusual or unique situation arises, a request is to be made to the Standards/Special Design Section for preliminary design and cost.

At each milestone before R/W in the development process, the Project Cost Estimating System (PCES) is to be used to generate an estimate for construction and preliminary engineering.

### REQUEST FOR COST ESTIMATES FROM OTHER DIVISIONS

Right of way, utility, relocation advisory assistance, and effect on the local tax base estimates and reports are to be requested on Form LD-419 or by memorandum, depending on the situation. This request is to contain the type access anticipated, a summary of the breakdown required and other information deemed important. Three copies of the proposed method/methods of development are to accompany all requests for R/W information. Request for cost estimates for items such as traffic sign illumination, signals, bridges, etc., required from other divisions, are to be requested on Form LD-419 or by memorandum. A copy of the proposed method or methods, of development is to accompany this request, if available. The Local Assistance Division makes all contacts with municipalities in urban funded projects.

## COST ESTIMATES

Cost estimates for Preliminary Engineering (P.E.), Right of Way (R/W) and Construction (Const.) are to be prepared on all plans of development necessary to advance to Preliminary Field Inspection stage. The estimates are to be submitted to the Programming Division for the allocation of funds and entered into the PPMS system within ten days, in accordance with the PPMS manual. (See IIM-LD-183)

The Project Manager reviews estimates (Preliminary Engineering and Construction) in PPMS at Scoping, Public Hearing, Field Inspection, Right of Way and Construction Stages, as well as at 90-day intervals between these milestones, for accuracy. If a project is significantly modified between these stages, the estimate must be adjusted and entered into PPMS and CES.

ALL Engineers' Estimates (Preliminary Engineering and Construction) will be reviewed by the Project Manager and updated, if necessary, for use by the Programming Division and Local Assistance Division in preparing the SYIP. At this time it is imperative that ALL estimates be reviewed for accuracy before incorporation into the new SYIP.

## SECTION 2B – 6 - CONSTRUCTABILITY QUALITY REVIEW

### CONSTRUCTABILITY

Constructability review is defined as the review of plans, specifications, and contract documents from a construction perspective to assure the documents propose an operation that is efficient, cost effective, and buildable. Its emphasis is primarily focused on “how” the documents propose the operation to be built and not on ”what” gets built.

AASHTO defines constructability review as “a process that utilizes construction personnel with extensive construction knowledge early in the design stages of projects to ensure that the projects are buildable, while also being cost-effective, biddable, and maintainable”.

This analysis is normally performed at the Preliminary Field Inspection, Public Hearing, Field Inspection and Pre-Advertisement stage of plan development. Additional reviews can be performed as needed when the plans are further developed.

The constructability review includes the report of findings, a completed checklist, and cost savings report. This report is a detailed tabulation of any anticipated savings identified during the review.

# SECTION 2B – 7 - THE PRELIMINARY FIELD INSPECTION

## PURPOSE

Preliminary Field Inspections (where necessary) are held to obtain consensus from the District Offices, Municipalities and other affected agencies and Divisions represented concerning items of major importance such as the location or the method of development, median widths, minimum right of way width, typical section geometrics, horizontal and vertical controls, hydrologic and environmental effects, right of way impacts, sight distances, bridges, utilities, need for bicycle facility, etc. It is not intended that minor items, such as exact pipe locations, exact balance of quantities, turning radii, etc., be reviewed and discussed.

## SCHEDULING THE PRELIMINARY FIELD INSPECTION

After the proposed method of development has been completed the Project Manager, or a representative, is requested to schedule the Preliminary Field Inspection. On Local Assistance Division projects, the Local Assistance Division makes this request, after being advised that preparations for the review have been completed. The Preliminary Field Inspection is to be scheduled far enough in advance to allow for proper distribution and review of the prints.

## AVAILABILITY OF PLANS

The availability of plans is to be made in accordance with instructions contained in IIM LD-68 and Form LD-320. A notice of the availability of the plans should be made two weeks in advance of the Preliminary Field Inspection.

## ITEMS TO BE REVIEWED

The proposed scheme of development is to be reviewed in its entirety, starting with the typical section. Items listed above, under PURPOSE, should be discussed, in addition to any other significant items relative to the project. Questions, comments, and recommendations from other divisions are to be considered and discussed. Certain items, such as entrance locations on urban projects, may require a separate review at a later date by appropriate personnel.

## REVIEWING THE PROPOSED METHOD OF DEVELOPMENT

All Preliminary Field Inspections are to be conducted by the Project Manager, or a representative, who may request that the Engineer who prepared the scheme of development make the presentation. On Urban projects, the Project Manager or the Engineer who prepared the method of development and/or a representative from the Local Assistance Division may make the presentation.

## PREPARATION OF INSPECTION REPORT

A report to the Project Manager, or to the file, is to be written immediately after the Preliminary Field Inspection outlining items discussed. A similar report is generally received from the District Administrator. Those disagreeing with the conclusions reached at the PFI may also file reports outlining their disagreement. On Secondary Projects, Form LD-430 must be completed and transmitted to the Local Assistance Division.

## INCORPORATING CHANGES INTO PLANS

When sufficient time has elapsed to allow those who wish to file a report concerning the Preliminary Field Inspection, the recommendations agreed upon are to be incorporated into the plans. If a difference of opinion exists, the State Location Design Engineer is to be consulted for a decision. On Urban Projects, the Local Assistance Division Director is to be consulted also.

## PREPARATION OF PROJECT COST ESTIMATE AND REPORT

Construction cost estimates are received from other divisions as noted in Section 2B-5-REQUEST FOR COST ESTIMATES FROM OTHER DIVISIONS (Form LD-297). Right of Way and Utility Estimates are then added to the construction estimate to complete the estimate of project costs. These costs are placed in the Project Cost Estimating System.

## INCORPORATING CHANGES INTO PLANS

When sufficient time has elapsed to allow those who wish to file a report concerning the Preliminary Field Inspection, the recommendations agreed upon are to be incorporated into the plans. If a difference of opinion exists, the State Location Design Engineer is to be consulted for a decision. On Urban Projects, the Local Assistance Division Director is to be consulted also.

# SECTION 2B – 8 - VALUE ENGINEERING

## VALUE ENGINEERING (VE)

Value Engineering is defined as the systematic application of recognized analysis techniques by a multi-disciplined team that:

- Identifies the function of a product or service.
- Establishes a worth for that function.
- Generates alternatives through the use of creative thinking.
- Provides the necessary functions at the lowest overall cost.
- Develops recommendations as a result of the job plan followed during a review.

Value Engineering is required on any project regardless of highway classification with a total construction cost of more than $5 million.

Upon receipt of the Initial Field Review and Scoping Report, the Value Engineering Section of the Scheduling and Contracts Division will review and submit the project to the Value Engineering Advisory Committee for their consideration as a VE review candidate.

The Value Engineering Section will assemble the required review team and conduct the review in accordance with Concurrent Engineering Process scheduling. On major/complex projects a second study will be conducted at approximately the 50% stage of development.

A copy of the Field Inspection notification is to be sent to the Scheduling and Contracts Division by the Project Manager advising of the pending Field Inspection.

**Prior to the review, the VE coordinator will send a letter to the Project Manager outlining the materials necessary for the review.**

The Value Engineering Team shall review the project to determine if any significant savings cost avoidance and/or quality improvements can be achieved by providing the required service or necessary function at the lowest overall cost.

In all instances, the required service or necessary function will be achieved at the lowest possible life-cycle cost consistent with requirements for performance, maintenance, safety, and aesthetics.

The analysis is to be performed promptly by the team and is to provide the appropriate Administrator, including the Resident Engineer and appropriate Assistant L & D Engineer, with the team's recommendations.

The Location and Design Engineer will review the Team's recommendations along with those from the District Administrator and the Division Administrators and determine the implementation potential of the Value Engineering proposals.

The Project Manager will verify that accepted VE recommendations have been incorporated into the project by initialing the accepted recommendation on a copy of the Chief Engineer's Response Letter/Project Summary Information Form and forward it to the VE Regional Coordinator.

Any savings should be noted on Form LD-404 (Final Scoping Certification).

## CHAPTER 2C - PRELIMINARY DESIGN

### SECTION 2C - 1 - PROJECT REVIEW



### SECTION 2C - 2 - COORDINATING TIME SCHEDULES



### SECTION 2C – 3 - REVIEW OF DATA / SETTING UP FILES



### SECTION 2C – 4 - PROJECT ASSIGNMENT AND FIELD RECONNAISSANCE



### SECTION 2C – 5 - PREPARATION OF PLAN AND PROFILE SHEETS

# CHAPTER 2C - PRELIMINARY DESIGN

## SECTION 2C - 1 - PROJECT REVIEW

### GENERAL

When the time arrives for presenting a project to the public through the public hearing process, it is the designer's responsibility to review the plans and supporting data to assure that it is current and representative of the section of roadway concerned. Such items include any change in topography, traffic counts or traffic data, project funding and a reassessment as to the actual need and scope of the project.

# SECTION 2C - 2 - COORDINATING TIME SCHEDULES

## REVIEW OF WORK LOAD

Upon receipt of a project, the appropriate Assistant Location and Design Engineer or District Location and Design Engineer, will review the work load of the design units and assign work accordingly.

The designer is to review the parameters of the project's classification, size and geographic location as shown on the report from the Program/Project Management System. The correct alignment length and elements of work should be reviewed for correctness. Any changes should be initiated by submitting Form LD-322 to the Human Resources Manager.

## ESTABLISHING PRIORITIES

The Location and Design Transportation Engineer Senior, along with the Location and Design Transportation Engineer will review the tentative schedules available and establish a priority for the work.

# SECTION 2C – 3 - REVIEW OF DATA / SETTING UP FILES

## REVIEW OF CORRESPONDENCE

All correspondence received with the project is to be carefully reviewed and checked for completeness.

## SETTING UP A CORRESPONDENCE FILE

All correspondence is to be kept in a general file which is conveniently segregated. These files are assigned a permanent location for the life of the project.

## REVIEWING AND SETTING UP A ROUTE FILE

All survey data, prints of plans and other related data are to be reviewed by the designer, clearly labeled, and filed appropriately. The route file should be checked periodically to remove data no longer required. This must be done with extreme caution, however, to assure that necessary data are not destroyed.

## SETTING UP PLAN FILE

A plan file is set up for original plans, depicting the original design as received from preliminary engineering.

## SECTION 2C – 4 - PROJECT ASSIGNMENT AND FIELD RECONNAISSANCE

### PROJECT ASSIGNMENT

Upon receipt of the survey data, and in accordance with the current schedules, the State Location and Design Engineer, or a representative, will request that the design unit, in either the Central Office or the district to which the project has been assigned, prepare the preliminary design. Assignments will be made on the basis of projected available manpower statewide and expertise in the particular type of design. Generally, secondary projects will be designed in the particular district where the project lies, unless the work load in that district dictates otherwise.

### HYDRAULICS COORDINATION

The Central Office Hydraulics Section will provide technical assistance, training and limited technical supervision to the District Hydraulics Sections. The Central Office management staff will visit the District Office staffs periodically to discuss general operational procedures and technical issues and assist in the resolution of specific technical problems. The Central Office staff will review the engineering design and documentation of randomly selected projects completed by the District staffs to ensure conformity to standard policies and procedures and to ensure statewide continuity. The Central Office Hydraulics staff will provide technical training for the District Hydraulics staffs on an as needed basis.

### PROJECT MANAGEMENT

The design unit responsible for design shall review the parameters of the project's classification, size and geographic location as shown on the report for the Program Project Management System. The correct alignment length, project numbers and elements of work shall be reviewed for corrections.

In order to identify early, any potential problem that may develop in meeting advertisement dates, the State Location and Design Engineer has selected a Central Office District Coordinator to ensure that the advertisement schedule is carried out as planned. The State Location and Design Engineer, in conjunction with the District Administrator, will conduct semi-annual manpower assessments of the design functions utilizing the Location and Design Division's manpower planning system. In the event any problem in the procedures outlined above cannot be resolved, the problem will be resolved by the State Location and Design Engineer and the District Administrator. If the problem cannot be resolved at this level, it will be referred to the Chief Engineer.

## FIELD RECONNAISSANCE

Field reconnaissance procedures (See Section 2A-5) are to be followed on projects received for initial development. Projects, which have been through the Location Public Hearing process, should generally follow these same procedures depending upon the elapsed time between the hearing and receipt of the survey.

# SECTION 2C – 5 - PREPARATION OF PLAN AND PROFILE SHEETS

## DRAFTING

All drafting will be accomplished in accordance with the CADD Users Guide. Care must be taken by the engineering technician to clearly distinguish items. Items of great importance should stand out over those of lesser importance. A proposed drainage structure should readily be obvious as to its location by plotting the structure to scale, clearly showing construction baseline stationing and clearly showing the skew, if any, the flow arrow and the description. It is important that the complete description of the existing structure not be obliterated by the proposed information. Where items of this nature conflict with proposed items, it is most important that the information be moved to a suitable location where it can be readily distinguished. Therefore, the need for legibility, clarity and neatness cannot be over emphasized.

## IDENTIFICATION

The first items to be shown on plan sheets are the applicable project numbers in blocks in the upper and lower right corners of the plan and profile sheets. The supervisor's and designer's name and phone number, including area code, and District if applicable, is to be shown in the upper left corner of the border.

## NUMBERING

Plan sheets are to be consecutively numbered beginning with "3". Match sheets for connection extensions, etc., are to be numbered "3B", etc., with the number corresponding to the applicable mainline plan sheet and the letter "A" reserved for the mainline profile sheets.

## LAYOUT

Interstate, Arterial, Primary and Secondary plans are normally plotted on a scale of 1:500 Metric (1"=50' Imperial). Urban projects or other complex projects are to be plotted on a scale of 1:250 Metric (1"=25' Imperial). Plan sheets must be laid out with mainline stations increasing from left to right on the plan sheet. Anticipated proposed construction should be as near vertically centered as practicable, considering interchanges, connections, drainage, etc., with 750 mm (28-inch) lengths along the construction baseline for the proposed highway, except where equalities occur (see Plan Equalities this section). Plan sheets are to be spaced longitudinally in order to show intersections entirely on one sheet where feasible and as much as possible of interchanges. A reasonable space, approximately 400 mm (16 inches) if feasible, is to be allowed at the beginning of the first plan sheet and at the end for the last plan sheet for possible extensions.

## SURVEY BASELINE

All survey baselines are to be shown in accordance with CADD Standards. Circles are to be shown at each T.S., S.C., C.S., S.T., (P.C., P.I., P.T.- Imperial Projects) and intersections of two or more survey lines, having these points as the center. Station marks are to be shown at 20 meter (100 foot)-Rural, and 10 meter (50-foot)-Urban intervals, perpendicular to the survey baseline and extending approximately 3 mm ($^{1}/_{10}$ inch) left and right. The 100 meter (500 feet) station marks are to be labeled with the station number equal distances to the left and at a distance adequate to clear anticipated proposed right of way. The last digit of the intermediate station is to be shown close to the station marks. (Imperial only)

## MATCH LINES

Match lines are to be shown perpendicular to the construction baseline and noted at even construction stations at the beginning and end of each applicable plan sheet and at necessary points on connection and traverse baselines.

## BEARINGS

Bearings are to be shown on each tangent or sub tangent segment on each plan sheet. If a tangent line extends for over half the length of the plan sheet, the bearing should be shown twice at equal intervals. Bearings should be shown so as not to conflict with station marks.

## CURVE DATA

T.S.'s, S.C.'s C.S.'s, and S.T.'s (P.C.'s and P.T.'s - Imperial Projects) are to be labeled along lines projecting from these points toward the center of the curve at a distance from the baseline adequate to clear anticipated proposed items and topography. P.R.C. lines may be projected toward either curve center point. Labeling is to be at an adequate distance from the baseline to clear anticipated proposed items and topography. Remaining curve data (degree; tangent; length; radius; curve stations) are to be shown on the inside of the curve, centered longitudinally and lettered along imaginary lines parallel to a line that would be tangent to the mid point of the curve. This data is to be shown as closely to the baseline as practicable, but beyond anticipated proposed items and topography. Complete curve data is to be shown on each sheet on which any portion of the curve appears. Curve data, including stations may, if necessary due to congestion, be located in other appropriate areas of the plan sheet. In these cases, the curve itself and the data are to be identified with a number ("1","2","3", etc.) inside a 6 mm (¼ inch) circle for existing and 8 mm ($^{5}/_{16}$ inch) circle for proposed curve data.

## REFERENCE POINTS

Reference points are contained on a survey data sheet (containing the project's horizontal survey alignment), which is furnished by the survey processing unit.

## NORTH ARROW

A North Arrow is to be shown on each plan sheet in a conspicuous location.

## SCALE

A bar scale is to be shown in the lower right corner of each plan sheet.

## TOPOGRAPHY

All existing topography provided by the electronic data collector is to be accurately plotted on the plans. Care must be exercised in turning right angles from the baseline in plotting items by station plus and distance. Any angles used for plotting purposes are to be turned by tangent offsets. Station pluses and distances are to be shown on the plans for items of great importance (such as property corners, iron pins, etc.) In critical areas, distances only are shown to other items of topography (such as the closest corner of buildings in critical areas are to be shown similarly. All existing drainage structures are to be shown similarly. All existing drainage structures are to be plotted to scale and noted with all available information such as size, materials, invert elevations, etc. Flow arrows are to be shown for all labeled, generally perpendicular to the baseline. An effort must be made to keep this lettering close enough to the item to readily identify it, but beyond anticipated proposed items.

## UTILITIES

All available existing utility information is to be shown on the plans. Overhead utility lines, except for high voltage transmission lines, are not to be shown. It is extremely important that all invert and rim elevations for sanitary sewer manholes (SMH) be shown. A note is to be shown in the upper left corner of the plan sheet listing owners of each utility shown on that sheet. The designation for all underground utilities should be shown frequently on the plans to easily identify the type of underground utility. At connecting roadways or other points where gravity sanitary sewer facilities leave the project corridor, it is essential to show the next manhole with its elevations.

## RIGHT OF WAY

All existing right of way acquired in fee will be shown on plans as established by the survey information or other data. The plans should not designate prescriptive or statutory right of way as existing right of way. It is not necessary to show entire property boundaries on plans. Property lines and lot lines are to be plotted from the information provided by the Electronic Data Collector, property data, and in conjunction with separately drawn plats as furnished with other survey information. All available information is to be shown on the plans in this respect (bearings, distances, lot numbers, all data used for plotting, etc.). This information is to be individually labeled, whether "survey" or "plat" information. Property line symbols are to be shown on all property lines. Property owners' names are to be shown in conspicuous locations within each applicable property, along with deed book numbers, page numbers, and total acreages. Distances, bearings and curve information (metes and bounds) are to be shown for the entire periphery of take on all properties owned by U.S. and state agencies; National Forests; Railroads and Power Companies.

## ROAD AND STREET NAMES

Road and street names are to be shown on plans and in correspondence in addition to route numbers. The name is to be shown below the route number block in the upper right hand corner of all plan sheets and, if feasible, the name is to appear within the roadway limits.

Otherwise, the name is to be shown on the plan sheet in close proximity to the road or street. This procedure is of particular value to field personnel and area residents who can more easily identify existing thoroughfares by road or street names rather than by route numbers. Individual lot numbers, where assigned, are to be shown in cities, towns and built-up areas. If lot numbers have not been assigned, the block numbers should be prominently shown. Lot numbers should be shown within the limits of the building, if possible. If not, they should be shown as close to the buildings as practicable.

## PLAN EQUALITIES

An equality in length can be described as a point on a line having a different back and ahead station. Stations along the portion of the line approaching the equality relate to the back station at the equality. An equality symbol is to be shown for each plan equality. Stations along the portion of the line beyond the equality relate to the ahead station at the equality. Where equalities in bearings are necessary, the station of the joining point of the two line segments to be shown with the bearing of the back segment equal to the bearing of the ahead segment. Plan equalities are not to be placed within proposed bridge limits.

## SITE PLANS

Site plans for developments to be constructed during the plan development process will not be shown on roadway plans until the development construction is complete and the site has been surveyed in the field.

## PLOTTING OF PROFILE SHEETS

Profile sheets are to be plotted at this stage using the base sheet available from the Automated Engineering Section and in accordance with the following:

## IDENTIFICATION OF ITEMS ON THE PROFILE SHEETS

The first items to be shown on the profile sheets are the applicable project numbers in the preprinted blocks. Supervisor's and Designer's name and phone number (including area code) and District if applicable, is to be shown in the left border.

## NUMBERING OF PROFILE SHEETS

Profile sheets are to be consecutively numbered beginning with "3A", with the numerical digit corresponding to the applicable plan sheet. Profile sheets for connections, ramps, etc., are to be appropriately numbered and lettered with numerical digit corresponding to the mainline plan sheet.

## PROFILES

Stationing of profiles is to match the station of the applicable plan sheet. Station numbers are to be shown in the space provided immediately below the ruled portion of the sheet. 100 meter (500 feet) stations and the first and the last stations on all sheets are to be shown in their entirety. Only the last digits of other stations are to be shown. Applicable elevation data information is to be shown in the upper left corner of the first profile sheet. Normally, the vertical scale of the profile sheet is 1:100-Rural (1"=0' Imperial), 1:50-Urban (1"=5' Imperial). Elevations are to be shown in the spaces provided both left and right at 2 meter (10-foot) intervals on the heavy ruled lines. Elevations are to be shown to encompass the high and low extremities of the profile line. The profile line is to be centered vertically as nearly as practicable; allowing space at the bottom of the sheet for proposed finished grade elevations. A profile line of the existing terrain is required for each construction baseline shown on the plans. Existing terrain profiles for survey baselines are to be shown where deemed appropriate by the designer. Profile lines are to be plotted at appropriate intervals, whether or not a cross section is taken at the particular plus or not, except for drainage sections reflecting flow line elevations, which are not to be shown on the plans. Profile lines are to be plotted as a solid line with straight segments connecting the plotted points. Connection route numbers, street names, railroads, etc. are to be labeled at appropriate stations along the mainline profile. Where individual profile sheets are required for connections, etc., the connection route number and street name is to be clearly shown in the upper right corner of the sheet.

In order to provide water level information on the highway plans that is complementary to other project documentation, only the following data are to be shown on the profile sheets when the project crosses or parallels a waterway:

1) Ordinary High Water is to be shown in lieu of normal water on non-tidal stream crossings. Normal water elevations provided by field survey will not be shown. The ordinary high water elevation will be supplied by the appropriate drainage engineer.

(2) Mean high tide and mean low tide will be shown on all tidal stream crossings. These elevations will be supplied by the appropriate drainage engineer. The tidal data provided by field survey or other source will not be shown.

(3) The maximum historical high water elevation will be shown for all stream crossings where such data is available. The plan designation shall read high water elevation, date of occurrence, flood frequency if known, e.g., High Water Elevation 141.8 m (465.3') August 1940, 50 year ± flood. The flood frequency will be determined by the appropriate drainage engineer.

**BENCH MARKS AND PERMANENT TURNING POINTS**

All benchmarks and permanent turning points, as shown in the survey level book or in the data collector, are to be shown on the survey data sheet. All survey processing units have the facilities to develop the survey data sheet. All survey plan assemblies will include the sheet(s).

**PROFILE EQUALITIES**

See "Plan Equalities" previously covered in this section. The profile equality is shown by vertical lines plotted at the actual back and ahead stations, with the approaching profile line tying to the back station and the leaving line tying to the ahead station. The equality lines are to be labeled with the complete back and ahead stations. No symbol is shown for the profile equality.

## SECTION 2C – 6 - DEPICTING TENTATIVE DESIGN ON PLANS

### PREDETERMINED DESIGN

On projects on which a location public hearing has been held, preliminary design is to be shown on the plans along with any necessary adjustments needed to conform with the current Road and Bridge Standards or necessary development. Items in Sections 2B-1 and 2B-2 should be reviewed and updated if necessary.

### INITIAL DESIGN

Projects without prior horizontal and vertical design are to be studied in accordance with instructions in Sections 2A-6, 2B-1 and 2B-2. The substitution of "plan of development " for the word "corridor" will render these sections applicable for this phase of the project.

### FRONTAGE ROAD (SERVICE ROAD)

On surveys where limited access is proposed or anticipated, properties that will be landlocked due to the control of access are to be noted on the survey roll, on the data collector, in the data file, or in the survey books. A comprehensive study is required to determine if it is in the public interest to construct a frontage road, having determined the estimated construction cost, which is to include any additional right of way and anticipated maintenance cost. This cost is then to be compared with the estimated damages that would be paid if access were not provided to the landlocked property to determine justification.

On the Interstate system, where service roads are parallel to, or visible from the roadway, the Interstate slope design is to be used, except where the cost would be excessive or where it would not be practical, such as in mountainous terrain.

After preliminary scheme(s) and grades have been developed, submit prints to the Traffic Engineer to obtain the design year traffic volumes, and to the Materials Engineer, requesting preliminary pavement design. Also submit two (2) sets of prints to the Right of Way Engineer, requesting that he furnish the Frontage Road Study Form CE7.

After receipt of information, the design is to be finalized to the extent necessary to determine justification to construct. The construction estimate, including additional right of way (see Form CE7) and maintenance (annual cost per kilometer (mile) x length x 2) is to be compared to the damage figure shown in column 5, Form CE7. Since the annual cost per kilometer (mile) for maintenance will vary from county to county and year to year, the Maintenance Division is to be consulted. To arrive at the maintenance cost, the annual cost per kilometer (mile) x length is doubled in consideration of two treatments within 10 years.

Projects with Federal Highway Administration participation require concurrence prior to construction. A set of prints transmitted by letter stating the estimated cost, accompanied by a copy of Form CE7 is to be submitted requesting approval. A copy of this request is to be retained in the project file.

Whenever a service road or other road, which is to be maintained by others, is to be constructed in a municipality or in the two counties, which maintain their own networks, the construction is to conform to the requirements, both structural and geometrical, of the particular city or county. Full Federal Highway Administration approval is also to be obtained for this work and the design should be an integral part of the plans from the earliest stage.

## CAPACITY ANALYSIS

If the project has been through the location study stage, the capacity stage checks previously documented should be reviewed and updated if necessary.

For projects that have not been through this stage, the capacity analysis as indicated in Section 2B-2 should be performed.

In addition, the designer should now proceed with the following:

Major at-grade intersection capacity checks:

1. Overall intersection level of service.
2. Level of service for each approach.
3. Number and length of turning lanes.
4. Pedestrian and bicycle influence.

Interchange capacity checks:

1. Basic ramp level of service.
2. Ramp termini level of service.
3. Entrance - exit levels of service.
4. Weave - merge lengths and widths.
5. Acceleration - deceleration lane lengths.

All capacity checks accomplished during this phase should be reviewed with the Mobility Management Division and the Transportation and Mobility Planning Division and documented in project files.

## SECTION 2C – 7 - SOLICITING COMMENTS WITHIN DIVISION AND COMPLETING DESIGN

### SOLICITING COMMENTS WITHIN DIVISION

In order that all disciplines within the Location and Design Division are given an opportunity to provide input into the total design, plans are made available through Falcon, for review prior to Preliminary Field Inspection. The Hydraulics Section must review the preliminary design plans at this stage and furnish recommendations, comments, and questions relative to drainage that are pertinent to the Preliminary Field Inspection and the resolution of a proper design. The appropriate design section must review the design for conformity to current Road and Bridge Standards and make recommendations concerning the design features shown.

### INCORPORATING COMMENTS INTO DESIGN

Upon receipt of comments, questions and recommendations, they are to be reviewed and a common solution determined and shown as the Division's proposals on the preliminary design scheme of development. Should time not permit the resolution of these matters, they are to be discussed at the Preliminary Field Inspection. In any event, the Preliminary Field Inspection is to consider all input that could lead to the most feasible scheme of development.

## CHAPTER 2D - PLAN DESIGN

### SECTION 2D – 1 - PROJECT REVIEW



### SECTION 2D – 2 - PREPARATION OF STUDY REPORTS AND INFORMATIONAL BROCHURES



### SECTION 2D – 3 - PREPARATION AND PROCESSING OF PUBLIC HEARING DATA



### SECTION 2D – 4 – PRE - PUBLIC HEARING MEETINGS



### SECTION 2D – 5 - NOTICE OF WILLINGNESS TO HOLD A PUBLIC HEARING



### SECTION 2D- 6 SCHEDULING THE PUBLIC HEARING



### SECTION 2D-7 PREPARATION OF ENGINEERING COMMENTARY

**SECTION 2D - 8 - CAPACITY ANALYSIS - PLAN IDENTIFICATION - ALIGNMENT AND GRADES**



**SECTION 2D - 9 - CROSS SECTIONS AND EARTHWORK QUANTITIES**



**SECTION 2D – 10 - PAVEMENT, ENTRANCES, PROJECT LIMITS**



**SECTION 2D – 11 - REQUEST FOR SUPPLEMENTAL DATA**



**SECTION 2D – 12 - CONSTRUCTABILITY QUALITY REVIEW**

**SECTION 2D – 13 - CONDUCTING THE PUBLIC HEARING**



**SECTION 2D – 14 - RESOLUTION OF PUBLIC HEARING QUESTIONS**



**SECTION 2D-15 PROJECT APPROVAL**



**LIST OF FIGURES**

# CHAPTER 2D - PLAN DESIGN

## SECTION 2D – 1 - PROJECT REVIEW

### GENERAL

When the time arrives for presenting a project to the public through the public hearing process, it is the designer's responsibility to review the plans and supporting data to assure that it is current and representative of the section of roadway concerned. Such items include any change in topography, traffic counts or traffic data, project funding and a reassessment as to the actual need and scope of the project.

# SECTION 2D – 2 - PREPARATION OF STUDY REPORTS AND INFORMATIONAL BROCHURES

## RESPONSIBILITY

The Location and Design Division will prepare study reports for all projects being prepared for Design Public Hearings. Combined Location and Design Public Hearings require informational brochures only, since the environmental document will satisfy the requirements of a study report, or in case of categorical exclusion, the requirement of a study report is waived. Study reports and informational brochures for Urban projects are to be prepared by the Local Assistance Division. Design study reports and informational brochures for Secondary projects are to be prepared by the designer.

## PURPOSE OF REPORT OR BROCHURE

Informational brochures and study reports are to be prepared in accordance with the Public Involvement Policy Manual. Such reports are to assist interested citizens in familiarizing themselves with various aspects of the project. They should be prepared in a professional manner, but remain easily understood by the layperson.

## REVIEW OF DRAFT ENVIRONMENTAL DOCUMENT

The draft environmental document must be completed prior to this stage, as certain data from this document must be included in the study report or informational brochure. It is essential that data in all publications be consistent with that shown on plans. Close coordination with other divisions and agencies is most important at this time.

## CONTENTS

Generally, the informational brochure and study report should contain, as a minimum, the following information:

(1) A general description of the highway system in the area

(2) Project description and length

(3) Design criteria, typical section, traffic data and costs

(4) Summary of environmental considerations

(5) On state funded projects, it may be required to consult the Environmental Division to determine if an air and noise study will be required

(6) Project Schedule

(7) Any other related information

A breakdown of project cost responsibility is to be included on Urban projects. Each project must be considered on an individual basis and the amount of detail and documentation will depend on whether the project has been classified as a major or minor action regarding Federal requirements. Informational brochures or study reports must be reviewed by the Public Involvement Section.

# SECTION 2D – 3 - PREPARATION AND PROCESSING OF PUBLIC HEARING DATA

## RESPONSIBILITY OF THE PUBLIC INVOLVEMENT SECTION

The Public Involvement Section is responsible for the processing and distribution of all public hearing data. The location site of the public hearing should be identified on this map if possible. It is also responsible for reviewing and assisting in the preparation and coordination of statements and visual aids for presentation and display at public hearing and meetings.

## URBAN AND SECONDARY PROJECTS

On applicable projects, the Local Assistance Division work closely with the Public Involvement Section in the processing of the aforementioned data.

## DATA REQUIRED FROM DESIGNER

In order to properly fulfill their responsibilities, the Public Involvement Section is to be provided certain data by the project designer, project manager, District Coordination Unit, or Consultant Services Section. All necessary data is to be furnished at least sixty days prior to the scheduled hearing date.

The designer should consult with the moderator of the public hearing and determine what materials will be required to properly present the project to the public. Depending on the complexity of the project, this data may vary from a simple plan layout to a presentation including slides, photographs, perspective drawings, models and other items to serve as aids for public understanding. The more complex displays may require up to 120 days to prepare.

After the needs have been determined, prints of plans and other necessary data are to be provided to the Public Involvement Section for their use in preparing display materials. The designer should also contact the District Administrator and other appropriate persons to determine if there are any special interest groups that require notification of the upcoming public hearing. This information is to be relayed to the Public Involvement Section.

The original study report or informational brochure is to be provided to the Public Involvement Section. This is to be accomplished by the Local Assistance Division on applicable projects. The Public Involvement Section is responsible for the distribution of all necessary materials to the District Administrators' and Resident Engineers' offices and other locations specified in the public hearing notice at the time the notices are posted.

# SECTION 2D – 4 – PRE - PUBLIC HEARING MEETINGS

## THE PRE-HEARING MEETING

Prior to a scheduled hearing, it may be desirable to hold an open forum meeting. These open forum meetings will permit the public to review and discuss with Department and Municipal (or other) engineers and officials, particular points of concern to them and to become generally familiar with the project to be presented. Mosaics, typical sections and other displays to be presented at the public hearing should be available at this meeting, along with unapproved detailed plans.

A properly conducted pre-hearing meeting may eliminate a great number of questions which would otherwise be asked at the formal hearing and will convey a sense of mutual concern between the Department and the public. As many public hearings are held at night, a period of approximately two hours prior to the formal hearing should normally be provided for this discussion prior to the formal hearing.

If sufficient interest is anticipated, consideration should be given to holding the pre-hearing meeting on the night preceding the hearing; or, if the projects are controversial or of great magnitude, consideration should be given to holding one or more meetings approximately a week in advance of the formal hearing.

# SECTION 2D – 5 - NOTICE OF WILLINGNESS TO HOLD A PUBLIC HEARING

## RESPONSIBILITY

Requirements for a public hearing may be satisfied by a well-publicized notice of willingness to hold a public hearing. An opportunity to review the project plans and other information is given in this procedure. A public hearing is held if a written request is made and contact by VDOT cannot resolve questions.

Willingness to hold a public hearing may be posted on most Federal-Aid Secondary projects and some Federal-Aid Primary, Urban, and Interstate projects. Responsibility for initiation of the process is vested in the Local Assistance Division for Secondary and Urban Projects, and Location and Design Division for all other projects.

## PROCEDURES

Until the Notice of Willingness to hold a public hearing expires, it must be assumed that a hearing will be required. The Department must have sufficient plans, maps and other information concerning the proposed project available for public review in the District and Residency offices. If a public hearing is requested, a study report or informational brochure (as well as other necessary displays such as mosaics) will be prepared for use at the hearing.

## PUBLISHING NOTICE OF WILLINGNESS TO HOLD A PUBLIC HEARING

The Public Involvement Section, upon receipt of all the required data, will prepare the public notice and arrange for proper advertisement of the Department's willingness to hold a public hearing. The notice is to be published subsequent to the preparation of the appropriate environmental document on Federal-Aid projects.

## NO REQUEST FOR PUBLIC HEARING

If no requests for a public hearing are received within the time limit given in the notice, a hearing is not required and the public hearing requirements are then considered to be satisfied.

The District Location & Design Engineer will write a memorandum to the appropriate Assistant Location and Design Engineer requesting approval with the following statement at the bottom of the letter for approval signature:

"Approval is hereby given to the Location and Major Design Features for this project."

By: ______________________________________
Assistant Location and Design Engineer

A copy will be sent to the Environmental Engineer, who will then prepare the Final Environmental Document.

Approvals for Secondary and Urban funded projects are the responsibility of the Programming Division.

Following approval of location and major design features and the FHWA approval of the Final Environmental Document, the project may be advanced to the right of way stage.

**REQUEST FOR PUBLIC HEARING**

In some instances, a request for a public hearing is simply a request for information. Unless a large number of requests are received, it may be desirable for a Department official to discuss the project with the person(s) making the request to determine if the question can be answered without a public hearing. If all questions or problems can be resolved to everyone's mutual satisfaction, the Department can ask for written correspondence rescinding the request and this will satisfy the public hearing requirements.

In the event that written correspondence cannot be obtained rescinding the request, a hearing will be held. The procedures in Section 2D-3 thru 2D-7 and Section 2D-12 thru 2D14 -(FINAL ENVIRONMENTAL DOCUMENT) is to be followed.

## SECTION 2D- 6 SCHEDULING THE PUBLIC HEARING

### ESTABLISHING TIME AND LOCATION

It is the District Administrator's responsibility to determine a time and place, allowing a minimum of sixty days in advance for the hearing, upon request from the Location and Design or Local Assistance Division. If a pre-hearing meeting is to be held, the time and place of this meeting is also scheduled and the Location and Design or Local Assistance Division so advised.

Upon notification of the time and location of the hearing, the designer or project manager will advise the Public Involvement Section so that they may prepare the public notice and arrange for proper advertisement of the hearing.

### PUBLISHING NOTICE OF THE PUBLIC HEARING

The Public Involvement Section, upon notification that the hearing has been scheduled, will advise the Office of Public Affairs to publish a notice that a public hearing is to be held.

If a pre-hearing meeting is to be held, the public hearing notice is also to include the time and place of this meeting.

The public hearing notice will also indicate that all pertinent data (including the environmental document) will be available for public review and copying at specified locations. This requires that the appropriate environmental document be prepared and cleared for public availability prior to the preparation of the hearing notice.

# SECTION 2D-7 PREPARATION OF ENGINEERING COMMENTARY

## CONTENTS OF COMMENTARY

The engineering commentary, which is of vital importance in the public hearing process, should be written and presented in a manner which can be easily understood by the layperson. The commentaries and all written statements shall be coordinated with the Public Involvement Section. In most instances, the commentary should contain the following information relative to the project being presented:

(1) The need for the project and the sequence of events leading up to the public hearing

(2) A brief history of other corridors considered and rejected (if a combined Location and Design Hearing)

(3) The project description and length, approximate lump sum cost (with a participation breakdown from other agencies or municipalities where applicable), and traffic data

(4) A brief summary of environmental effects

(5) Remaining steps required following the public hearing

## THE ENGINEER

The Project Designer who prepares the commentary should also make the presentation. He/she should be thoroughly familiar with all facets of the project and should make an on-site inspection prior to writing the commentary. He/she should be proficient in the delivery and be familiar with all visual aids used.

## SECTION 2D - 8 - CAPACITY ANALYSIS - PLAN IDENTIFICATION - ALIGNMENT AND GRADES

### CAPACITY ANALYSES

The capacity checks previously documented should be reviewed and updated if necessary. The capacity analyses as indicated in Chapter 2B, Section 2B-3 should be performed. In addition, the designer should review the following:

Major at-grade intersection capacity checks:

1. Overall intersection level of service
2. Level of service for each approach
3. Number and length of turning lanes
4. Pedestrian and bicycle influence

Interchange capacity checks:

1. Basic ramp level of service
2. Ramp Termini level of service
3. Entrance - Exit levels of service
4. Weave - merge lane lengths and widths
5. Acceleration - deceleration lane lengths

All capacity checks accomplished during this phase should be reviewed with Mobility Management Division and Transportation and Mobility Planning Division and documented in project files.

### UPDATING PLAN IDENTIFICATION

The Supervisor's and Designer's names are to be shown in the top left corner of the border of each plan and profile sheet. Project numbers not previously assigned are to be obtained from the Administrative Support Section thru Form LD-219. State project numbers must be shown on the plan and profile sheets to which they apply. (Federal project numbers are to be shown on the Title Sheet only.) Bridge project numbers are to appear only on the sheets that actually apply to the structure such as the plan sheet showing the bridge, its profile and typical section, the crossroad profile, if applicable, and the title sheet.

The "PE" project number is to be shown on the title sheet only.

## REFINING HORIZONTAL ALIGNMENT

Although horizontal alignment is in the proper location at this stage, it must be reviewed for exact tie-ins with adjoining projects, connection tie-ins, interchange ramp tie-ins, traverse tie-ins, etc. Horizontal alignment is to be computed, where possible, to locate special design bridges either completely on tangent or on a curve, with superelevation transitions encroaching neither on the bridge itself nor the approach slabs. Equalities are not to be placed on bridges.

## DEPICTING HORIZONTAL ALIGNMENT ON PLANS

P.I.'s, P.C.'s, P.T.'s, etc., curve data, bearings, and tie stations are to be shown where applicable as outlined in Section 2C-5 (Curve Data).

Construction baselines are to be shown by a heavy solid line (see standard symbols in CADD Manual and sample plan sheet Figure 2D-1) with all alignment data clearly noted "Const.", "Survey", etc., where applicable.

Superelevation is to be applied to horizontal curves in accordance with the latest Road and Bridge Standards. The rate of superelevation, length of transition, and design speed are to be shown directly below the applicable curve data.

Where right of way is to be acquired for future design features, the outline of these features is to be shown on the plans with a dashed line. This applies to ultimate interchanges, dual lane highways, etc. The entire configuration of interchanges is to be shown with a dashed line. This will show the reason for acquiring additional right of way and will serve as a means of recording the original design intent. Designs for ultimate interchanges and dual lane highways are to be shown graphically and, if available, computed alignment is to be shown. Ultimate dual lanes are to be labeled on each plan sheet as "Approximate Location Future (NBL, EBL, etc.) baseline." It will also be necessary to show the grades graphically or computed as is the case for horizontal alignment. The proposed future grade is to be labeled on each profile sheet as "Approximate Future (NBL, EBL, etc.) Grade." The ultimate construction limits are to be plotted on the plans showing cuts and fills.

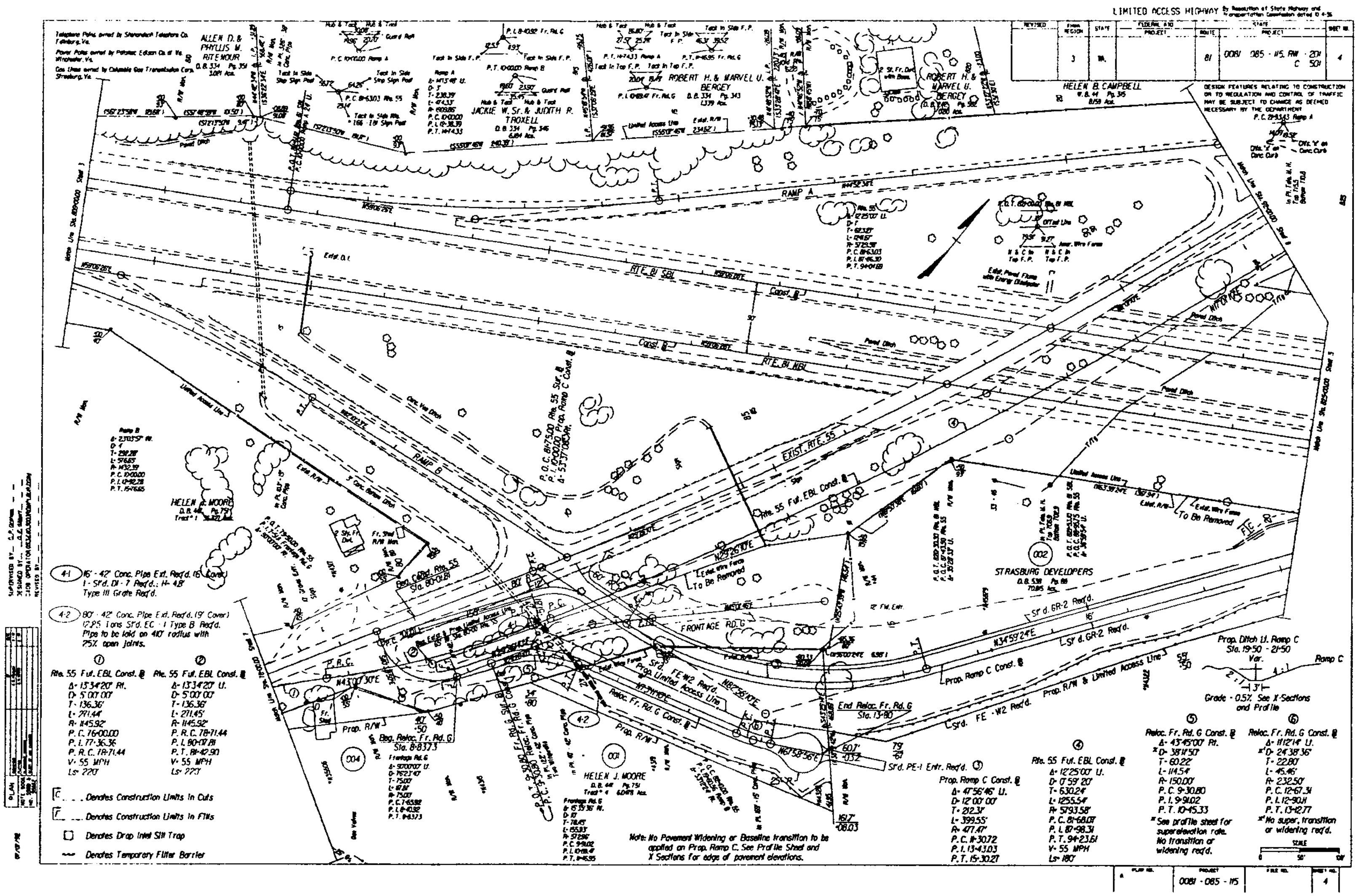

**FIGURE 2D - 1  SAMPLE PLAN SHEET**

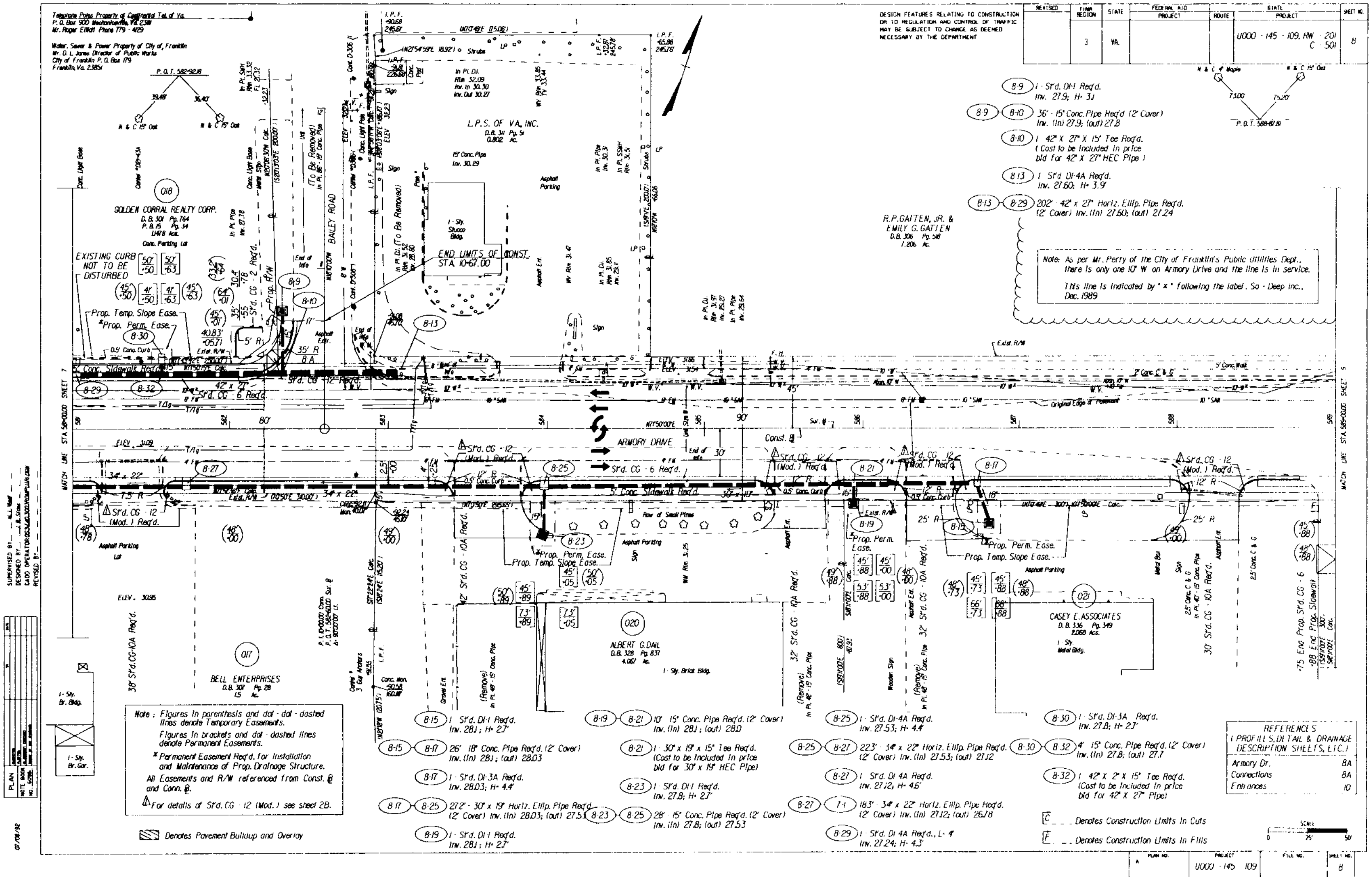

FIGURE 2D - 2  SAMPLE PLAN SHEET

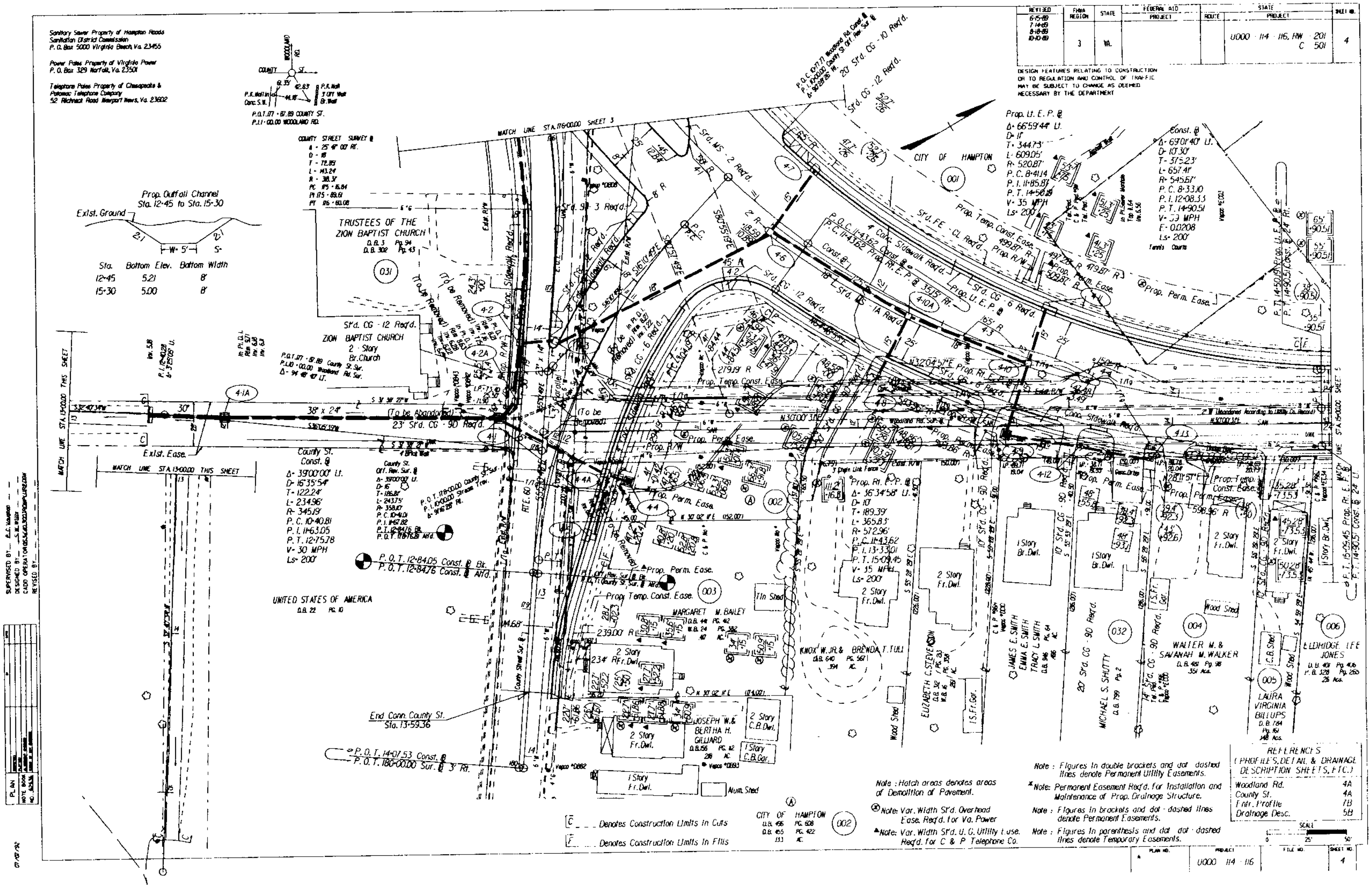

**FIGURE 2D – 3 SAMPLE PLAN SHEET**

## REFINING VERTICAL ALIGNMENT

Vertical alignments or grades are to be reviewed and computed for smooth, exact tie-ins with adjoining projects and existing road elevations. Also, connections, interchange ramps, etc., are to be computed considering pavement crowns, variable widths, etc.

Grades on divided highways are to provide for allowable crossover grades (See Appendix C, Section C-1-CROSSOVER GRADES). Grades are to be checked for proper mainline sight distances at crossovers, connections, and entrances.

Connection grades are to provide for a smooth tie-in with the mainline edge of pavement in accordance with Appendix C, Section C-1-INTERSECTING CROSS ROAD GRADES and are to provide for adequate sight distance.

Current practice is to eliminate scuppers on most bridge designs. For this reason a minimum gradient of 0.5 percent is desirable to facilitate surface run-off. There will be instances where flatter gradients are required, through vertical curves, long water crossings, etc.; therefore, the water should be removed by means of inlets in lieu of open scuppers. Gradients are to be computed to as few decimal places as possible and should be in numbers evenly divisible by four, where feasible.

All grades are to be checked, as accurately as possible at this stage, for proper minimum vertical clearances at underpasses and overpasses.

Minimum vertical clearances for structures or limits of work at grade crossing of railroads are to be obtained from the Department of Rail and Public Transportation.

Drainage of the existing terrain and adequate cover for drainage structures are also important factors to be considered in designing grades.

Conflicts with utilities are to be avoided wherever practicable. See IIM LD-140 for additional analysis information.

The Department's permit policy allows vehicles with excess heights to operate on our highways under an overheight permit. In view of this, 4.3 m (14'0") has been accepted as the maximum allowable height to be provided for during construction, reconstruction, or maintenance operations. Every effort must be made to insure that a minimum vertical clearance of 4.4 m (14'2") is provided on existing grade separation structures during construction, reconstruction, or maintenance. If temporary reduction in the vertical clearance below 4.4 m (14'2") is unavoidable and is apparent in the design stage, the Permit Office is to be advised when the project is turned in to the Scheduling and Contract Division. The following information is to be furnished so that permit holders can be notified:

- Route, County, and Mile Post
- Name of railroad or Route overpass

- Minimum overhead clearance prior to change
- Minimum overhead clearance after change

Date of change
Temporary or permanent

**SAG VERTICAL CURVES**

Criteria for establishing lengths of sag vertical curves are (1) headlight sight distance, (2) rider comfort, (3) drainage control, and (4) a rule-of-thumb for general appearance. (See AASHTO's A Policy on Geometric Design of Highways and Streets for controls - applicable to both rural and urban projects). (Also see IIM LD- 117).

**CREST VERTICAL CURVES**

Crest vertical curves are to be in accordance with Geometric Design Guidelines for the Functional Classification, traffic volumes and design speed of the road being designed. (Also see IIM LD- 117).

**DEPICTING VERTICAL ALIGNMENT ON PLANS**

Proposed grade lines are to be shown in a heavy solid line, except for dual lane highways, in which case one lane should be shown as a heavy dashed line. Both are to be clearly labeled.

Percent of gradient is to be shown on each tangent line.

Grades are to be designed in conformance with the Geometric Design Guidelines shown in Appendix A for the Functional Classification, traffic volumes and design speed of the road being designed.

Finished grade elevations are to be shown in the bottom 25 mm (1") of the profile sheet from beginning to end at prescribed intervals and at chord points. (Chord points are to be shown through the transitions of all horizontal curves. For clarification of chord points, see Road and Bridge Standards.) When showing these elevations on the profile sheet, the pluses shall be shown just ahead of the elevations. If projected grades are computed manually, the St'd. TC-5 Tables are used in computing chord point elevations. Finished grade elevations are also to be shown at change of grade points without vertical curves, at the beginning and end of each profile sheet, at the beginning and end of the project, beginning and end of bridges, at equalities, and equivalent stations.

Begin and end project stations are to be flagged as shown in Figure 2D-4.

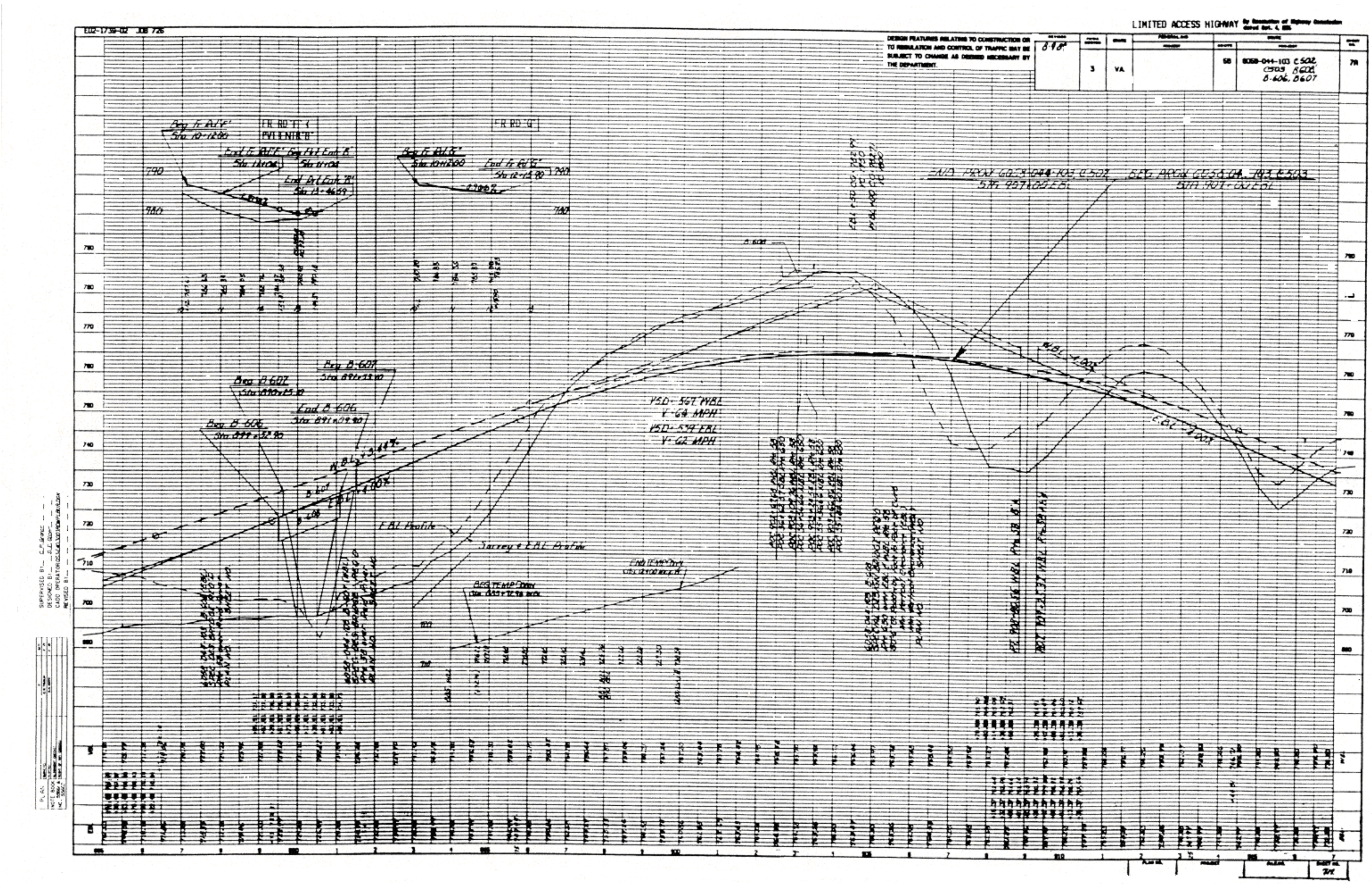


FIGURE 2D-4 SAMPLE PROFILE SHEET

Odd pluses shown for begin and end elevations for connection grades, ramp grades, etc., will preclude the need for flagging in these instances on plan and profile sheets.

Splined (not mathematically computed) grades are to be used only where computed grades are not practical and are to be noted "Spline Grade" with elevations shown, to the nearest five hundredths of a meter (foot) (or more accurately, if available), from beginning to end at 10 meter (25 feet) intervals. Approximate percent of gradient is to be shown on each tangent line and approximate vertical sight distances are to be shown for each crest vertical curve. Approximate design speeds are to be shown in accordance with IIM LD-117. For splined grades, these values are to be clearly marked "approximate".

## DESIGN EXCEPTIONS

When plans are being prepared where, for any reason, one or more locations do not meet the criteria for the stated design speed, the location(s) and reason for difference(s) are to be noted on the title sheet. In order to alert everyone concerned, it will be necessary to identify these locations from the earliest stages of plan development. If changes are made during plan development that would alter the situation, then the title sheet must be corrected to reflect the new design. Design exceptions shall have the approval of the State Location and Design Engineer on both State and Federally funded projects. On Federally funded National Highway System projects exceeding $1 million, Interstate Replacement projects exceeding $1 million and projects funded with Interstate completion funds, all exceptions to minimum AASHTO Standards require written agreement from the Federal Highway Administration.

The following methods will be used to show these exceptions:

a. Plans with Functional Classification block:

| EXCEPTIONS TO MAINLINE DESIGN SPEED | | |
|---|---|---|
| Sta. To Sta. | Design Speed (mph) | Reasons for Exception |
| 102 + 75 to 104 + 75 | 50 | Crest Vertical Curve |
| 621 + 00 to 624 + 50 | 60 | Horizontal Alignment |

The data as indicated in the previous example is to be shown directly below the Functional Classification block.

b. Plans Without Functional Classification block:

Exceptions should be noted inside the title sheet border lines immediately following the design speed classification as follows:

| |
|---|
| V = 70 mph Exceptions: 102 + 75 - 104 + 75 (50 mph) Crest Vertical Curve<br>621 + 00 - 624 + 00 (60 mph) Horizontal Alignment |

# SECTION 2D - 9 - CROSS SECTIONS AND EARTHWORK QUANTITIES

## PLOTTING CROSS SECTIONS

On projects utilizing manual cross sections, the sections are plotted from field notes usually with the survey baseline vertically centered on the sheet. Certain conditions will allow two rows of sections to be shown on a sheet. (Secondary projects, connections, service roads, etc.)

Cross sections are to be plotted dark enough to readily reproduce. Buildings, edges of pavement, edges of streams, walls, etc., are to be shown as noted in the field notes.

Survey baselines are to be labeled on the first and last sections on each sheet. Construction baselines are noted similarly, with finished grade elevations shown on the left side of the baseline, readable from the right side of the sheet. Care must be taken in vertical spacing to allow for the templates without overlap.

Datum elevations are to be shown immediately above the datum line in the last block on the right end of the sheet. Datum elevations should be shown every 2 meters ( 5') with no decimal.

Cross sections are generally plotted on a scale of 1:100 Meters (1" = 10' Imperial) and so noted at the top of each sheet. Curb and gutter projects, or other projects requiring greater detail, are plotted on a scale of 1:50 Metric (1" = 5' Imperial).

Book numbers and initials of personnel performing various tasks are to be shown in the space provided in the lower left corner.

Begin and end projects, connections, ramps, frontage roads, etc., are to be shown centered with the baseline, at the appropriate locations.

Computer plotted cross sections are to be requested in the preliminary stage of plan development, kept up-to-date with appropriate changes in the design, and retained by the designer, who will furnish prints of updated sections as required.

## DETERMINING WIDTH OF PAVEMENT

Preliminary design typical sections are to be thoroughly checked for compliance with the applicable Geometric Design Standards (see Appendix A). Interchange Ramp typical section geometrics are to be checked for adequate pavement widths for the curvature used as explained in AASHTO's A Policy on Geometric Design of Highways and Streets. Minimum ramp pavement widths are to be as shown in the Geometric Design Standards (see Appendix A).

## PLOTTING TEMPLATES

Templates are to be plotted in a heavy line in accordance with the appropriate typical section, to the finished grade elevation shown. Care must be taken to correctly plot all superelevated sections, pavement widenings, and transitions, in accordance with the appropriate geometric, slope and superelevation standards (see Appendix A).

An index is to be shown on the first cross section sheet showing sheet numbers assigned to the mainline, connections, ramps, frontage roads, etc.

Cross section sheets are to reflect all applicable project numbers in the appropriate blocks and are numbered in order beginning with "1".

## DETERMINING AREAS AND QUANTITIES

Earthwork areas are computed to the bottom-most line of pavement trenching. Areas are shown immediately below ground lines with the cut area in the third block to the left of the construction baseline preceded by the letter "C" and the fill area in the third block to the right preceded by the letter "F".

Earthwork quantities are computed as follows:

Metric: Add the areas of adjacent cut or fill, multiply by the distance between stations along the

Construction baseline, and divide by 2.

(See Appendix D, Section D – 1 – QUANTITY TABLES):

English: Add the areas of adjacent cut or fill, multiply by the distance between stations along the

Construction baseline, and divide by 54.

(See Appendix D, Section D – 1 – QUANTITY TABLES):

The quantity is shown centered vertically between sections and in the second block left (for cut) or right (for fill) of the construction baseline in numbers approximately 8 mm (0.3") in height.

On projects where the typical section and cross sections indicate a base or subbase material extended beyond the proposed pavement, curb, or curb and gutter in cut sections, the regular excavation will be computed to a vertical plane bounded by the farthest point.

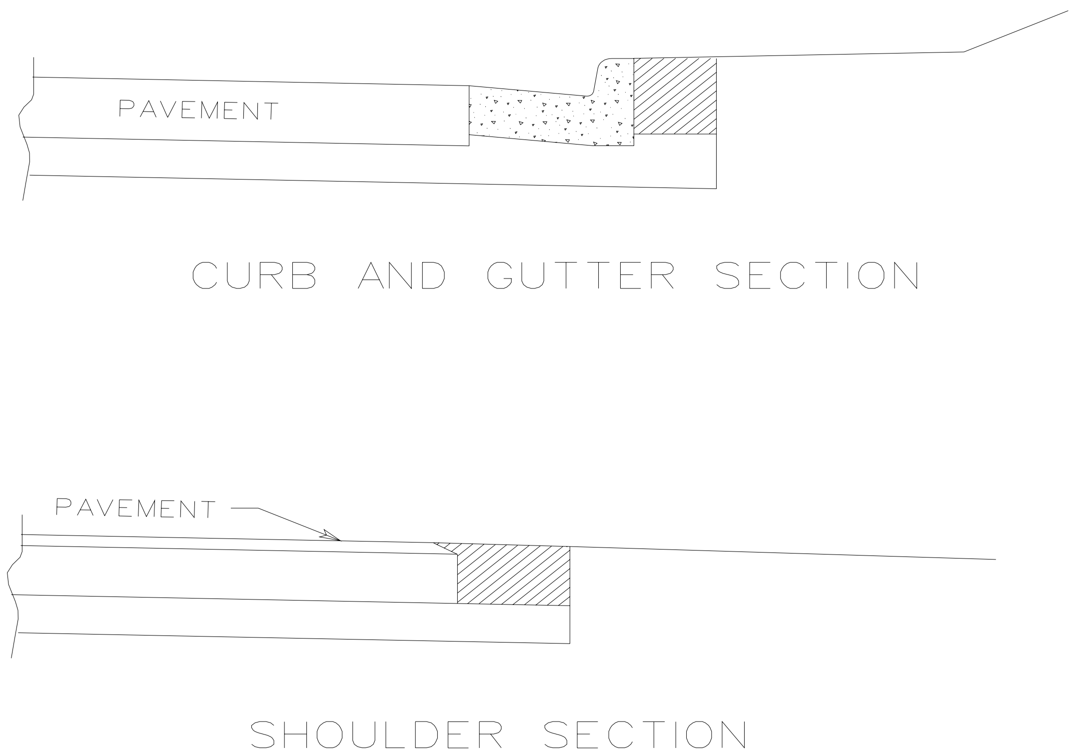


**FIGURE 2D – 5  EARTHWORK QUANTITY EXAMPLE**

A quantity is to be included in the plans for backfill of the hatched areas as shown in Figure 2D – 5 above.

On projects which have computer quantities, the designer must code the required computer input forms such as Bridge Spills, Earthwork Volumes, Subsurface Volumes, Supplementary Earthwork Volume, and Earthwork Summary.

## SECTION 2D – 10 - PAVEMENT, ENTRANCES, PROJECT LIMITS

### PLOTTING EDGES OF PAVEMENT

All edges of pavement are to be plotted on plans, using care to properly apply "TC" standards where applicable. For ramp terminal treatment, see IIM LD -20.

### PLOTTING ENTRANCES AND CROSSOVERS

All proposed entrances are to be designed in accordance with VDOT's Minimum Standards of Entrances to State Highways.

Previously located entrances and crossovers are to be shown on plans to proper tie-ins and labeled as to width, type, material, and grade. Grades for entrances are to be depicted as shown in Figure 2D-4. Procedures shown in APPENDIX C, Section C-1 are to be followed.

The Standard CG-9D entrance gutter is to be used for most single family residential entrances with curb and gutter.

The Standard CG-9A, 9B, or 9C entrance gutters should be considered only as a last resort in situations such as extremely narrow lots, closely spaced entrances, or if it is known that the lane adjacent to the curb will be used as a parking lane at all times.

The Standard CG-11 is to be the required method of treatment for **ALL** entrances with curb and gutter except for single family residential entrances. If the use of Standard CG-11 will result in:

1 - Major drainage problems or excessive drainage costs,
2 - Driver confusion due to the close proximity of an adjacent intersection, or
3 - Closely adjacent entrances on a road with a design speed < 50 km/h (35 mph),
then: consideration may be given to using one of the other Standard entrances.

The minimum entrance radii outlined in the Minimum Standards of Entrances To State Highways should be adhered to in the design of **ALL** entrances. For Commercial Entrances where a high percentage of trucks are anticipated, consideration should be given to increasing the entrance radii to accommodate the turning requirements of those vehicles.
For entrances at new locations, a centerline with bearing, delta and tie-in station is required.

Site plans for developments adjacent to a proposed project will be reviewed by the designer and proposed entrances will be shown on the site plan. A note reading as follows is to be placed on the roadway plans on the parcels of land affected by the site plan:

> "ALERT: SITE PLAN PROPOSED FOR THIS AREA. CHECK FOR THE SITE PLAN CONSTRUCTION AT EACH STAGE OF PROJECT DEVELOPMENT AND ORDER ADDITIONAL SURVEY WHEN CONSTRUCTED. STATUS OF ANY PROFFERED R/W SHOULD BE CHECKED AT R/W STAGE."

## APPLICATION OF STIPPLING

Stippling is to be applied, as deemed necessary by the designer, to depict proposed pavement areas by applying dots to the pavement area in accordance with the CADD Manual. Stippling is not necessary for showing proposed pavement on a new location; however, to depict widening of an existing roadway, stippling should be used.

## DETERMINING PROJECT LIMITS

Beginning and ending points of projects are generally determined by the first and last full width points of construction. These points are flagged with State right of way and construction project numbers and stations. Temporary construction beyond these points is to be flagged showing beginning and end construction and applicable stations.

## SETTING PROJECT TERMINI

Proposed Right of Way Lines and Easements (Permanent and Temporary) should be projected, whenever practical, to allow for any anticipated future construction. Right of Way and Easement should also be projected to any property line within a reasonable distance. This should minimize the need for negotiations with the same property owner on a future project. The Right of Way Project Limits should encompass all proposed, and projected, Right of Way and Easement on the project. Any deviation from the sketch in Figure 2D – 6 (there may be many) should be discussed at the Field Inspection.

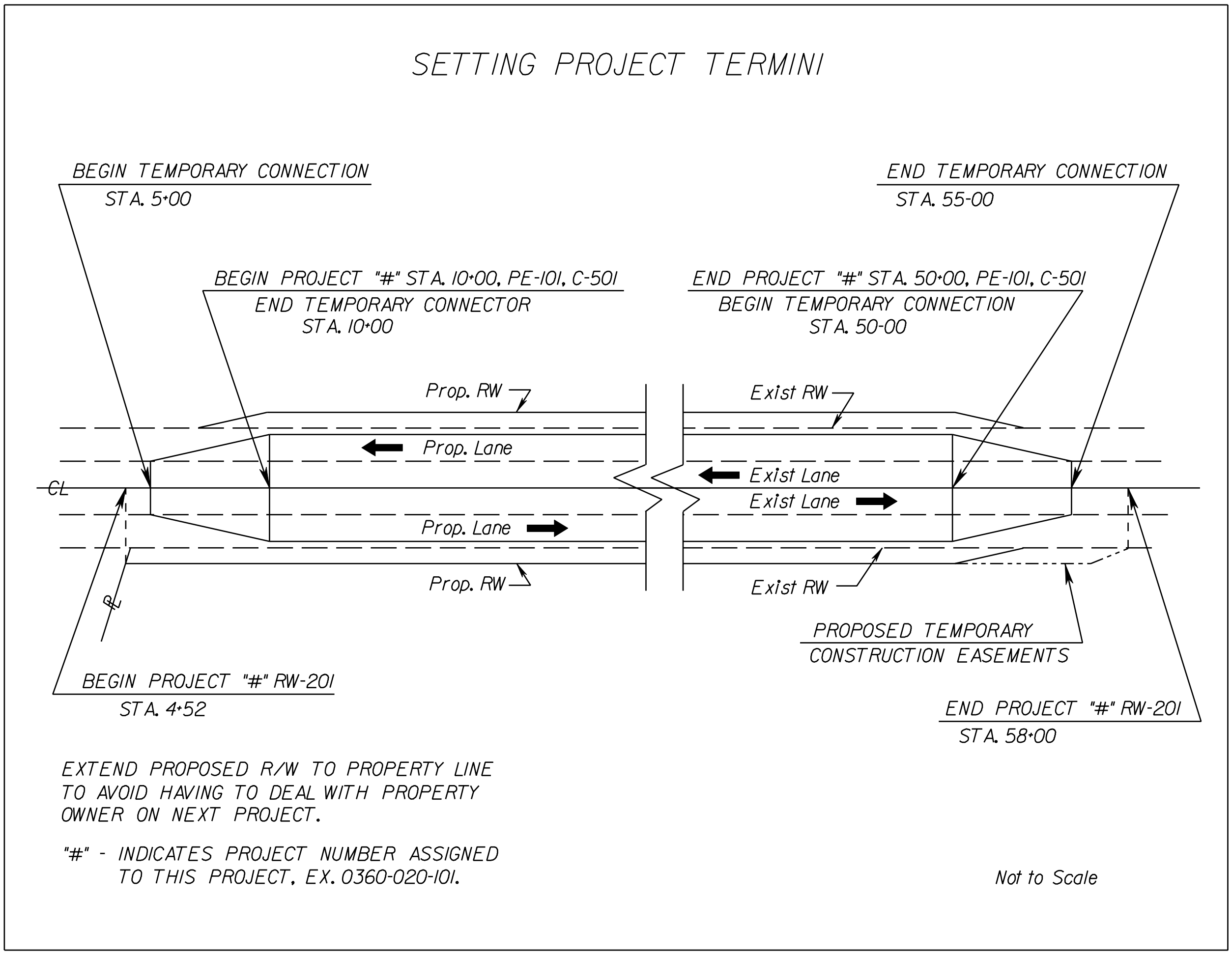


**FIGURE 2D – 6 SETTING PROJECT TERMINI**

## PAVEMENT TERMINATION

On projects where dual laning is expected to be extended in the near future, provide for the stubbing of the pavement of the parallel lane. This practice allows the next project to tie in with a minimum of interference with traffic.

Do <u>not</u> provide the pavement stub if a period of over five years is anticipated, due to the deterioration of pavement which is not exposed to traffic.

Figure 2D - 7 is a sketch outlining the method of pavement stubbing. This cannot be accomplished on every project due to super elevation required to tie into the existing pavement, or other circumstances. Pavement stubbing should be discussed in detail at Field Inspection and comments noted in the F.I. Report.

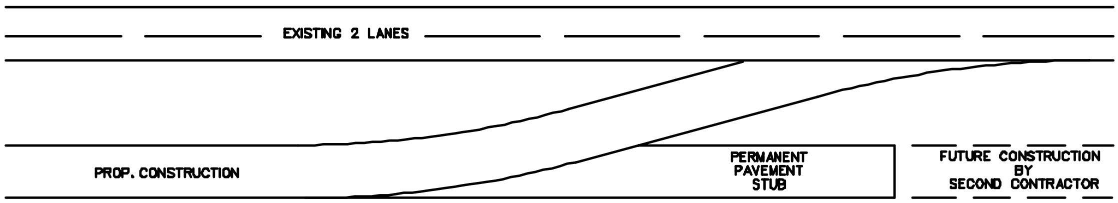


**FIGURE 2D – 7 SUGGESTED PAVEMENT STUBBING TREATMENT**

## PLOTTING CONSTRUCTION LIMITS

Proposed and ultimate (where applicable) construction limits are to be plotted from cross section limits using short dashed lines for cuts and longer dashed lines for fills with "C" and "F" notations separating cuts and fills. A note should be placed on the plan sheets showing cut and fill symbols (See Sample Plan Sheets, Figures 2D-1, 2D-2, and 2D-3).

Construction limits are to be plotted through entrances to the point of normal roadway construction. This distance is to be used for establishing right of way and easements. For entrances on which grades and cross sections are available, show any construction limits

Where rock slopes are used, construction limits for both rock slopes and normal slopes are to be plotted with proposed R/W encompassing normal slopes.

## SECTION 2D – 11 - REQUEST FOR SUPPLEMENTAL DATA

### SOIL INVESTIGATION, PAVEMENT RECOMMENDATIONS AND STAKING

The location (in Falcon) of plans, profiles, and typical sections, along with Forms LD-252 and LD-312 are sent to the State Materials Engineer requesting soil investigations, pavement recommendations, and staking data (if required). Request is to be made after Final Scoping.

If staking is required (after discussions with Materials Division), it should be so noted in the space provided for remarks on Form LD-252, with a copy to the Assistant Location and Design Engineer in charge of location.

### BRIDGE DESIGN

Form LD-153, Form LD-23, and the location of the plans pertaining to each bridge (title sheet, typical sections, plan and profile sheets) are to be sent to the Structure and Bridge Engineer after Final Scoping. Future requests because of changes can be noted via email with the PPMS number and the Falcon location of the plans.

Situation plans are to show all revised alignment data, making certain that the alignment is clearly delineated to insure that the correct line is used in the design of the structure.

Structure and Bridge Division should be requested to provide this information a minimum of 30 days prior to the scheduled Public Hearing date.

### PUBLIC HEARING DATA

Form LD-252 and the location of plans on Falcon are to be distributed (as noted on Form LD-419 and in IIM LD- 68) to the applicable divisions whenever a combined Location and Design or a Design Public Hearing is required. Requests for data on Urban projects are the responsibility of the Local Assistance Division.

# SECTION 2D – 12 - CONSTRUCTABILITY QUALITY REVIEW

## CONSTRUCTABILITY QUALITY REVIEW

Constructability review is defined as the review of plans, specifications, and contract documents from a construction perspective to assure the documents propose an operation that is efficient, cost effective, and buildable. Its emphasis is primarily focused on “how” the documents propose the operation to be built and not on ”what” gets built.

AASHTO defines constructability review as “a process that utilizes construction personnel with extensive construction knowledge early in the design stages of projects to ensure that the projects are buildable, while also being cost-effective, biddable, and maintainable”.

This analysis is normally performed at the Preliminary Field Inspection, Public Hearing, Field Inspection and Pre-Advertisement stage of plan development. Additional reviews can be performed as needed when the plans are further developed.

The constructability review includes the report of findings, a completed checklist, and cost savings report. This report is a detailed tabulation of any anticipated savings identified during the review.

# SECTION 2D – 13 - CONDUCTING THE PUBLIC HEARING

## THE PRE-HEARING MEETING

Prior to the scheduled hearing, it may be desirable to hold an open forum meeting. This meeting will permit the public to review and discuss with Department and Municipal (or other) engineers and officials, particular points of concern to them and to become generally familiar with the project to be presented. Mosaics, typical sections and other displays to be presented at the public hearing should be available at this meeting, along with unapproved detailed plans. A properly conducted pre-hearing meeting may eliminate a great number of questions which would otherwise be asked at the formal hearing and will convey a sense of mutual concern between the Department and the public.

As many public hearings are held at night, a period of approximately two hours prior to the formal hearing should normally be provided for this discussion prior to the formal hearing.

If sufficient interest is anticipated, consideration should be given to holding the pre-hearing meeting on the night preceding the hearing; or, if the projects are controversial or of great magnitude, consideration should be given to holding one or more meetings approximately a week in advance of the formal hearing.

## PROCEDURE FOR THE PUBLIC HEARING

The District Administrator, or a designated representative, moderates all public hearings except in rare circumstances when the Chief Engineer determines otherwise.

At the appropriate time, the engineering commentary (as described in Section 2D-7) is presented. This presentation is made by a representative of the Location and Design Division, District Administrator's office or the Local Assistance Division (on applicable projects). It is desirable to have the project designer, project manager, or a representative, assist in this presentation.

At the conclusion of the presentation, those present are afforded an opportunity to provide comments. Department representatives with expertise in the fields of right of way, environmental quality, etc. should be present and may be called upon by the moderator to answer general questions which may arise. Department representatives should remain as long as necessary at the conclusion of the hearing to discuss individual problems and questions relative to the project.

The moderator is to advise those attending the hearing that ten calendar days will be allowed from the date of the hearing for the submission of written statements to the Department for inclusion in the public hearing record. It is the District Administrator's responsibility to transcribe the proceedings and post the transcript on PCES (Project Cost Estimating System), along with his/her comments and recommendations, to the State Location and Design Engineer.

When the public hearing package (design or location and design) is ready for submission to the Chief Engineer for approval of the public hearing, LD Form 441 must be completed and distributed to the Right of Way and Utilities Division and/or the Environmental Division as appropriate. This should occur approximately 45 to 60 days ahead of the Right of Way submission date. This form will initiate the Right of Way Quality Control and/or the Environmental Re-evaluation process. The Location and Design Project Manager will be notified by email upon completion of the review. Upon receipt of the email, the Location and Design Project Manager will finalize the plans for Right of Way submittal.

## SECTION 2D – 14 - RESOLUTION OF PUBLIC HEARING QUESTIONS

### REVIEW OF PUBLIC HEARING TRANSCRIPT AND POST-HEARING CORRESPONDENCE

When the transcript of the public hearing is received, it is first reviewed by the Public Involvement Section for their determination of areas of concern which may require further investigation. It is then forwarded to the appropriate Assistant Location and Design Engineer, the Environmental Engineer, the Local Assistance Director for review, comments and recommendations. The FHWA is furnished a copy of the transcript for informational purposes on all Federal-Aid projects. Appropriate members of the Commonwealth Transportation Board are furnished copies of the transcript on all projects.

### STUDY OF ALTERNATE SOLUTIONS

Any item of concern requiring further investigation is to be studied by the designer or project manager and discussed with the localities (if appropriate) for possible solutions. All feasible solutions are to be explored, taking into consideration engineering judgment, economics, standard policies, etc.

### RECOMMENDING A SOLUTION

Upon reaching a conclusion as to the most feasible solution to an area of concern, the designer or project manager will furnish his/her recommendation to the appropriate Assistant Location and Design Engineer, Urban Engineer or Secondary Roads Engineer for a decision. If further public involvement programs are necessary, the Public Involvement Section is to be contacted for assistance.

### PROCESSING DATA TO PUBLIC INVOLVEMENT SECTION

When all areas of concern requiring further investigation have been explored, the designer or project manager will prepare a report for the signature of the State Location and Design Engineer to the Public Involvement Section (with a copy to the Environmental Division) outlining the proposed resolution of the questions. Secondary and Urban Projects are the responsibility of the Local Assistance Division.

# SECTION 2D-15 PROJECT APPROVAL

## BOARD APPROVAL

The Public Involvement Section will assist the State Location and Design Engineer in preparing a memorandum to the Chief Engineer requesting consideration by the Board. This memorandum is to cover the proceedings of the public hearing and the resolution of questions and recommendations. The project is then forwarded to the Vice-Chairman of the Board who arranges to have it placed on the agenda for Board action. After the project has considered by the Board, the Public Involvement Section shall advise the District Administrator of the action taken. The District Administrator advises those who spoke at the hearing or who corresponded with the Department as part of the hearing record of the action taken, including any changes in the proposal presented at the hearing and appropriate responses to the individual's comments or questions. The District Administrator will also advise all other local officials of the action taken. The Public Involvement Section will notify the appropriate mayor and/or chairman of the Board of Supervisors of the Board's action.

The Commonwealth Transportation Board only approves proposed highways on new corridor locations.

## DISTRIBUTION OF PRINTS

Distribution of prints is to be made in accordance with IIM LD-68 and the procedure to inform everyone where the plans are located in Falcon.

## FINAL ENVIRONMENTAL DOCUMENT

On Federal-Aid projects, the final environmental document must be completed before location and/or design approval is granted by the FHWA. If the document was approved at the Location Public Hearing stage, environmental requirements will have been satisfied (except as noted below in FHWA Approval) and no further action need be taken on the environmental document. If a Combined Location and Design Public Hearing was held, the Public Involvement Section will advise the Environmental Engineer of the Board Action and request that the final environmental document be completed. The designer is to furnish the Environmental Division with updated plans that reflect all modifications resulting from the public hearing process for their use in completing the environmental document.

## FHWA APPROVAL

Approval of the Final Environmental Document is the FHWA's concurrence with the project. If this was done at the Location Public Hearing stage for a Certification Acceptance Project, and following adoption of the major design features, the project may now be advanced to the Right of Way Acquisition Stage.

An update of the environmental document is required if significant changes in the project have taken place.

If a Combined Location and Design Hearing was held, the Public Involvement Section will forward the hearing transcript and report (as noted in Section 2D-13, Processing Data to Public Involvement Section) to the FHWA for their review prior to approving the Final Environmental Document. Following approval of the Final Environmental Document by the FHWA, the public is notified and the project may be advanced to the Right of Way Acquisition Stage.

## REQUEST FOR APPROVAL OF MAJOR DESIGN FEATURES (FOR NON-CA PROJECTS WHERE ENVIRONMENTAL DOCUMENT WAS APPROVED AT LOCATION PUBLIC HEARING STAGE)

Following approval by the Board, the updated Final Environmental Document (if updating is necessary) is forwarded by the Environmental Division to the FHWA.

Public Hearing Certification, the study report and report (as noted in Section 2D-13-Processing Data to Public Involvement Section) are forwarded to the FHWA along with the request for approval of major design features. The public is notified through the office of Public Affairs of the Department's request for approval and is also notified of the FHWA's response to the request.

Following approval of the major design features by FHWA, the project may be advanced to the Right of Way Acquisition Stage.

## FINAL SCOPING CERTIFICATION

Prior to the plans being signed for right of way (or construction when no right of way is needed), the coordinator fills out a certification form stating the project is within original scope or documentation as to deviations.

The State Location and Design Engineer will use Form LD-404 for this purpose.

## CHAPTER 2E - PHASE III, FIELD INSPECTION

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**SECTION 2 E - 5 - PROPOSED RIGHT OF WAY AND LIMITED ACCESS**



**SECTION 2E - 6 - PREPARATION OF SUPPLEMENTAL SHEETS**

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**SECTION 2E-13 UTILITY FIELD INSPECTION**



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# CHAPTER 2E - PHASE III, FIELD INSPECTION

## SECTION 2E – 1 - SOIL SURVEY AND PAVEMENT DESIGN

### SOIL SURVEY AND PAVEMENT DESIGN RECEIVED

Soil survey and pavement design recommendations are not always received prior to field inspection. Should they be received just prior to the field inspection, every effort should be made to have the recommendations included in plans prior to printing. In some cases, the field inspection will be held based on the preliminary pavement design without the benefit of the soil survey. (See Section 2E-6-TYPICAL SECTION SHEET)

### RESOLUTION OF BORROW / SURPLUS AND UNSUITABLE MATERIAL

VDOT's Road and Bridge Specifications requires that the contractor deposit unsuitable and surplus material off the project if the plans do not require that the material be placed within the right-of-way.

The procedural flow chart (See Figure 2E-1) is self-explanatory in the development of plans to resolve the disposition of materials on either a borrow or surplus project in connection with disposal areas and borrow pits.

The non-environmentally sensitive fill areas within the limits of a project should be reviewed for possible locations to dispose of unsuitable material. Do not place disposable material in areas where retaining walls or sound walls will be used. Check all proposed drainage items pertinent to this procedure. In some instances, the Materials Division will recommend that disposable material be placed in the bottom of fills; however, the available areas may or may not satisfy the volume of material to be disposed. The designer must therefore look to other methods of placing this material along with the placement of surplus root mat material that may be disposed of by using it to cover fill slopes. Placement of unsuitable material in fills is limited to an elevation 2 m (6') below the top of the proposed subgrade at the side slope. This will prevent entrapment of moisture in the embankment below the pavement structure (See Figure 2E-2). Unsuitable material is defined as highly plastic clay soil (PI $\geq$ 35). Wet material (moisture content $>$ 30 per cent above optimum moisture content), muck, peat, and other deleterious material. Organic material (stumps, tree trunks, limbs, roots, leaves, grass cuttings) shall not be disposed of on slopes. A plan for disposal of all unsuitable material shall be submitted by the Contractor to the Engineer at least 7 days prior to disposal for review. Inorganic material such as brick, cinder block, broken concrete, (without exposed reinforcing steel) asphaltic concrete, rock or other such material may be disposed of in fills.

Consideration should be given to flattening slopes using borrow on top of unsuitable material instead of installing guardrail (Exception: When major slopes of 3:1 and flatter will provide an acceptable condition for a vehicle leaving the roadway. Provide recoverable 6:1 slope when possible (See Appendix A for guidelines). Gore areas of ramps and median areas of divided facilities (unless they are used for stormwater management) are prime areas for placing disposable material. (See Figures 2E-2 and 2E-4)

It is also likely that in some cases, such as the placement of unsuitable material in the bottom of fills, that borrow can be reduced, thereby reducing the cost of a project. Another case would be in the area between the normal and the proposed flatter safety slope.

In no case should a vertical line be used to separate the good material from the unsuitable material (See Figure 2E-2). Roadway compaction must be obtained over the width of the normal roadway section from toe to toe of fill.

Unsuitable material placed outside the normal roadway section will not normally require the standard practice for compaction of fills. If concurrence is received from the Materials Engineer to waive density requirements of fill material placement outside the normal roadway section, then the following note is to be shown with the typical sections denoting the method of placing unsuitable material, giving location, station to station, etc.

| |
|---|
| Note: "The density requirement for embankment will be waived in the placement of unsuitable material." |

When the shoulders are being constructed of commercial material, this material should be extended to intersect the flatter slope (See Figure 2E-2).

Figure 2E-4 is a sample plan that has been prepared to denote, by a series of double hatched lines, the designated area for the placement of unsuitable material on slopes of a roadway facility being constructed in fills. Typical sections showing the theoretical methods to be used for the placement of such materials are to be included in the plans, along with the roadway typical sections. The designer is reminded to check all proposed drainage items pertinent to this procedure.

In essence disposal of unsuitable material within the project limits eliminates the need to haul the material to a waste site, which should reflect in the unit price for regular excavation. There could be a savings in right-of-way cost to acquire the site, if one is not available. Borrow excavation is reduced in some cases, depending on the position the material is placed within the roadway fill section. With flatter slopes, some guardrail may be eliminated, reducing costs and providing a safer facility. The designer should make a careful analysis of where the unsuitable material is being removed and where it is to be placed to determine if a double haul will be required. If a double haul is required, it could make the design uneconomical due to the extra cost in handling and stockpiling. Consequently, once the soil survey is available, the method of disposing of unsuitable material must be reviewed and approved by the District Administrator or his/her designated representative.

When root-mat is disposed of by using it to cover fill slopes, the following note is placed on the plans on the grading diagram and summary sheet:

> "_____ $m^3$ (______ Cu. Yds.) of Root-mat topsoil is to be stockpiled and used for covering fills to a depth of ____ mm (____ inches). Placement is limited in all situations to an elevation of at least 2 meters (6 feet) below the top of the proposed subgrade at the side slope and at locations where and as directed by the Engineer. All debris which would impede mowing operations is to be removed from the top 3 meters (10 feet) of the fill slope."

The designer is to adjust the depth used in an effort to use up the supply of root-mat. Removal and stockpiling root-mat is paid for as regular excavation and the basis of payment for spreading is to be "Topsoil Class A," by the acre.
The Grading Diagram and Summary, as discussed in Section 2G-2, provides guidelines in arriving at usable cut quantities when using the Grading Diagram method.

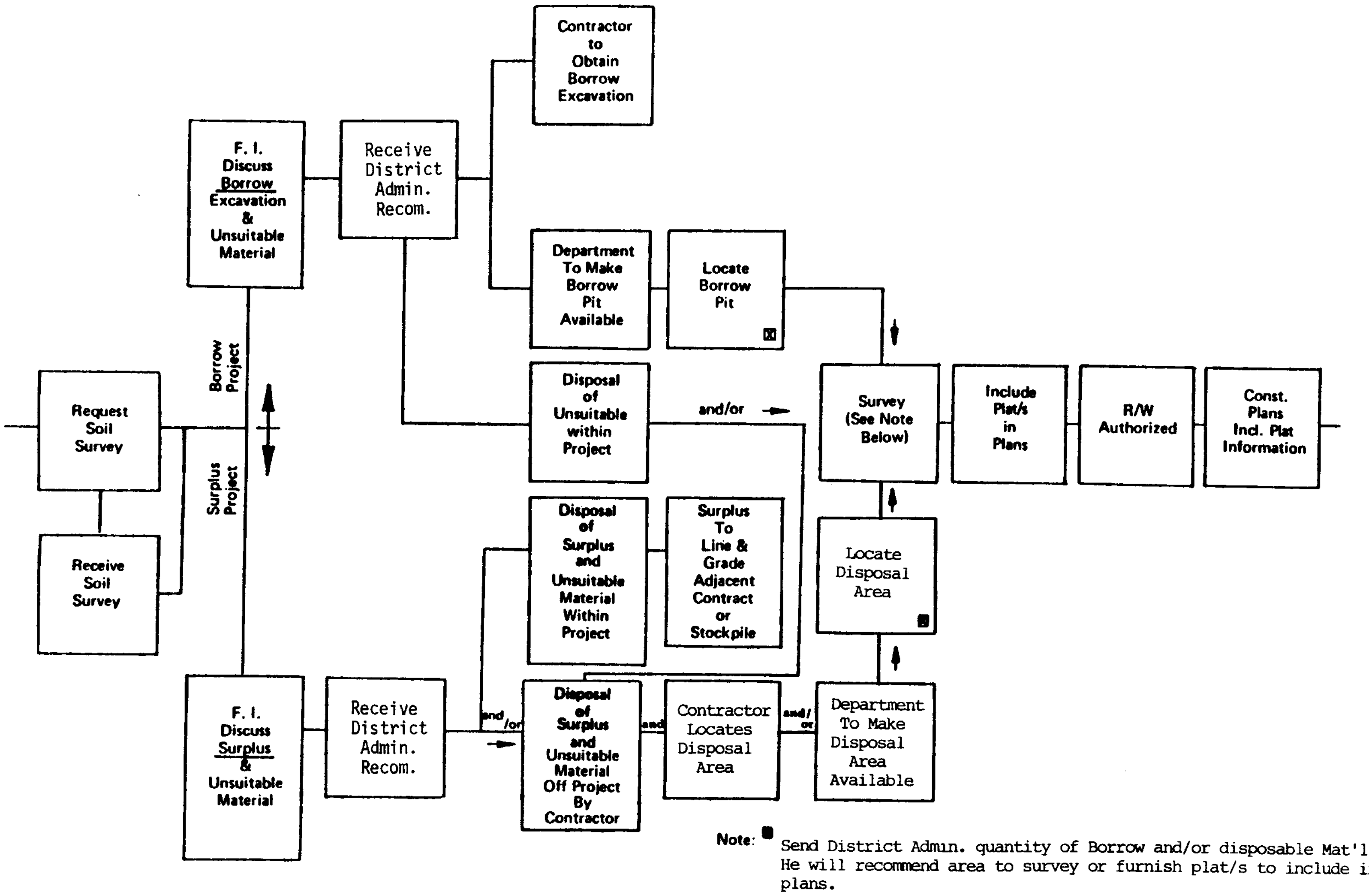



**FIGURE 2E – 1 PLAN DEVELOPMENT/RESOLUTION OF BORROW/SURPLUS AND UNSUITABLE MATERIAL**

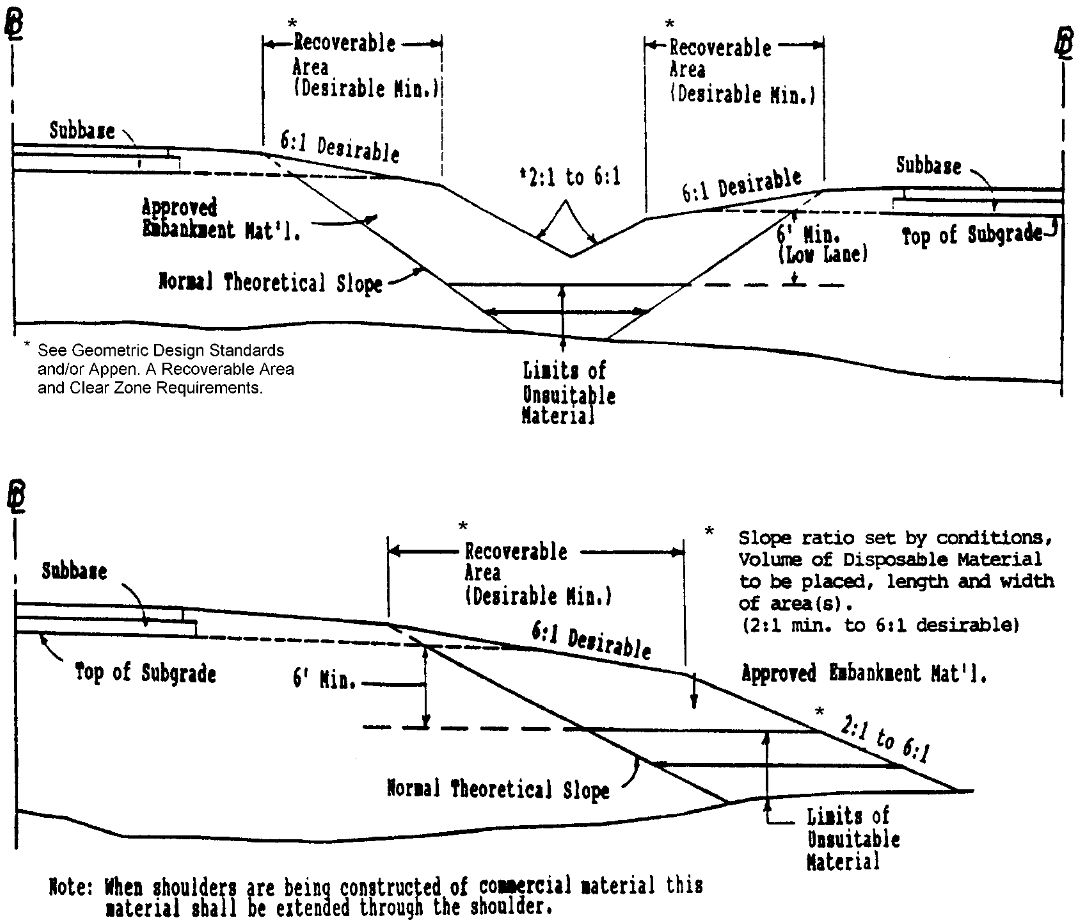



**FIGURE 2E-2 TYPICAL METHOD OF PLACING UNSUITABLE MATERIAL**

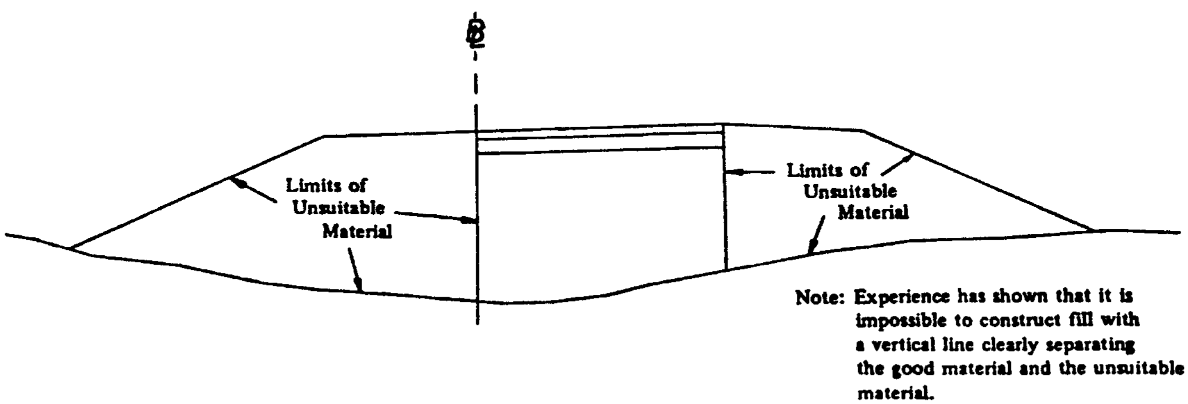



**FIGURE 2E-3 <u>INCORRECT</u> METHOD OF PLACING UNSUITABLE MATERIAL**

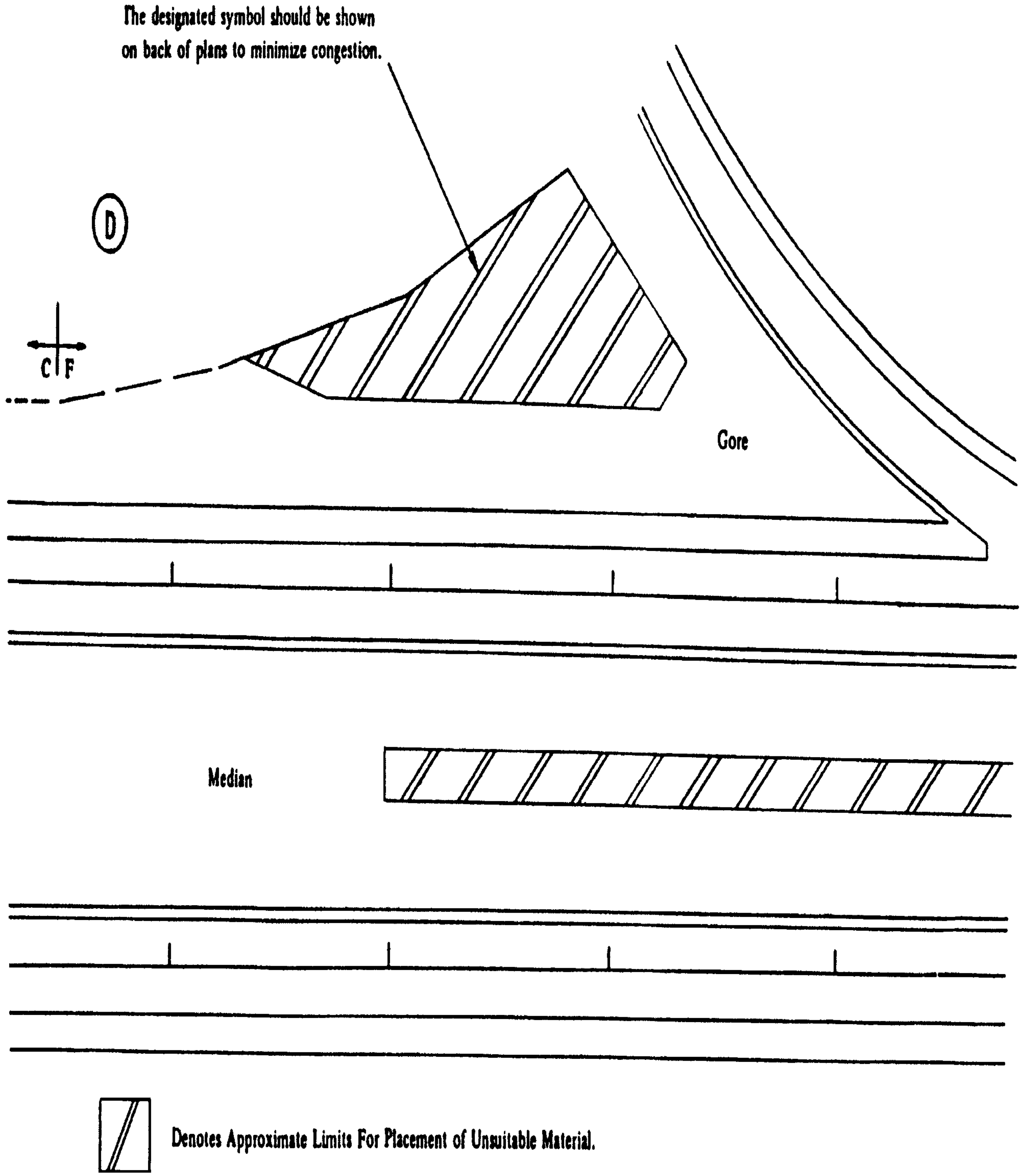



**FIGURE 2E-4 TYPICAL METHOD OF SHOWING PLACEMENT OF UNSUITABLE MATERIAL ON PLANS**

# SECTION 2E – 2 - DETAILED DRAINAGE DESIGN

## DESIGNING DRAINAGE

Drainage shall be designed in accordance with criteria established in the Drainage Manual and Instructional and Informational Memoranda.

Highway drainage will be designed by the District Drainage Engineer (with such technical assistance as may be necessary from the Central Office Hydraulic Section) or by the Hydraulic Section of the Central Office, depending on whether the road plans are being developed in the District or in the Central Office.

At the time the drainage design is initiated, the plans should be reviewed by the Hydraulic Section or the District Drainage Engineer for information as to areas that have been delineated as flood prone, have designated regulatory floodways and/or other constraints that may affect the design.

In developing the plans for field inspection, careful consideration must be given to erosion and sediment control. Required measures, in addition to those covered by construction specifications, that necessitate additional plan details, will be included in the plans and will be considered by the field inspection party on a site-by-site basis.

Guidelines for erosion and sediment control may be found in the VDOT Drainage Manual, the Virginia Soil and Water Conservation Commission's Virginia Erosion and Sediment Control Handbook, IIM LD-11, and IIM LD-195.

## DEPICTING DRAINAGE ON PLANS

Proposed drainage items are to be shown on plans to scale, with construction limits being adjusted accordingly.

Drop inlets are to be drawn to actual scale, using a heavier line weight than the curb and gutter for distinction. Proposed pipes and box culverts are shown by dashed lines (See Figures 2D-2 and 2D-3).

Proposed pipes that are 1050 mm (42") or smaller are to be shaded, while 1200 mm (48") and larger pipes are to be shown using the open method with heavy lines. Flow arrows are to be shown at each proposed pipe, box culvert, and ditch.

Special Design drawings showing details for erosion and siltation control are available in the CADD Directory. Frequently, additional special design drawings are required for a project. These sheets are to be inserted in the plans and numbered in the "2" series where applicable.

In cases where complexity will not permit individual labeling, numbers within ellipses are to be shown for individual structures. The first number within the ellipse will designate the sheet number of the plan sheet that contains the proposed item, and the second number will designate the assigned item number (See IIM LD-223). The corresponding descriptions are to be shown where space will permit. If all descriptions cannot be shown on the plan sheet, a separate sheet should be provided. This separate sheet is to be referenced on the plan sheet. When numbering storm sewer items, the individual numbers should be assigned to items at the ends of pipes such as drop inlets, manholes, endwalls, end sections, etc., with the pipe description labeled number to number. The pipe size should be shown adjacent to the pipe and as close to the flow arrow as possible.

Drainage descriptions should not be shown on profile sheets.

In cases where structure numbers are provided by the Hydraulic Section, these numbers should be shown as submitted. If, for some reason, it is necessary to change these numbers, the Hydraulics Section is to be advised so that computation sheets may be revised accordingly. Changes shall not be made without the knowledge and consent of the drainage designer.

Drainage descriptions are to be consistently worded and in the form shown in Figures 2D-1 and 2D-2 and in IIM-LD-223.

Minor structure excavation is to be computed for all box culverts, pipes of 1200 mm (48-inch) diameter or over, and multiple pipe lines with a total span of 1200 mm (48 inches) or over, in accordance with Road and Bridge Specifications, IIM LD-71 and recommendations received from the Materials Division. The minor structure excavation is to be shown in the applicable drainage description. (See Appendix D-1 "Ratios For Minor Structure Excavation")

## NON-STANDARD ROADSIDE DITCHES

Safety, appearance, and economy necessitate that non-standard roadside ditches be eliminated from our plans or be minimized to the greatest extent reasonable for all highway projects.

Where the volume, flow, or other considerations dictate enlarging or deepening the roadside ditch or otherwise deviating from the standards, careful study must be given to the following:

1. Enclosing the drainage, where economically feasible, in order to eliminate the need for the non-standard roadside ditch or channel.

2. Minimizing the size and depth of the proposed non-standard roadside ditch or channel. Careful consideration of the available locations for the ditch (each side of the road and median area) could facilitate this.

3. Flattening the front slope (the slope adjacent to the highway shoulder) of the non-standard roadside ditch or channel. Where right of way is available, or can reasonably be obtained, the front slope of the non-standard roadside ditch or channel should be no steeper than the front slope of the standard roadside ditch for that particular project.

4. Locating necessary non-standard roadside ditches or channels as far from the proposed highway shoulder as the existing or proposed right of way will reasonably allow.

Hazardous and unsightly roadside ditches and channels must be eliminated from the plans wherever possible.

## END SECTIONS FOR PIPE CULVERTS

The Standard ES-2 drawing in the Road and Bridge Standards includes a pay line designation that should not be interpreted as a required length of pipe to be attached to the end section. The connector section length may be whatever length the supplier wishes to attach, but the portion of the culvert included within the limits of the "C" dimension will be considered, for payment purposes, to be included with the end section.

Road and Drainage Designers should compute or measure the actual length of culvert required and deduct the "C" dimension length for summaries and pipe description on plans.

Metric Example:
Culvert req'd. = 30.0 m of 900 mm pipe and two end sections
Pipe description and summaries will read thus:
28.0 m - 900 mm Pipe Required
2-St'd. ES-1 or 2 Req'd.

Imperial Example:
Culvert req'd. = 100' of 36" pipe and two end sections
Pipe description and summaries will read thus:
94' - 36" Pipe Required
2-St'd. ES-1 or 2 Req'd.

The supplier may furnish CM sections with no connector section (Alternate connection) or with whatever length of connector section is convenient. The supplier and contractor will be responsible for determining what combination of culvert pipe length will be required for various lengths of connector sections if any, they wish to furnish. Regardless of the length connector furnished as an attachment to the end section, that portion of the culvert designated "C" will be measured and paid for as end section.

It is especially important that inspectors and other field personnel are aware of these instructions in order that an end section will not be rejected simply because the length of the connector is not the same as that shown on the Standard. This variance is entirely acceptable provided the contractor has adjusted the length of the pipe.

## PIPE ENDWALLS WITH LOAD CARRYING GRATE

Pipe endwalls with load carrying grates (St'ds. EW-11 and EW-11A) were designed as a safety feature to prevent an errant vehicle from encountering the hazards of a collision with conventional endwalls. They are intended for use on low height embankments which would be traversable by an out of control vehicle and where guardrail would otherwise not be required. The Standard EW-11A is designed for use at crossover locations where there is no other alternative to placing a pipe culvert under the crossover.

The designer is to carefully study each situation before specifying Standard EW-11 or EW-11A on the plans. Guidelines for the use of these designs are given below:

1. Pipe endwalls with load carrying grates are to be used with traversable slopes (3:1 or flatter) on all classes of highways.
2. Pipe endwalls with load carrying grates are not to be installed where guardrail is required.
3. Pipe endwalls with load carrying grates will not be required on culverts with ends located outside of the required clear zone width. For guidelines, see Section A-2.
4. Crossover locations should be carefully studied to eliminate the need for a pipe culvert under the crossover. In the event there is no other alternative, the Standard EW-11A is to be specified. The approach slopes of the crossover are to be graded 10:1, regardless of the need for a pipe. Cross slopes (i.e., median crossovers, intersecting roads, or driveways) on freeways and other high speed facilities with design or operating speeds of 80 km/h (50 mph) and higher should be desirably sloped at 10:1 or flatter with a 6:1 maximum slope. On low volume or low speed roads, where accident history does not indicate a high number of runoff the road occurrences, slopes steeper than 6:1 may be considered as a cost effective approach.
5. When pipe endwalls with load carrying grates are specified, the designer must be sure that all other hazards in the area are treated in an equally safe manner.

Each project presents the designer with unique circumstances which may require special treatment. If there is any question in the designer's mind, he is to discuss the situation with the appropriate Engineer.

## REMOVAL OF EXISTING PIPES

Pipes to be removed, abandoned or cleaned out are to be indicated on the plans forbidding purposes and labeled "To be Removed", "To Be Abandoned", or "To Be Cleaned Out". Any large amount of pipe to be removed, such as an existing storm sewer, should be set up as a separate bid item and summarized in a separate column in the incidental summary. Incidental pipes to be removed should be included in other appropriate pay items such as Regular Excavation (to be specified in the General Notes) or Clearing and Grubbing. (See IIM-LD-110)

## REMOVAL OF BRIDGE APPROACHES

In the process of building a new bridged waterway and approaches, it often becomes necessary to remove all or a portion of the existing bridge approach roadway fill throughout the floodplain area. This is necessary for two reasons. First, leaving portions of the old bridge approaches in place may hinder the hydraulic capacity and efficiency of the new facility. In most instances the hydraulic performance of the new facility was predicated on the complete removal of the old one. Second, many of the State and/or Federal Environmental review agencies require that the old bridge and roadway approaches be removed in their entirety and land graded back to its natural contour as a contingency for the issuance of certain environmental permits. The hydraulic engineer responsible for the performance of the hydrologic and hydraulic analysis for the proposed bridged waterway will notify the road designer as to whether or not it will be necessary to remove all or portions of the existing bridge and approaches with the standard form LD-293B memorandum. If it is found necessary to do so, the extent of such removal will be indicated in that memorandum. The details concerning the removal of the old bridge approach fills are more fully described in Chapter 12 of the VDOT DRAINAGE MANUAL.

## BERM DITCH LOCATIONS

In all cases, except where severe right-of-way limitations exist, a minimum of 1.5 m (5 feet) and preferably more, is to be provided between the end of the cut slope round-off and the front slope of a berm ditch. Additional right-of-way is to be obtained for construction and maintenance of the berm ditch. (See St'd. PG-7)

## EXTENSION OF EXISTING PIPES

Existing pipes are to be extended with the same size and type of pipe that is in place. If end sections are required, then only Standard ES-1 or Standard ES-2 of the same size pipe is to be used. Pipes for extension are to be so noted in the "remarks" column of the drainage summary. An example of the plan description is as follows:

9 m - 450 mm (30'-18") C.M. Pipe Req'd. for Extension
3 m (9') Cover
1 St'd. ES-2 Req'd.

Projects on which the allowable pipe tabulation provides an option for new pipe installations and end sections are required, the drainage summary shall have a column indicating the optional standard, St'd. ES-1 or St'd. ES-2 Req'd., for the end section. A separate column is required when specifying either a St'd. ES-1 or St'd. ES-2 end section for extensions of pipes of a particular type.

## SKEW ANGLE OF DRAINAGE STRUCTURE

The angle of skew shown on the plans for a drainage structure is the angle formed by the centerline of the structure and a line drawn perpendicular to the roadway baseline nearest the ends of the structure.

Where the roadway baseline at opposite ends of the structure are not parallel, an angle of skew for each end of the structure shall be shown on the plans and in the summaries. The angle formed by the structure centerline and a line drawn perpendicular to the mainline baseline shall be shown only on the plans.

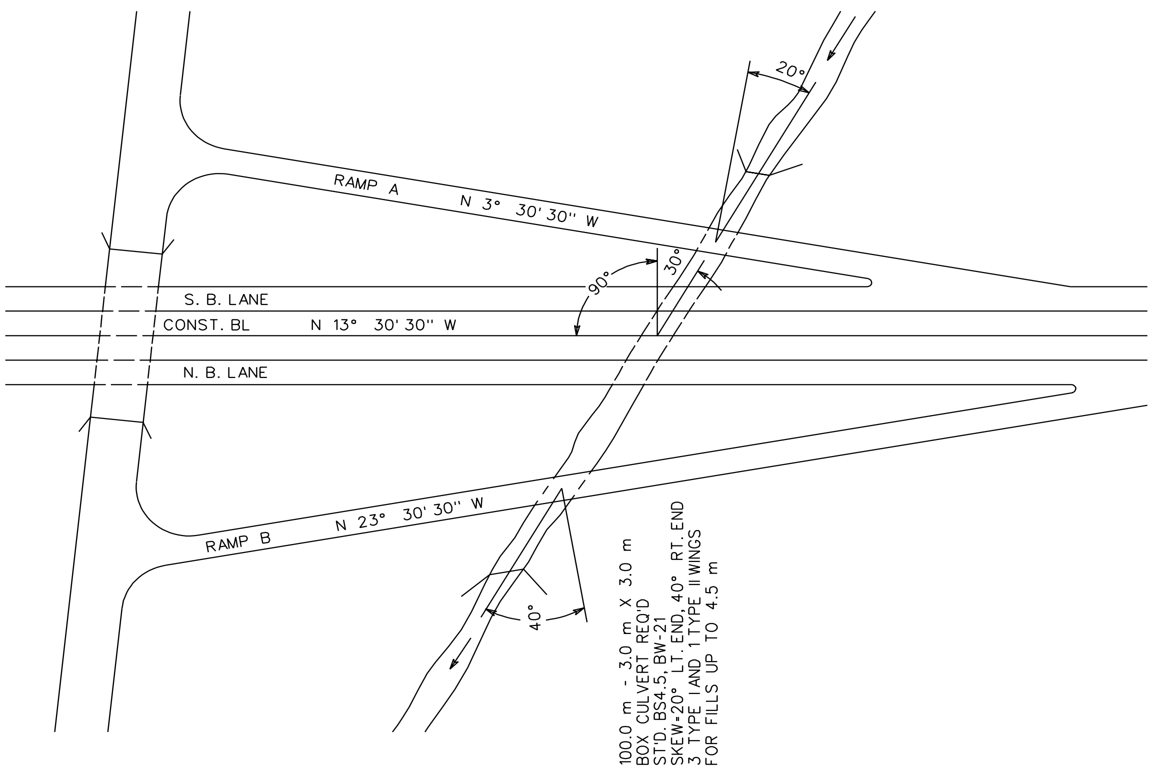



**FIGURE 2E-5 ANGLE OF SKEW FOR DRAINAGE STRUCTURES**

## SECTION 2E - 3 - DETAILED PLAN DESIGN

**CURB AND GUTTER** (Also see "Mountable Curb and Curb and Gutter")

Curb and gutter on Urban projects will be specified on Form U-9 from the Local Assistance Division. This is the Location and Design Division's authorization to incorporate curb and gutter in the plans. On other projects, curb and gutter will generally be specified only as replacement in kind or as determined at the Preliminary Plan Review.

When using an urban roadway typical section which includes curb and gutter and sidewalk, several design elements should be addressed. Following is a list of the most important items:

1. Will the utility poles be placed back of the sidewalk? While there is a safety advantage to placing poles back of the sidewalk, care must be taken to accommodate the pole crossarm with additional right-of-way and to be sure that local building codes are not violated by placing poles too close to existing buildings.

2. Proposed storm drainage should generally be accommodated under the proposed roadway. The preference of the municipality involved should be considered in this regard.

3. In some instances, retaining walls placed back of the sidewalk can also be in conflict with proposed drainage pipe and/or utilities.

4. The location of traffic signal poles and the need for additional rightt of way to accommodate them is to be considered.

5. The location of Curb Ramps is of prime consideration (See IIM LD-55).

6. The accommodation of rural type mailboxes must be considered on some projects.

7. The location of guardrail and the need for additional right of way to accommodate the guardrail is to be considered. Fills may need to be widened if guardrail is required.

St'd. CG-6 Curb and Gutter is to be specified unless a municipality specifically requests their own design and the request is approved by the Local Assistance Division. In this case, details are to be shown on the typical sections and basis of payment to be municipality's standard (example: Norfolk St'd. Curb and Gutter).

Curb and gutter is to be plotted to scale in a line weight heavy enough to readily reproduce and stand out over existing items, but not so heavy as to lose details. At street intersections, the face of the radial curb returns should have a minimum 9 mm (30') radius where this can be accomplished with minimum impact on adjacent property. Curb Ramps are to be provided in each quadrant of each intersection or at authorized crosswalks where sidewalk or sidewalk space is provided in conjunction with curb (See IIM LD-55 for additional Curb Ramp instructions).

**CURB** (Also see "Mountable Curb and Curb and Gutter")

Curb is shown in conformance with the Road and Bridge Standards in the "CG" or "MC" standards for various uses.

Curbs are to be depicted similarly to the previous instructions for curb and gutter.

**MEDIANS** (Also see "Mountable Curb and Curb and Gutter")

A median is defined as the portion of a divided highway separating the traveled way for traffic in opposing directions. The median width is expressed as the dimension between the through-lane edges and includes the left shoulders, if any. Some of the more common functions of a median are to:

1. Separate opposing traffic
2. Provide a recovery area for out-of-control vehicles
3. Provide a stopping area in case of emergencies
4. Allow space for speed changes/storage of left turning vehicles
5. Provide width for future lanes
6. Minimize headlight glare
7. Offer open green space and areas for landscaping
8. Provide refuge for pedestrians

Medians may be depressed, raised or flush with the pavement surface. The general range of median widths is from a minimum of 1.2 m to 2.4 m (4' to 8') or more. As far as the safety of motor vehicle operation is concerned, the wider the median the better for rural areas, while the opposite is true in urban/suburban areas. Notable exceptions to this are at-grade intersections, where wide medians may cause drivers to become confused over the operational characteristics and the increased time for vehicles to cross the median may lead to inefficient signal operation. Economic, environmental and land use factors very often limit the width of median that can be provided. Therefore, in the selection of a median width, the function(s) the median is to serve must be thoroughly evaluated in balance with the economic, environmental and other impacts.

Depressed medians are preferred on freeways and other high speed facilities where greater separation of opposing traffic is desired. They also allow for more efficient drainage and snow removal. Side slopes should be 6:1; however, a combination of 4:1 and 6:1 may be adequate. The recommended minimum depressed median width is 12.2 m (40') because from a physical and psychological sense, separation from opposing traffic is obtained when medians are 12.2 m (40') or wider. A 12.2 m (40') median also allows for two future lanes with 4.9 m (16') raised median. Again, the wider the median, the better, but with particular attention given to the operational characteristics of at-grade intersections. Also, clear zone requirements for a particular facility should have significance in the assessment of depressed median width.

Raised medians have application on arterial or urban streets where speeds are in the low to intermediate range and where it is desirable to regulate left turn movements. Raised medians have been found to be most advantageous under the following conditions:

1. High volume of through traffic
2. Little strip development or midblock left turn demand
3. Reasonable indirect access available to serve adjoining properties
4. Undeveloped areas composed of large land parcels
5. Areas where sight distance limitations prevent the use of a two-way left-turn median

The curb of raised medians should be offset 0.3 m (1') from the through lane edge. Raised medians should have a minimum width of 1.2 m (4'). When the raised median's primary purpose is to provide space for speed change/left turn storage, the minimum width should be the required lane width plus 1.2 m (four feet) (i.e. 3.6 m + 1.2 m = 4.8 m (12'lane + 4' = 16') total width).

All raised medians wider than 2 m (six feet) are to be seeded, unless they are deemed to create an unnecessary maintenance problem.

Flush medians have application on nearly all functional classifications of roadway. On low to intermediate speed facilities, where there is not a heavy concentration of left turn moves, flush medians can provide for two-way left turn lanes. Two-way left-turn medians are most beneficial under the following conditions:

1. Areas of strip development generating large mid-block left-turn demand
2. Areas with numerous small land parcels and many driveways
3. Sections with less than 12 public streets per 1.6 km (mile)
4. In corridors where operational flexibility is needed for future development and/or traffic needs

The recommended minimum width for this application should be the normal lane width plus 0.6 m (2') i.e., 3.3 m + 0.6 m = 3.9 m (11' lane + 2' = 13') total width). When used on higher speed facilities, such as freeways, a median barrier is nearly always required (see AASHTO's Roadside Design Guide for selection and use of median barriers). The minimum median width for this usage is 3 m (10') i.e., 2 – 1.2 m shoulders plus 0.6 barrier (2-4' shoulders plus 2' barrier), when used with a four lane facility. When a flush median with median barrier is used on a six lane facility, the minimum median width is to be 6.6 m (22'). If truck DHV exceeds 250, then a median width of 7.8 m (26') is desirable. Additional clearance may be required to provide the minimum stopping sight distance along the median lane on relatively short radius curves, when a median barrier is used.

Left turn lanes for all median widths are to be designed using controls shown in Appendix C, Section C-1.

Raised medians or median barriers are to be shown on plans in accordance with VDOT's Road and Bridge Standards and as shown on the approved preliminary design.

## STAKING FOR CONCRETE ITEMS

Formed concrete items, such as curb and gutter, curb, median openings, straight line tapers, turn lanes, and channelization require that sufficient station pluses, offset distances, and radii be shown to the face of curb to insure that the project is constructed as proposed and to assist the survey party in staking out the project. This information is usually computed by the designer in order to properly show the design on the plans; therefore, the desired information is readily available and should be included in plans. Be sure that sufficient offsets, pluses, and radii are shown to insure that the staking party can set stakes without field computations.

To more clearly show the required information on the plans and to reduce plan clutter, minimal data is to be shown on the plans with the remaining data shown in tabulation form on a series 2 plan sheet. Figures 2E-6, 2E-7 & 2E-8 denote a typical straight-line taper detail, the method of showing the required information on the plan sheet, and the minimum data that is to be included in the tabulation of data for reverse curve turn lanes and radial offsets.

When reverse curve transition are dictated by local policy, offsets to the reverse curves at maximum 7.5 m (25') intervals along the transition radii of the turn lane are to be provided, in addition to the reverse curve lengths, radii, and begin and end stations with offsets. The radii for these reverse curves should be set using radius lengths such as 60 m (200') (most commonly used), 45 m (150'), or 30 m (100') to provide consistent radii intervals for the contractor. The length of transition for these three radii with a 3.6 m (12') offset only varies from 29 m (97')± to 25 m (84') to 20 m (68'). Therefore, other odd radii may only cause problems in forming concrete.

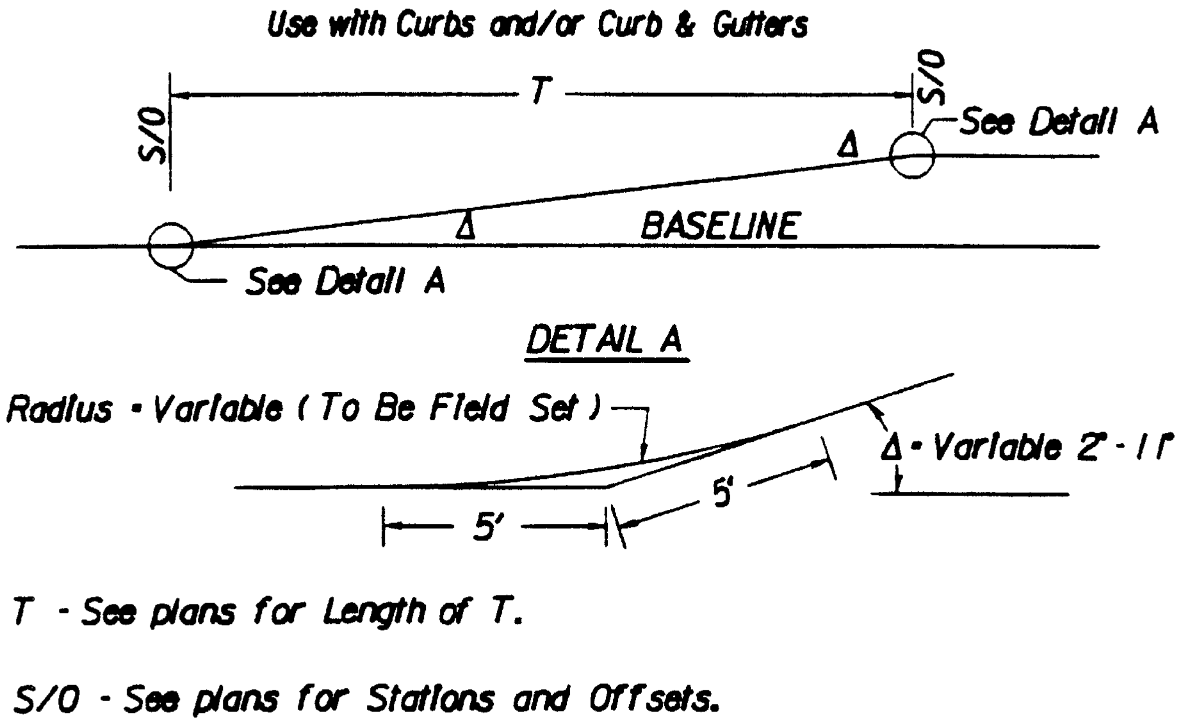



**FIGURE 2E-6 TYPICAL STRAIGHT-LINE TAPER LANE**

See Figures A-3-1 and A-3-2 for length of taper requirements.

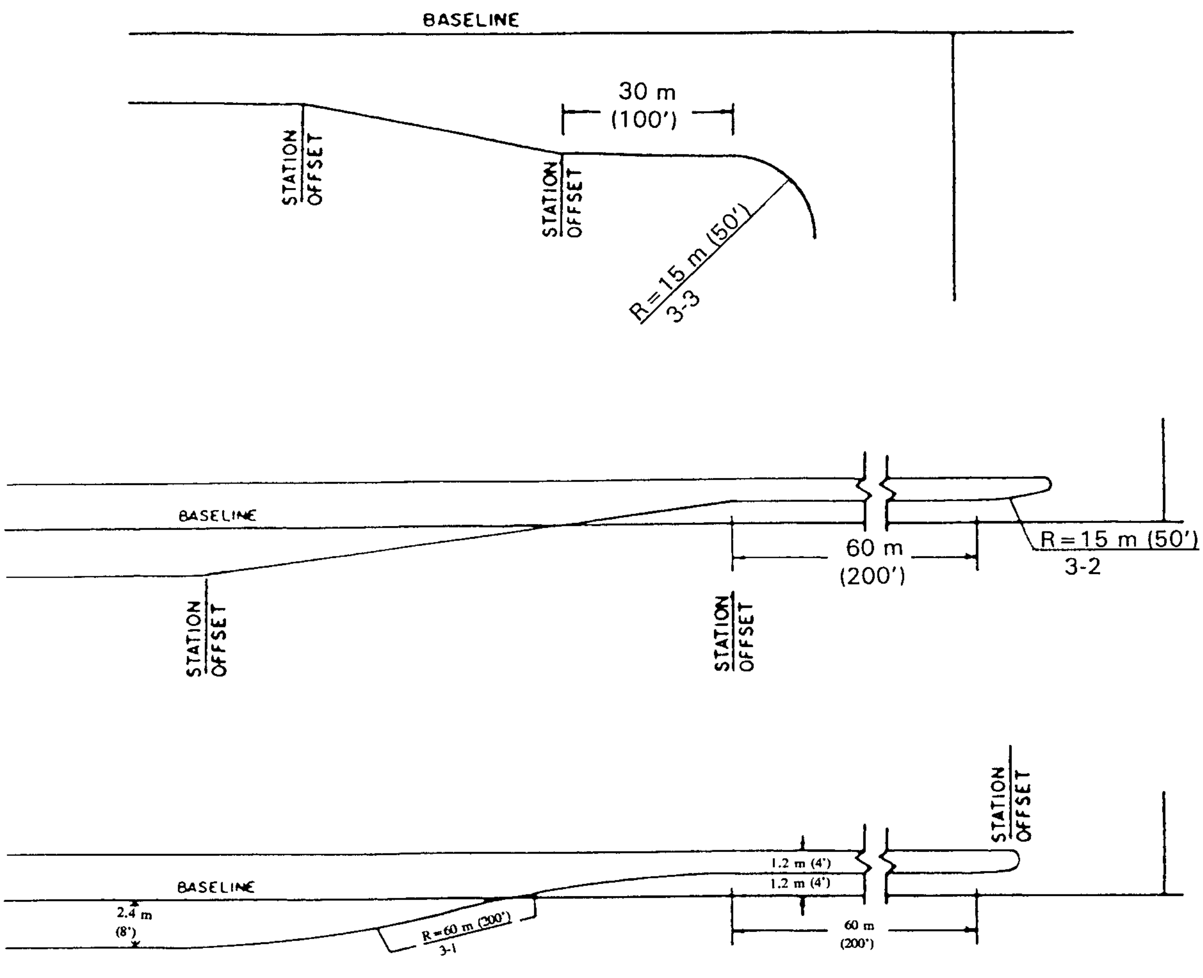
The following note is to be included on the General Notes Sheet, under incidentals, when straight-line taper lanes are used in curb and/or curb and gutter sections.

| |
|---|
| I-17 For method of constructing straight-line taper lanes in curb and/or curb and gutter sections, see typical details on sheet__. |

The Typical Straight-Line Taper Lane detail is to be shown on a number 2 series Typical Section, Detail or Summary sheet when required.

When used for right turn lanes on Urban projects with parallel R/W behind the C & G or sidewalk, the R/W shall be clearly labeled to assure that the desired R/W is obtained.

For method of showing required information on roadway plan sheets, see Figure 2E-8.




**REQUIRED INFORMATION**

Radial Offset....Radius and Reference No.

Turn Lanes.......Radii, Reference No. and Full Turn Lane Length

Taper Lanes......Begin and End Stations and Offsets

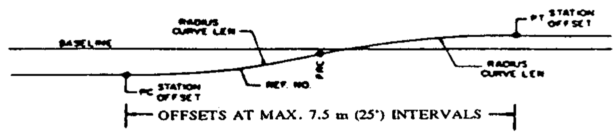
Bullet Noses.....Main Radius and Reference Number

## FIGURE 2E-7

## METHOD OF SHOWING REQUIRED INFORMATION ON ROADWAY PLAN SHEETS

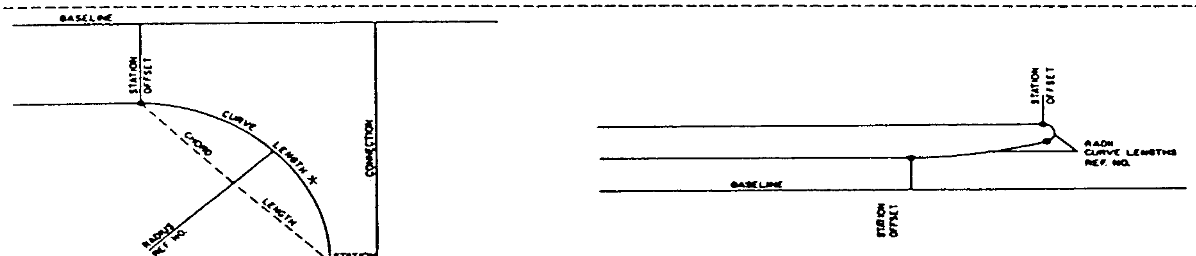
## FOR RADIAL OFFSETS – TURN LANES – BULLET NOSES

TURN LANES - REVERSE CURVE DATA




| LOCATION (REF. NO.) | BASELINE | REVERSE CURVE | OFFSET | CURVE LENGTH | RADIUS |
|---|---|---|---|---|---|
| Sheet-Item | Station | Point | m (ft.) | m (ft.) | m (ft.) |
| 3 - 1 | 10+15.00 | PC | 8.000 | 49.11 | 200.00 |
| | 10+25.00 | | 7.750 | | |
| | 10+50.00 | | 4.914 | | |
| | 10+63.62 | PRC | 2.000 | 49.11 | 200.00 |
| | 10+75.00 | | -0.502 | | |
| | 11+00.00 | | -3.625 | | |
| | 11+12.24 | PT | -4.000 | | |

RADIAL OFFSETS / BULLET NOSE DATA




* Curve length measured along face of curb

| LOCATION (REF. NO.) | BASELINE | | CONNECTION | | RADIUS LENGTH | CHORD LENGTH | CURVE LENGTH |
|---|---|---|---|---|---|---|---|
| Sheet-Item | Station | Offset | Station | Offset | m (ft.) | m (ft.) | m (ft.) |
| 3 - 2 | 70+67.07 | 4.00 | | | 50.00 | | 14.33 |
| | 70+80.93 | 8.00 | | | 1.00 | 1.98 | 2.85 |
| 3 - 3 | 49+96.95 | 30.50 | 8+98.90 | 19.50 | 50.00 | 77.59 | 88.82 |
| 4 - 1 | 48+55.76 | 30.50 | 9+23.97 | 19.50 | 50.00 | 65.16 | 70.97 |
| 4 - 2 | 48+70.66 | 30.50 | 10+60.51 | 25.50 | 30.00 | 42.43 | 47.12 |
| 4 - 3 | 49+91.77 | 30.50 | 10+70.62 | 25.50 | 40.00 | 56.62 | 62.90 |
| 5 - 1 | 56+91.70 | 30.50 | 10+60.57 | 16.50 | 30.00 | 42.39 | 47.07 |
| 5 - 2 | 56+02.70 | 30.50 | 10+60.57 | 16.50 | 30.00 | 42.46 | 47.17 |
| 6 - 1 | 64+27.95 | 30.50 | 10+57.87 | 16.50 | 30.00 | 41.16 | 45.36 |
| 6 - 2 | 65+21.11 | 30.50 | 10+63.34 | 16.50 | 30.00 | 43.65 | 48.89 |

**FIGURE 2E-8 SAMPLE TABULATION OF DATA**

**FENCE**

Proposed fence is to be shown on previously determined fenced limited access projects as submitted on the approved preliminary design.

Fenced proposed right of way and limited access lines are denoted by showing "X"s along a solid line. Normally, chain link fence is used within municipalities or other urbanized areas and farm fence is used in rural areas. The type of fencing to be used should always be discussed at the project Field Inspection to assure compliance with local ordinances. Hazardous conditions (barbed wire) should not be created in areas where there will be pedestrians.

Plans are to specify Standard FE-W1 for farm fence, except where specifically recommended otherwise (spacing of vertical strands) as a result of field inspection.

Existing fence replacement is normally covered in right of way agreements and is not a contract item except in rare instances. Proposed fence or fenced limited access lines, where they deviate from proposed right of way lines, are denoted by a dashed line with "X"s between dashes, in a somewhat heavier line than existing fence.

All limited access roadways will be fenced, except where natural terrain prohibits access. Each project shall be studied individually to determine if the fence can be eliminated in locations where deep cuts, high fills, rivers, streams, or other natural means prohibit access. Areas where sound barriers are proposed near the right of way line should be examined to determine the possibility of eliminating fencing beyond the sound barrier at the normal fence line. Otherwise, permanent easements may be required for maintenance.

The maintenance requirements of the sound barrier should be thoroughly discussed at the field inspection to determine if the fence can be eliminated.

When it is recommended at the preliminary plan review not to fence the limited access line, each location is to be thoroughly discussed at the field inspection. Recommendations of these locations shall be included in the Field Inspection Report from the District Administrator and approved by the State Location and Design Engineer.

The above policy is in accordance with An Informational Guide on Fencing Controlled Access Highways - AASHTO 1990.

Fencing of Stormwater basins may occasionally be needed and should be used when:

1 - Basin’s ponded depth is greater than 1m (3’) and/or has side slopes two or more side slopes steeper than 3:1; or

2 - Basin is in close proximity to schools, playgrounds or similar areas where children may be expected to frequent; or

3 - Recommended by the Field Inspection Report, the Resident Engineer or the city/county (where city/county will take over maintenance responsibility.)

Metal fencing adjacent to an airport sometimes interferes with airport traffic control radar by causing erroneous display on the radar screen. In order to avoid this potentially dangerous situation, when a highway project is adjacent to an airport and has proposed fencing, the designer shall contact the Aircraft Operations Section, which will check with the Federal Aviation Administration to ascertain if metallic fencing will be a problem. Should the FAA determine that the metallic fencing will be a problem, then a nonmetallic design will be used.

Unless circumstances dictate otherwise, plus and distance references for fence breaks will only be required on plans where the fence deviates from the proposed right of way line.

## TRAFFIC BARRIERS - GUARDRAIL AND CONCRETE BARRIERS

Traffic barriers are to be provided in accordance with the applicable "GR" or "MB" Standards and Appendix A (Section A-3 Traffic Barrier Installation Criteria).

## SHY LINE

Shy line offset is defined as a distance beyond which a roadway object will not be perceived as a threat by a driver. In other words, a driver will not react to an object beyond the shy line offset. If possible, the roadside barrier should be placed beyond the shy line offset. See Appendix A (Section A-2 Clear Zone Guidelines).

## CLEAR ZONE

Clear zone is defined as the roadside border area, starting at the edge of the through traveled way (edge of pavement), available for safe use by errant vehicles. Previously, 9 m (30 feet) was considered to be standard clear zone, but current guidelines in Appendix A and AASHTO's Roadside Design Guide give values greater or less than 9 m (30 feet), depending on the roadside slopes, operating speed, and traffic volumes.

## RUN-ON TERMINALS

Guardrail terminals are to be provided for all installations, regardless of Functional Classification. The termini of guardrail must be designed and located so there are no exposed rail element ends on which a vehicle could be impaled. With St'd. GR-2, the preferred treatment is to bury the end of the guardrail, using the St'd. GR-6 end treatment, into a cut slope even if the guardrail must be extended a short distance to accomplish this. If the use of St'd. GR-6 treatment is not practical, the St'd. GR-7 or GR-9 is to be used. (See Section A-3 for further instructions).

For concrete barriers the run-on terminals are to be buried into a cut slope where feasible. When it is impractical to bury the terminal, an approved impact attenuator or a section of guardrail with an approved transition and guardrail terminal is to be used. When operating speeds are below 65 km/h (40 MPH), a turned down section of concrete barrier may be used. It will be necessary to review the location with the Standards/Special Design Section and, if approved, they will furnish design details.

Proposed guardrail is depicted on the plans similarly to existing guardrail, except that circles are to be shaded and lines are solid and somewhat heavier. Proposed concrete barrier is depicted by a series of parallel lines. See the CADD Manual and the cel library for existing & proposed guardrail cells.

## RETAINING WALLS

Retaining walls are to be shown where specified on the approved preliminary plans. Refinement of alignment and grades may, however, necessitate some adjustment in wall locations. Handrail or fencing along the top of walls is to be thoroughly discussed at field inspection for safety considerations.

Where right of way damages may justify the use of retaining walls, the walls are to be shown on prints and presented at the field inspection along with an estimated construction cost. For comparison purposes, a projected right of way line (without the retaining wall) is to also be shown on field inspection prints.

Alternate retaining wall designs, such as cantilever, reinforced earth, etc., are to be considered and discussed with the Standards/Special Design Section for possible use in lieu of standard designs (especially if wall height exceeds 3 m (10 feet).)

Replacement of decorative or other walls, differing from standard walls, is to be thoroughly discussed at field inspection and, if a special design is necessary, a request is to be forwarded to the Engineering Services Section for design.

## SOUND BARRIER WALL DESIGN PROCEDURES

The necessity for sound barrier walls is determined by the Environmental Division. If the wall is deemed necessary, the Environmental Division will contact the Road Designer concerning requirements for the sound wall design. Environmental Division will determine the location and profile elevation of the sound wall and the Road Designer will include the information in the plan assembly.

The contractor is responsible for the design and construction of the sound wall based on the Special Provision and applicable industry guidelines (such as AASHTO *Guide Specifications for Structural Design of Sound Barriers*). These Special Provisions specify the design and construction requirements as part of the road project specifications.

Special Provisions for the sound barrier wall designed by VDOT engineers are prepared by the Scheduling and Contract Division.

For sound barrier walls designed by consultants, Consultant Services Section shall advise the consultants to contact Engineering Services Section for input and direction prior to initiating the development of special provisions. When Engineering Services Section is made aware of a need for special provisions, it will coordinate with the Scheduling and Contract Division and provide Consultant Services Sections a suggested draft of the provisions.

## STEPS AND HANDRAILS

Steps and handrails are to be provided where necessary, in accordance with St'd. S-1 or S-2 of VDOT's <u>Road and Bridge Standards.</u>

If decorative, wooden, etc., steps are desired for replacement, they are to be designed by the Engineering Services Section.

## SIDEWALK

Sidewalk is to be provided as specified on Form U-9, for replacement in kind, or as shown on the approved preliminary plans.

Proposed sidewalk is depicted with solid lines. For CADD plans, however, proper labeling and line weights will depict. Please review IIM55.

## SIGN ISLANDS

Standard Sign Islands are not to be shown on plans prior to field inspection. They will be shown on completed plans only where recommended by the District Traffic Engineer and in accordance with the standard. Sign islands for Secondary projects are to be shown only where recommended by the Resident Engineer.

# RAILWAYS: ADJACENT HIGHWAY DESIGN CONSIDERATIONS

## Design of Roadways in the Vicinity of Railways

The design of roadways in the vicinity of railways deserves special attention. Avoid designs where traffic signals, road intersections, road grades, and etc. could trap vehicles on the tracks Design alternatives must be considered which avoid a highway-rail crossing relatively close to an adjacent highway, running parallel to the railway track. Inadequate stacking or storage of stopped vehicles, at an adjacent road intersection, may trap vehicles on the tracks. This topic should be discussed with the Traffic Engineer, who should communicate and coordinate with the railway authority for an acceptable design. They may consider an electrical circuit between the grade crossing warning system and the highway traffic signals which allows the normal sequence of highway signals to be preempted to avoid trapping vehicles on the tracks. The Federal Highway Administration Manual on Uniform Traffic Control Devices addresses the topic of traffic signals at or near grade crossings. Also, avoid highway-rail crossing at which there is an abrupt change in the level of the road's surface as it crosses the tracks.

## Highway Construction Adjacent To Railway Tracks

Design details are to be included in the project plans when construction adjacent to a railway track requires temporary sheeting or a bulkhead to protect the tracks. IIM-LD-229 for the minimum railway roadbed section that must be retained (not undercut) for construction adjacent to the track and also denotes the limits where sheeting is required when excavation is involved. Actual requirements may vary slightly and the railway will determine specific submittal requirements.

The applicable typical section, plan, profile and cross section sheets and foundation information (i.e. borings, roadway soundings or consolidation information) for structures such as standard retaining walls, box culverts, etc., are to be furnished to the in the design of the temporary sheeting or bulkheads. The final design details for these structures will be included in the road plans. Bridge or other structure plans, under the supervision of the Structure and Bridge Division, will include the temporary sheeting or bulkhead design, when necessary, along with their other design details.

When required, three (3) copies of the detail drawing along with calculations covering the proposed design are to be furnished to the Department of Rail and Public Transportation for their use in obtaining Railway Company approval.

**Criteria For Temporary Sheeting And Bulkheads To Protect Railway Track During Adjacent Highway Construction**

1. The live load surcharge from track adjacent to sheeting and bulkheads shall be taken into account in the sheeting and bulkhead design. The recommended live load for each track is the Cooper E 80 load.

2. Allowable stresses contained in the American Railway Engineering Association "Manual for Railway Engineering"* (Chapters 7, 8 and 15) shall be used.

3. A construction procedure for temporary sheeting or bulkhead construction shall be included on the drawing. Show step by step sequence.

4. Safety railings shall be installed when temporary sheeting or bulkheads are within 4.6 meters (15 feet) of track.

5. A safety factor of 2 shall be used in the temporary sheeting or bulkhead design.

*Available from the Department of Rail and Public Transportation.

**Drawings and Calculations Needed For Approval**

1. Three (3) copies of detailed drawings showing the following:

   a. Timber, steel, bolt and weld sizes and details.

   b. Dimensions showing distances from centerline track to temporary sheeting or bulkheads and between supporting elements.

   c. Section showing temporary sheeting or bulkhead heights and track elevation.

   d. Note: Contractor to provide handrail protection (H = 0.9 meter (3'-0") minimum for excavation adjacent to track or leave sheeting 0.9 meters (3'-0") minimum above ground line adjacent to excavation.

   e. Drawings <u>must</u> be to scale.

2. Calculations covering temporary sheeting or bulkhead design.

**Clear Zone Requirements**

A minimum of 6.7 meters (22') of clear zone is required adjacent to railway tracks.

## BICYCLE FACILITIES

Bicycle Facilities are to be provided as specified, for replacement in kind, or as shown on the approved preliminary plans.  Proposed Bicycle Facilities and crossing of bicycle facilities are to be depicted with light, solid lines and proper labeling.

## GREENWAYS

All official Greenways (as defined in Chapter 1B, Section 1B-2) that cross the proposed highway right-of-way are to be depicted with light and solid lines.

## UNDERDRAINS

Underdrains are installed for a number of purposes, most of which may be included in the following classifications:

1. Control of seepage in cuts or side hill location.
2. Lowering of ground-water table.
3. Base, subbase and subgrade drainage.

(See IIM LD- 130 for more information on underdrains).

St'd. UD-1 Underdrains are to be shown on the plans at locations prescribed in the soil investigation report from the Materials Division.  The underdrains are to be depicted similar to pipe culverts and located generally parallel to the roadway as shown in VDOT's Road and Bridge Standards.  St'd. UD-4 or UD-5 pavement edgedrains will be provided, where recommended, to provide drainage for pavement subbase, in addition to St'd. UD-1's as recommended at F.I.

St'd. UD-2 underdrains are to be located under raised grass medians at locations discussed at field inspection and recommended by the Materials Division.

St'd. EW-12 is to be used at the outlet ends of all St'd. CD's and UD's which do not tie to other drainage structures.

St'd. UD-2 underdrains are to be depicted on the plans as described for St'd. UD-1 underdrains.  Care must be taken to insure proper treatment of drainage at the outlet end of the system.  St'd. CD-1 underdrains are to be located where the proposed grade passes from a cut to a fill condition.  They are to be placed only in cuts of  appreciable length and in downgrade situations as shown in VDOT's Road and Bridge Standards.

They are to be depicted as described for St'd. U-1 underdrains. St'd. CD-2 underdrains are to be placed in sag fill situations and at bridge approach slabs as indicated in VDOT's Road and Bridge Standards. They are depicted as described for Standard UD-1 underdrains.

St'd. UD-3 Sidewalk Underdrains are to be provided as determined at the project Field Inspection.

Underdrains are to be provided in ramp gore areas to collect subsurface water on down grade situations as described in IIM LD-130.

**DEMOLITION OF PAVEMENT - OBSCURING OLD ROAD**

Demolition of pavement and obscuring old road are to be computed and depicted on plans as outlined in IIM LD-47. These items are to be shown on the plans after right of way has been plotted.

**TREE WALLS AND TREE WELLS**

The designer is required to review the proposed location and design of all tree walls and tree wells with the Environmental Division prior to inclusion in the plan assembly.

**LABELING INCIDENTAL ITEMS**

All incidental items, if not denoted individually, may be denoted by numbers within equilateral triangles having 10 mm (3/8") sides with a description of the particular item shown in a conspicuous location on each plan sheet. Labeling should be consistent between plan sheets and typical sections.

**PEDESTRIAN RAMPS**

See Instructional and Informational Memoranda IIM LD- 55.

**MOUNTABLE CURB AND CURB AND GUTTER**

Mountable curb and mountable combination curb and gutter, St'd. CG-3 and St'd. CG-7, will be used on rural highways with a design speed greater than 65 km/h (40 MPH) and in developed Urban and Suburban areas with a design speed greater than 70 km/h (45 MPH). The use of barrier curb and combination curb and gutter, St'd. CG-2 and St'd. CG-6, will be limited to Rural projects with a design speed of 65 km/h (40 MPH) or less and 70 km/h (45 MPH) or less in developed Urban and Suburban areas. When St'd. CG-3 and/or St'd. CG-7 is specified on the plans, the regular designation for entrance gutters, street Connections, median strips, etc., will be used.

## GRADING CONTOURS

The need to provide proposed grading contours at interchange locations should be discussed at field inspection. Particular attention should be given to contouring gore areas and areas where drainage structures will be constructed to insure that the final design can be safely traversed by a vehicle within the established clear zone for a particular project. Gore areas at entrance ramps in cut situations should also be discussed to assure that adequate horizontal sight distance will be provided. Unless otherwise directed, as a result of field inspection or written recommendations, proposed grading contours are to be included in the plan assembly using 1 meter (2-foot) intervals. The proposed contours are to cover either all or portions of the interchange area where the design can more clearly be defined in order that the plans clearly reflect the limits of fill or cut construction. This will also be of benefit in the placement of guardrail, in the interest of safety and general final appearance of the proposed design.

## CONSTRUCTION OF CATTLE PASSES

Cattle passes will not be built on two-lane highways with right of way of 33 m (110 feet) or less; however, existing structures may be widened. If the property owner desires a cattle pass and pays the difference between such a structure and the structure that is required for drainage, then a cattle pass may be constructed. Where the right of way width is over 33 m (110 feet) and the plans for the present or future construction provide for a four-lane divided highway, cattle passes may be constructed under certain conditions. If the land on each side of the highway is under the same ownership, at least forty (40) head of horses or cattle are to be passed from one side of the right of way to the other daily, and its construction is recommended by the Right of Way Engineer and approved as to location by the Transportation Engineer, a cattle pass may be constructed upon approval by the Chief Engineer.

Previous studies and investigations have determined that a St'd. 1.5 m x 2.0 m (5' x 7') Box Culvert or an equivalent metal pipe is to be provided for access when the need has been established and so documented. In the location and design of the structure, especially on a four lane divided facility where the barrel length would be long, special attention is required to provide day-lighting when the barrel length approaches or exceeds 60 m (200 feet). Sufficient light must be available or the structure will not serve its intended purpose. Erosion control, if required, should have a smooth surface. Sufficient light and a smooth surface are both necessary for horses and cattle to enter a structure. The plan description shall indicate the purpose of the structure. Example: St'd. 1.5 m x 2.0 m (5' x 7') Box Culvert Req'd. For Cattle Pass.

# SECTION 2E - 4 - SHOWING BRIDGE LIMITS ON PLANS

## DETERMINING APPROXIMATE LENGTH OF BRIDGE

The approximate length of a proposed bridge is determined by projecting the spill slope upward from existing stream banks, proposed channel slopes, or existing or proposed roadway ditches to the finished grade line of the higher roadway.

These limits must be adjusted when bridge plans are completed.

## DETERMINING APPROXIMATE WIDTH OF BRIDGE

The approximate width of proposed bridges is determined by applying the appropriate geometric design standard, with additional sidewalk spaces where applicable.

## DEPICTING ON PLANS

Outer limits of bridges, including wingwalls, are to be plotted with heavy solid lines. Beginning and ending of bridge projects are to be flagged.

## SECTION 2 E - 5 - PROPOSED RIGHT OF WAY AND LIMITED ACCESS

### DETERMINING PROPOSED RIGHT OF WAY ENCOMPASSING SLOPE LIMITS

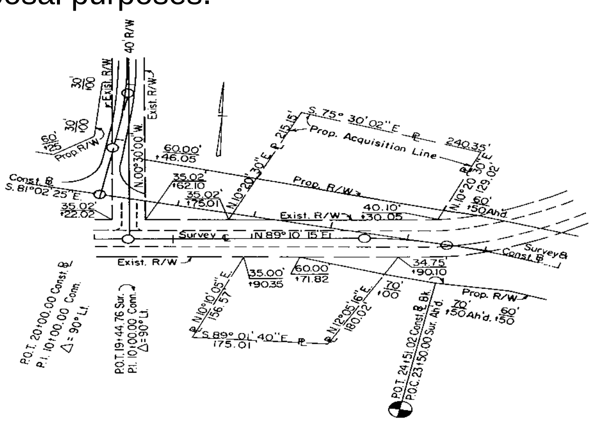
All existing right of way acquired in fee will be shown on plans as established by the survey information or other data. The plans will not designate prescriptive or statutory right of way as existing right of way.

The width of proposed right of way shall be sufficient to accommodate the roadway cross-section elements and requisite appurtenances necessary for an adequate facility in the design year and for known future improvements.

Minimum right of way widths are to be set in accordance with the "CS" standards in VDOT's Road and Bridge Standards.

Right of way breaks are to be set at reasonable longitudinal distances so as not to obtain excessive right of way. Breaks are to be spaced at sufficient intervals so that the right of way line will not be unreasonably irregular and are to be located in accordance with the Criteria for Placement of Right of way Monuments covered in Appendix C, Section C-3-RIGHT OF WAY.

There are instances when it is desirable to acquire an entire parcel. This occurs when only a portion of the parcel is required for the construction of the project, (e.g., - only small residue remains; dwelling, etc., taken by construction, and residue does not meet minimum requirements for reconstruction). These situations should be reviewed at the project field inspection and a decision regarding the property made at that time or during the right of way appraisal stage. When this occurs, the normal right of way line is to be established (clearly dimensioned) and labeled "Proposed Right of Way" and the residue property line(s) labeled "Proposed Acquisition Line" (See Appendix C, Section C-3-RIGHT OF WAY). By labeling the residue in this manner, the surplus property has been established and will be included in the Right of Way Division's "Residue Parcels Inventory" for disposal purposes.



Right of Way breaks are to be shown as near as feasible to the applicable break, and lettered along a line parallel to the baseline. The distance from the baseline is to be shown above a solid line with the baseline plus below. When more than one baseline is used, the referenced line should be identified.

Proposed right of way is to be labeled on each side of the roadway at least once per plan sheet unless broken by a connection or relocation.

**DETERMINING PROPOSED RIGHT OF WAY WITH SLOPE EASEMENTS**

On most Urban projects, and in some other instances, it is desirable to acquire right of way only for the proposed roadway, buffer strips, and sidewalk. The proposed right of way line, in this case, is usually based on the computed back of sidewalk line or on a line parallel to the back of sidewalk.

**DETERMINING SLOPE EASEMENTS**

Permanent or temporary slope easements are acquired encompassing the area actually needed for slopes, plus a working area of approximately 1.5 m (5'). The need for maintaining the slopes following the completion of construction is to be determined at Field Inspection. Should continued maintenance be deemed necessary, then a permanent easement will be recommended. Otherwise, a temporary easement to terminate at the end of construction will be recommended.

The slope easement line is established spacing breaks similar to the method indicated previously in this section for right of way lines and is shown in a dot-dot-dashed medium weight line for temporary easements or dot-dashed line for permanent easements with the pluses and distances for the breaks shown in parentheses for temporary easements, or brackets for permanent easements. If an easement break falls on a right of way break, a separate easement break will also be shown.

A note is to be shown on each applicable plan sheet in a conspicuous location as follows:

> "Note: Figures in parentheses and dot-dot-dashed lines denote temporary easements."

Or "Note: Figures in brackets, and dot-dashed lines denote permanent easements."

Or "Note: Figures in double brackets, and dot-dashed lines denote utility easements."

The usage of the easement will also be indicated on the plans (e.g. Prop. Temp. Slope Easement, Prop. Perm. Drainage Easement, etc.).

## CONSTRUCTION EASEMENTS

Frequently, there are items located within the proposed construction easements, such as signs, light poles, steps, etc., which for some reason it is preferable to work around rather than remove. When it has been determined that certain items are not to be disturbed, this should be clearly noted on the plans so that the Right of Way Division will not purchase unnecessary items. These requirements are normally determined by the Right of Way Division.

## DETERMINING PERMANENT EASEMENTS

Permanent easements are used where perpetual maintenance is required, such as slope easements as recommended by the District Administrator or where fee right of way is impractical, such as for ditches or pipes extending beyond the project limits. In these instances, the permanent easement is to generally parallel the item in question, clearing the construction limits by approximately 1.5 m (5') or a sufficient width for the required maintenance necessary.

The permanent easement lines are tied to the proposed right of way line and at necessary points around the periphery of the item in question, allowing adequate space for construction activity.

The permanent easement lines are to be dot-dashed and pluses and distances are shown in brackets. A note is to be shown, in a conspicuous location on each applicable plan sheet, as follows:

> "Note: Figures in brackets and dot-dashed lines denote permanent easements."

The exact usage of the easement needs to be specified at each location, such as "Prop. Permanent Easement for Installation and Maintenance of Prop. Drainage Structure" or "Prop. Permanent Easement for Construction and Maintenance of Prop. Drain Ditch." If space is not available in the area of the easement, label the easement "Proposed Permanent Easement" with an asterisk (or similar notation) and show a note detailing the exact usage of the easement at another location on the sheet. Highway aerial easements are to be shown similar to the drainage easements and labeled "Proposed Aerial Easement for Bridge" and, if necessary, asterisks (or similar notations) are to be shown on all applicable easement breaks to distinguish the easement from other easements in the area.

In cases where permanent and temporary easement requirements overlap, the permanent easement takes precedence over the temporary easement; therefore, a temporary easement is to be tied into the permanent easement, not run through it. In some cases, a temporary construction easement will be necessary to generally run parallel to the permanent easement to provide adequate working and storage space. Where this is necessary, the temporary construction easement is to be shown, in its entirety, as the previously mentioned temporary slope easements and labeled "Prop. Temporary Construction Easement."

Easements that run away from the roadway (generally perpendicular) are to be dimensioned by pluses and distances to each corner.

**UTILITY EASEMENTS**

In the past, utility easements have not been identified on public hearing plans. Following the public hearing and even as late as construction, concerns have been raised that citizens have not always been informed that utility easements may be added after the public hearing.

Discuss the necessity of showing preliminary utility easements on project plans at the scoping stage and at field inspection. Strong consideration should be given to showing proposed preliminary easements on project plans in residential areas prior to the willingness and public hearing stage.

The field inspection recommendation regarding inclusion of preliminary utility easements should be reviewed with the appropriate Assistant L & D Engineer or District Location and Design Engineer.

If the decision is made to add preliminary utility easements on the project plans, three sets of prints will be furnished by the designer to the District Utility Engineer along with a written request to develop preliminary utility easements for the public hearing stage. The date this information will be needed to meet the public hearing schedule will be included in the request.

If the decision is made not to add preliminary easements on the project plans, the appropriate plan note (note B) is to be shown on prints for the willingness, public hearing and prints furnished outside the department.

When the preliminary utility easement information is received from the utility section, they are to be shown on prints for the willingness or public hearing and prints furnished outside of the department along with the appropriate plan note.

After the utility field inspection and before submission of approved right or way plans, detailed utility easement information will be provided by the Right of Way Division and shown on original plan sheets.

Notes A or B shall be removed from plans after the public hearing stage prior to submitting plans for right of way.

The following note should be shown on the title sheet and <u>all</u> plan sheets <u>when preliminary easements are shown</u> on plans.

**NOTE A**

| |
|---|
| PRELIMINARY EASEMENTS FOR UTILITY RELOCATIONS<br>ARE APPROXIMATE ONLY AND SUBJECT TO CHANGES<br>AS PROJECT DESIGN IS FINALIZED |

When the decision is made <u>not to add preliminary easements</u> the following note is to be shown.

**NOTE B**

| |
|---|
| ADDITIONAL EASEMENTS FOR UTILITY RELOCATIONS<br>MAY BE REQUIRED BEYOND THE PROPOSED RIGHT OF<br>WAY SHOWN ON THE PLANS |

One of the above notes should be shown on all prints for the willingness or public hearing stage and prints furnished outside the Department.

On prints for public hearing or willingness and prints furnished outside the Department, shade in yellow with highlighting marker, the above notes for additional emphasis.

A discussion concerning possible additional or adjusted utility easements shall be included in:

Engineering presentation
Public Hearing handout/booklet

The following are examples of how this discussion may be worded:

(1) When preliminary easements <u>are shown</u> on project.

"As we further coordinate and finalize project development, preliminary utility easement locations shown on public hearing plans may change. The property owner will be informed of the exact location of the easements during the right of way acquisition process and prior to construction."

(2) When preliminary easements <u>are not shown</u> on project.

"As we further coordinate and finalize project development, additional easements for utility relocations may be required beyond the proposed right of way shown on the public hearing plans. The property owner will be informed of the exact location of the easements during the right of way acquisition process and prior to construction."

Detailed utility easements requirements are determined by the District Utility Engineer after the Utility Field Inspection (Chapter 2E, Section 2E-13) has been conducted. The District Utility Engineer will furnish marked prints to the designer showing the utility easements which are to be shown on the plans. If this information is received prior to approved right of way plans, it is included as a part of those plans. Otherwise, it must be added as a revision to the approved right of way plans.

Marked plans furnished, showing the necessary easements, shall contain the appropriate note indicating type (standard or trim and overhang) and for which utility company the easement is being acquired. There are instances where joint use utility easements are proposed. In those cases, all companies are to be shown. Utility easements are separate from any other permanent or temporary easement and are not to be broken where they cross these other easements. They are to be stopped at any location where they intersect the proposed or existing right of way line.

The marked prints of utility easements shall contain adequate information to incorporate the utility easement into the plans. When a utility easement is parallel to the proposed right of way line and is of a consistent width, it is not necessary for the marked prints to show pluses and distances. The designer shall show and/or calculate the appropriate break points. For easements that are not parallel, the marked prints shall contain sufficient information for the designer to add the utility easements to the plans. (i.e. pluses and distances or distances on a property line). All easements must mathematically close.

The utility easement lines are to be dot-dashed with pluses and distances shown in double brackets [[-]]. Each line is to be labeled as to type and utility company. Parallel utility easements 1.5 m (5') apart or closer should be questioned. Normally these lines should be combined into a joint easement at the wider width; however, the District Utility Engineer should be consulted before making that change.

Once the right of way acquisition process has begun, requests for easement revisions must originate with or be coordinated with the District Right of Way office.

For utility easements, an appropriate note is to be shown on each plan sheet which contains an easement, using appropriate notes as furnished by the Right of Way Division and symbols as shown in the CADD Manual.

**LIMITED ACCESS LINES**

Where limited access lines coincide with proposed right of way lines, the common line is to be labeled "Proposed Right of Way and Limited Access Line" with breaks shown as previously described for proposed right of way.

Where limited access lines deviate from proposed right of way, they are to be shown as dashed lines and are to be labeled "Proposed Limited Access Line."

Proposed limited access lines are to be continuous for the length of the project, except at interchanges. Where frontage roads are provided, the limited access line is to tie to the proposed right of way line at appropriate points and usually run parallel to and between the frontage road and mainline. Where applicable, the limited access line is to be labeled: "Proposed Limited Access Line (insert distance) from and parallel to Frontage Road Baseline."

At interchanges, the limited access lines are to encompass the entire periphery of the interchanges and should extend beyond the ramp terminals a minimum of 30 m (100') in urban areas and 90 m (300') in rural areas. (See Figure 2E-9). These distances usually satisfy any congestion concerns. However, in areas where the potential for development exists which would create traffic problems, it may be appropriate to consider longer lengths of access control. The beginning and ending points of limited access lines are to be flagged with "Begin" and "End Limited Access" with stations referenced to the connecting road. Limited access lines are to be broken and flagged with stations based on the mainline at grade separations.

Unless specifically advised to the contrary by the Right of Way and Utilities Division, begin and end limited access is to be flagged only at or near the beginning and end of the right of way project and at interchanges and grade separations as previously noted.

On all projects designated as "Limited Access Highways", the date of the resolution passed by the commission, Board, etc., and the words "LIMITED ACCESS HIGHWAY" are to be shown above the project block on the title sheet and on each plan sheet. This is applicable to all new projects and also to all projects involving previously designated "Limited Access Highways".

Over the years the "Highway Commission" has been updated to the "State Highway and Transportation Commission", the "State Highway and Transportation Board" and as of January 1, 1987, is the "Commonwealth Transportation Board".

Following are the notes that are to be used along with the applicable project situations:

**(1) LIMITED ACCESS HIGHWAY** **By Resolution of Commonwealth Transportation Board dated ________.**

All projects designated after December 31, 1986 by "Commonwealth Transportation Board" (includes interstate and other highways that tied the original L/A line down by stations and thereby, require a new resolution)

**(2) LIMITED ACCESS HIGHWAY** **By Resolution of Highway Commission dated ________.**

All interstate highways and all highways previously designated by "Highway Commission".

**DEPICTING LIMITED ACCESS RIGHT OF WAY**

The method of designating Right of Way on a proposed limited access project should be as indicated in Figures 2E-9 and 2E-10. Unusual conditions, not covered by these examples, may require individual study and should be discussed at Field Inspection.

**SEPARATE RIGHT OF WAY PLANS**

If plan sheets are extremely congested with topography, etc., separate right of way plans may be justified. This determination is to be made by the Engineer in charge of the project design.

**PROPERTY REQUIRING METES AND BOUNDS DESCRIPTION**

Complete metes and bounds information is to be included in the approved right of way plan assembly for projects requiring procurement of property from unique clients (e.g. Federal and State governmental agencies, railways and Power companies). This requirement shall apply to all land and permanent easement acquisitions. It is not necessary to provide metes and bounds descriptions for temporary construction easements. Temporary construction easements shall be designated with conventional plus and distance on the breaks and acreage of take.

This information is to be shown on a "METES AND BOUNDS" sheet included in the approved right of way plan assemblies for applicable projects as a "1 series" sheet. Information shown shall include property owner names (including adjacent parcels), utility company names (e.g. Bell Atlantic, Virginia Power, Hampton Roads Sanitation District, etc.) types of easement (permanent drainage, permanent utility, temporary construction, etc.) property lines, right of way and easement lines (proposed and existing), centerline/baseline identification with stationing, bearings, lengths, curve data, and acreage of take. Right of way and permanent easement takes on radius are to show chord length, chord bearing, arc length, and radius.

The Metes and Bounds closure is to be calculated in a clockwise direction, with all break points labeled and information (bearings, lengths, curve data) shown in tabular form on the Metes and Bounds sheet. The point of beginning for each parcel will be a readily identifiable point, such as an iron pin, Right of Way monument or reference to the Construction Baseline. Deed records for railroad properties are to be referenced from a railroad mile post and tied specifically to railroad track stationing. The Metes and Bounds sheet should have sufficient descriptive detail to be used independent of the construction plan sheets; however, construction plans and Metes and Bounds sheets should reference each other for supplemental information.

A separate metes and bounds sheet may not be needed on non-complex projects, provided data can be shown legibly on the roadway plan sheet.

The District Survey Sections (or Central Office Survey Section) shall confirm that the metes and bounds are shown correctly. The road designer shall furnish any available original property line back up information to the Survey Section for this review. At the completion of the review, the road designer shall furnish the sheet to the Right of Way and Utilities Division, normally, as part of the approved right of way plan assembly for their use in preparing the deed description. (See sample Metes and Bounds Sheet 2E-9).

Some Federal agencies prefer that only a single roadway easement be shown, rather than separate easements for roadway, drainage, stormwater management or other types of permanent easement. It would be advantageous to the designer to contact the Right of Way and Utilities Division's Special Negotiations Section (804-786-2986) for directions prior to determining right of way requirements.

# METES AND BOUNDS FOR COMMONWEALTH OF VA. NATIONAL GUARD

**AREA 1 — PERMANENT DRAINAGE EASEMENT**

| LINE | BEARING | LENGTH | RADIUS |
|---|---|---|---|
| A B | N76°00'20"E | 111.13' | |
| B C | N76°00'20"E | 12.28' | |
| C D | S14°30'47"E | 6.16' | |
| D E | S76°00'20"W | 12.28' | |
| E B | N14°30'47"W | 6.16' | |
| TOTAL ACREAGE = 0.002 ACRE | | | |

**AREA 7, PARCEL 002 — FEE RIGHT OF WAY**

| LINE | BEARING | LENGTH | RADIUS |
|---|---|---|---|
| C X | N76°00'20"W | 175.89' | |
| X S | S67°26'50"E | 105.16' | |
| S R | CHORD S63°05'11"W | 144.82' | 319.30' |
| R O | S76°00'20"W | 16.36' | |
| O K | S76°00'20"W | 102.00' | |
| K C | N14°30'47"W | 95.00' | |
| TOTAL ACREAGE = 0.470 ACRE | | | |

**AREA 2 — UNDERGROUND UTILITY EASEMENT FOR CITY OF NORFOLK**

| LINE | BEARING | LENGTH | RADIUS |
|---|---|---|---|
| A C | N76°00'20"E | 123.41' | |
| C F | S14°30'47"W | 10.00' | |
| F G | S76°00'20"W | 123.56' | |
| G A | N31°39'40"W | 10.10 | |
| TOTAL ACREAGE = 0.027 ACRE | | | |

**AREA 4 — PERMANENT DRAINAGE EASEMENT**

| LINE | BEARING | LENGTH | RADIUS |
|---|---|---|---|
| H L | S14°30'47"E | 85.00' | |
| L M | S75°50'50"W | 10.00' | |
| M I | N04°30'47"W | 85.00' | |
| I H | N75°52'50"E | 10.00' | |
| TOTAL ACREAGE = 0.020 ACRE | | | |

**AREA 5 — PERMANENT DRAINAGE EASEMENT**

| LINE | BEARING | LENGTH | RADIUS |
|---|---|---|---|
| C K | S14°30'47"E | 95.00' | |
| K N | N76°00'20"E | 77.00' | |
| N O | N76°00'20"E | 25.00' | |
| O P | S06°13'05"W | 40.50' | |
| P Q | S75°59'26"W | 11.00' | |
| Q N | N04°00'31"W | 38.00' | |
| TOTAL ACREAGE = 0.016 ACRE | | | |

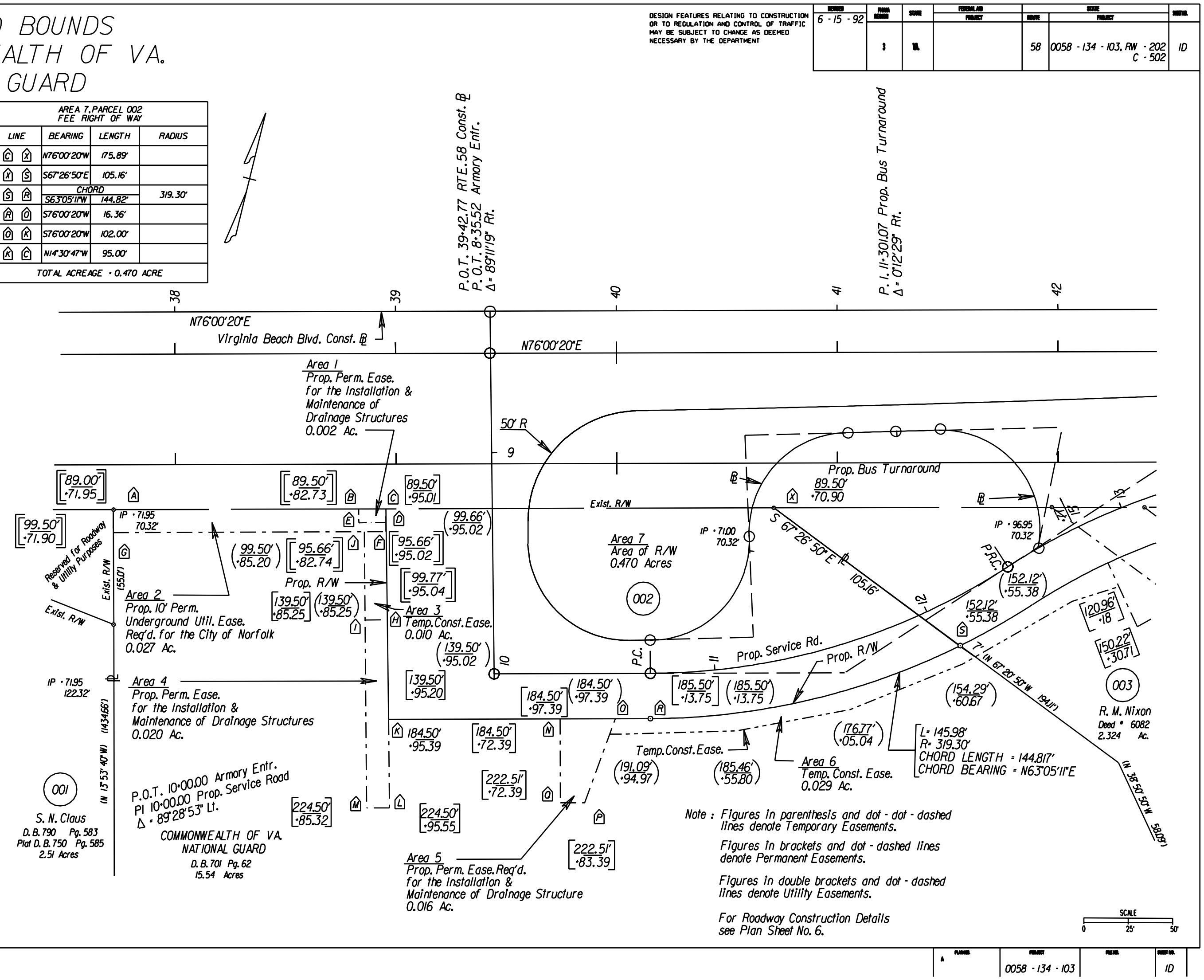



FIGURE 2E-9 SAMPLE METES AND BOUNDS SHEET

## RIGHT OF WAY DESCRIPTION FURNISHED TO ENVIRONMENTAL DIVISION

The environmental planning process requires that the following right of way data must be furnished to the Environmental Quality Engineer upon request for an environmental document.

1. Both a right of way description and estimate of total right of way area will be included in all categorical exclusions and Environmental Assessment Documents.

2. The U.S. Farmland Protection Act requires that all federally funded highway projects be coordinated with the U.S. Soil Conservation Services to determine impact, if any, upon Farmlands. The process for coordination with the U.S. Soil Conservation Service requires that an estimate of the area of right of way for all projects be provided to the district conservationist.

"Right of Way", regarding the description and area, is defined as fee-simple right of way, temporary and permanent easements and donations of lands. Specify if the land required for "Right of Way" is developed residential, commercial, and/or industrial.

The following are example statements describing the right-of-way for an environmental assessment.

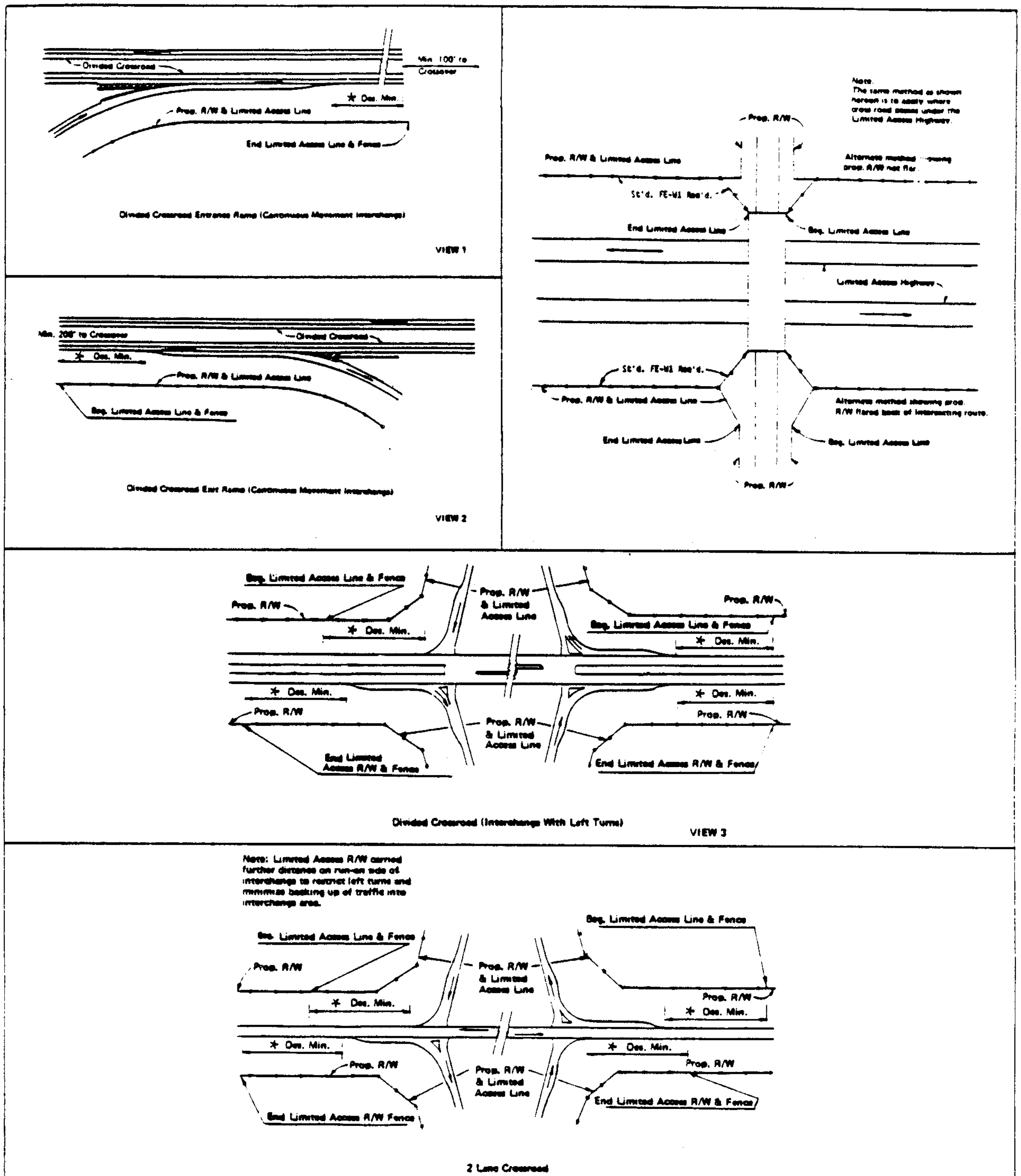
1. Less than 3 m (10') strips on both sides of the roadway for the length of the project.

2. Less than 2 ha (5 acres) for widening and removal of several hairpin curves.

3. Approximately 1 ha (2 acres) of right of way and easements for constructing bridge and improving 300 m (1,000') of approaches.

There are other situations which will require right of way descriptions and area estimates other than the above examples.

The area can be just a rough approximation of the combined right of way, easements, etc., and should entail only a minimum amount of calculation. This area will be helpful to the FHWA in deciding whether more than minor amounts of right of way are involved.




* 100' Urban, 300' Rural

-NOTE-

1. Distances and locations shown for beginning or ending limited access R/W are approximate only. Each case will have to be studied individually.
2. Adjacent crossover distances referred to in views 1, 2, and 3 are desirable minimums only. Actual distances will vary with the individual case.

**FIGURE 2E-10 DEPICTING LIMITED ACCESS RIGHT-OF-WAY**

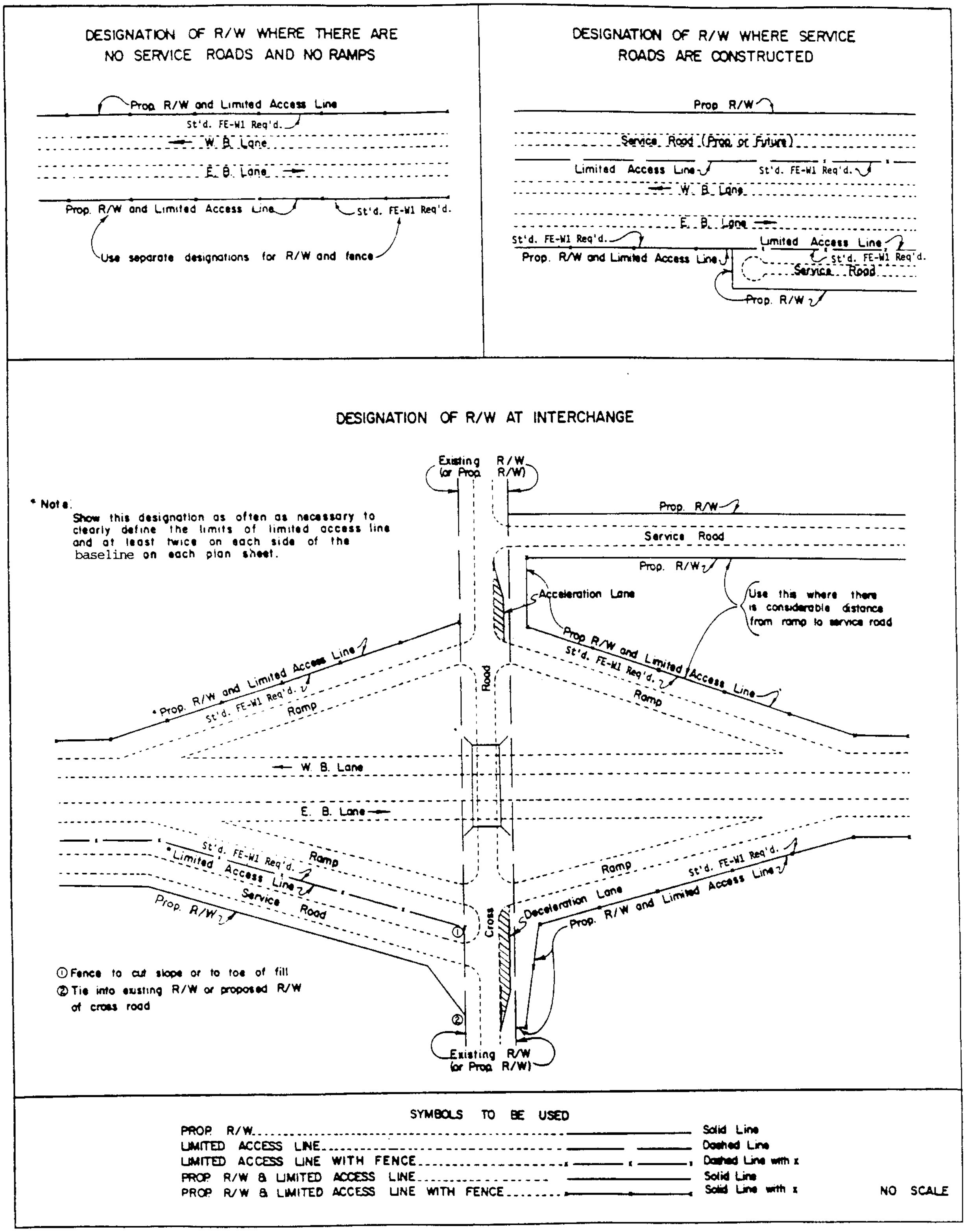



**FIGURE 2E-10 DEPICTING LIMITED ACCESS RIGHT-OF-WAY**

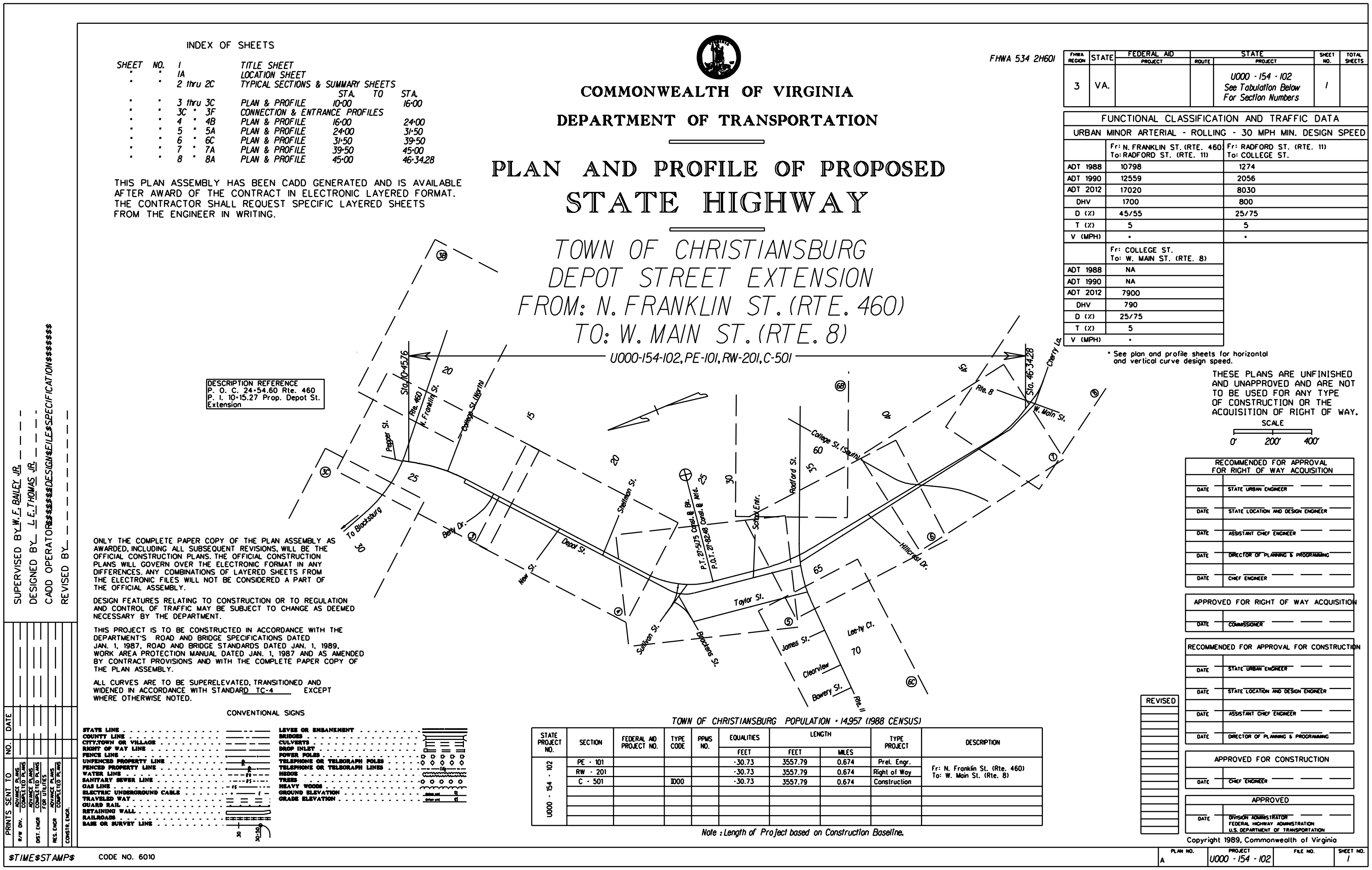
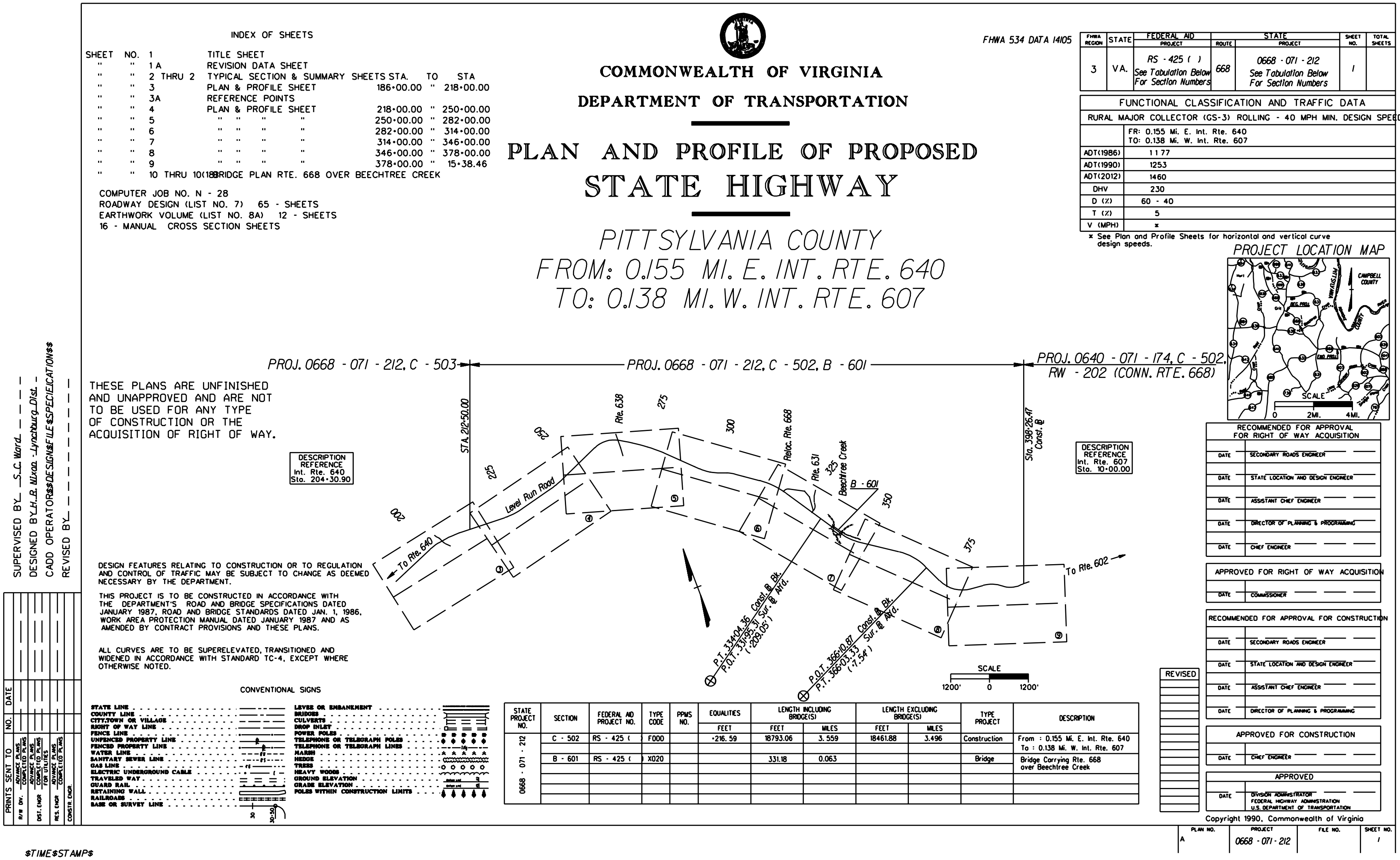



**FIGURE 2E-11 SAMPLE TITLE SHEET (URBAN DESIGN)**




| STATE PROJECT NO. | SECTION | FEDERAL AID PROJECT NO. | TYPE CODE | PPMS NO. | EQUALITIES FEET | LENGTH INCLUDING BRIDGE(S) FEET | MILES | LENGTH EXCLUDING BRIDGE(S) FEET | MILES | TYPE PROJECT | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0668 - 071 - 212 | C - 502 | RS - 425 ( ) | F000 | | -216.59 | 18793.06 | 3.559 | 18461.88 | 3.496 | Construction | From : 0.155 Mi. E. Int. Rte. 640 To : 0.138 Mi. W. Int. Rte. 607 |
| | B - 601 | RS - 425 ( ) | X020 | | | 331.18 | 0.063 | | | Bridge | Bridge Carrying Rte. 668 over Beechtree Creek |

**FIGURE 2E-12 SAMPLE TITLE SHEET (SECONDARD DESIGN)**

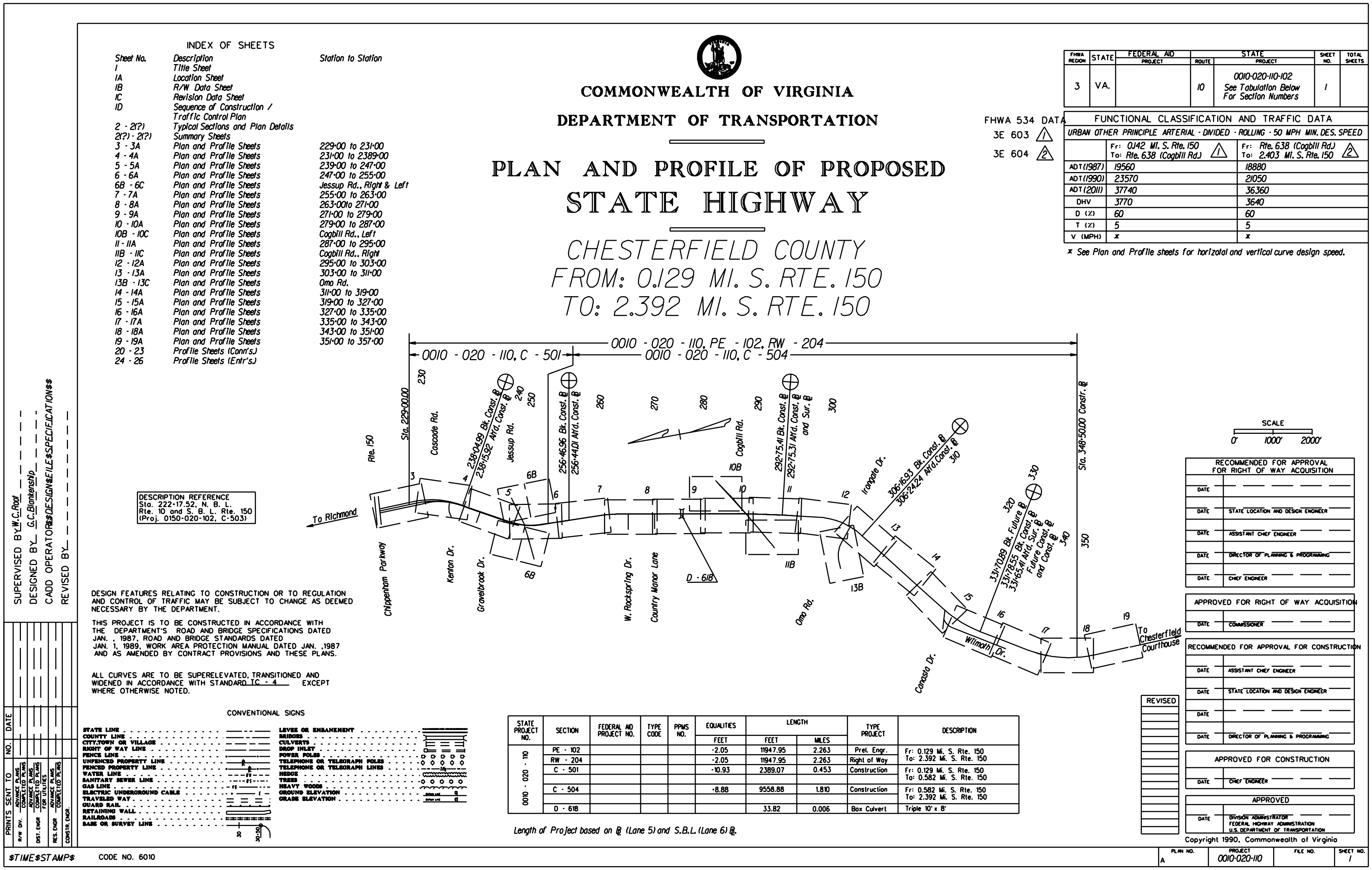



**FIGURE 2E-13 SAMPLE TITLE SHEET (PRIMARY)**

## PLAN REVISIONS

When a request is made to revise plans that would change a proposed right of way line or proposed easement, the request should indicate to the designer if the property has already been acquired. If so, the original proposed right of way line or proposed easement is <u>not</u> to be removed from the plans and is to be designated as follows:
"Orig. Proposed Right of Way" or "Orig. Proposed <u>type of easement</u>". Label the revised right of way or easement lines "Rev. Prop. Right of Way (<u>date</u>)" or "Rev. Prop. <u>type of easement and (date</u>)," respectively.

# SECTION 2E - 6 - PREPARATION OF SUPPLEMENTAL SHEETS

## TITLE SHEET (SEE FIGURES 2E - 11, 2E - 12, & 2E - 13)

A title sheet is to be prepared generally for each project or group of projects previously determined to be advertised simultaneously. The basic sheet is to be adapted to all uses (such as limited access, urban projects, secondary projects, etc.)

## IDENTIFICATION

The project base number(s) on all projects are to be shown in the block provided in the upper right corner of the title sheet. For Federal projects, an identifier will be added as a prefix to the project number on the title sheet. This identifier will be (FO) for projects with Federal Oversight and (NFO) for projects with No Federal Oversight. Federal-Aid number(s), when applicable, will be shown in this block (on the title sheet only), showing the parentheses without numbers within. All project numbers are to be referenced with a note to "see the project length tabulation block". The project base number(s) are to be shown in the block provided in the lower right corner of the sheet. The Federal-Aid number is to appear on the title sheet only.

See Example below:

| STATE | FEDERAL AID | STATE | | SHEET NO. |
|---|---|---|---|---|
| | PROJECT | ROUTE | PROJECT | |
| VA. | RS – 425 ( )<br>SEE Tabulation Below<br>For Section Numbers | 668 | (FO)0668-071-112<br>SEE Tabulation Below<br>For Section Numbers | 1 |

The Highway Capital Outlay Code (FHWA-534) is to be shown on the title sheet in the upper right-hand corner to the left of the project number block. (See IIM LD-151 for further instructions).

The title sheet is always numbered "1".

The Designer's name and phone number (including area code) is to be shown in the middle left margin in the space provided. The Supervisor's name is to be shown directly above the Designer's name.

Copyright date is to be shown directly below the signature blocks in the lower right corner. (See IIM LD-186).

For additional notes to be shown on the title sheet, See IIM LD- 110.

The appropriate TC-5.01 designation (TC-5.01ULS, TC-5.01U, or TC-5.01R) must be shown on the title sheet.

**LAYOUT**

A layout of the project limits is to be plotted depicting the existing baseline of the mainline roadway, interchanges, connections, railroads, rivers, major (usually named) streams, and major landmarks. Street names, as well as route numbers, are to be shown where applicable. These items are to be labeled in accordance with the CADD Users Guide with destination for the mainline, connections, and railroads. Flow arrows are to be shown for rivers, etc..

The layout is to be plotted to a reasonable scale large enough to utilize the space provided but not so large as to encroach on other items (index, project tabulation, etc.).

Description reference blocks are to be shown to coincide with the project description and previous projects.

The number of and distance to the nearest railroad mile post is to be shown if the project crosses or involves a railroad.

A heavy solid line is to be shown depicting the proposed mainline, connections, ramps, frontage roads, etc., with station marks shown at appropriate intervals depending upon the length of the project.

Station numbers are to be shown above the station marks in accordance with the CADD Users Guide readable from the right end of the sheet.

Equalities are to be shown, where applicable to the project length, with symbols similar to previous instructions for plan sheets. (See Figure 2E-12).

Light dashed lines are to be shown over the layout delineating the limits of each plan sheet with the corresponding sheet numbers shown within light dashed circles.

Proposed bridges, culverts, or other items requiring "B" or "D" numbers are to be clearly shown and labeled in accordance with the with the applicable "B" or "D" number. (See Project Length Tabulation, this section)

Interchange ramps are to be labeled with the description used on the plans. (Ramp "A", etc.)

Vertical lines are to be projected upward from the begin and end project points with the applicable State project numbers shown in accordance with the CADD Users Guide along horizontal lines between them. Begin and end project station numbers are to be shown in accordance with the CADD Users Guide along the vertical lines. If the preliminary engineering project limits extend beyond the normal project limits, the arrows for the PE numbers are to extend beyond the vertical lines indicating continuation of the project.

Tie-in project numbers are to be shown on each end of the project, where applicable, showing status such as "Under Const.", "Under Design", etc..

A north arrow and bar scale are to be shown in conspicuous locations with the scale in the lower center or right area of the layout.

## DESCRIPTION

The county or city name is to be shown in the center of the title sheet, directly below the line under the large pre-printed title. Directly below this line, centered horizontally, is shown the project description, with distances from intersections, etc., shown to the nearest thousandth of a kilometer (mile).

If a "from" and "to" description is used, "from" is shown on the top line and "to" on the bottom. Descriptions are to be referenced from items such as county or city lines, primary routes, secondary routes, rivers or major streams, railroads, etc.

In cases where the mainline has a designated commonly used street name, it is to be shown between the county or city name and the description.

## PROJECT LENGTH TABULATION

A block is to be provided in the lower center of the title sheet for the following information (Show in accordance with the CADD Users Guide where practicable):

State Project No." - Listing of applicable state project base numbers

Section" - Listing of various section numbers such as "PE-101", (if the PE number extends beyond the limits shown on the layout, no reference is to be made in the length tabulation) "RW-201", "G-301", "P-401", "C-501", "B-601", etc.

"Federal Project No." - Listing of complete Federal project number

"Type Code No."- Listing of applicable Type Code Nos. such as "F000", "I000", "K000", etc.

"P/PMS No." - Listing of applicable P/PMS Nos. "

"Equalities in meters (feet)" - Listing of equality lengths, whether "+" or "-" for the various sections. If none, the word "none" is to be shown.

"Exceptions, meters (feet) - Listing of exception lengths where applicable "Length, meters (feet), kilometers (miles)" - Listing of lengths of various roadway sections - to be shown to the nearest hundredth of a meter (foot) and nearest thousandth of a kilometer (mile); "Length Including Bridges", "Length Excluding Bridges", listing of bridge lengths based on the same line as the roadway lengths and affecting the roadway lengths; "Length Including Box Culverts", "Length Excluding Box Culverts", listing of box culvert lengths based on the same line as the roadway lengths and affecting the roadway lengths. (Only where traffic is placed directly on the top slab of the box culvert). All "B" and "D" projects are to be shown in the length tabulation block, but are to be included in the headings of the length columns only where they affect the roadway project length.

"Type Project" - Listing of project types such as: "Preliminary Engr.", "Right of Way", "Grading", "Paving", "Construction", "Bridge", etc.

"Description" - Listing of various section descriptions. See example:

| STATE PROJECT NO. | SECTION | FEDERAL AD PROJECT NO. | TYPE CODE | PPMS NO. | EQUALITIES | LENGTH INCLUDING BRIDGES | | LENGTH INCLUDING BRIDGES | | TYPE PROJECT | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | FEET | FEET | MILES | FEET | MILES | | |
| 0668 – 071 - 202 | C - 502 | RS –425 ( ) | F000 | 559 | 205.59 | 18,793.06 | 3.559 | 18,461.88 | 3.496 | CONSTR. | From: 0155 MI. E. Rte. 640 |
| | | | | | | | | | | | To: 0138 MI. W. Rte. 807 |
| | B - 601 | RS –425 ( ) | X020 | 425 | 3.311 | 0.063 | | | | | Bridge Carrying Rte. 668 over Peachtree Creek |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

The following codes will be used for all drainage structures measuring over 6 m (20 feet) along the centerline between the inner faces of the outer walls (as defined by 23 CFR 650 © National Bridge Standards, Section 650.301, Application of Standards). Such structures are classed as major structures and are to be set up as separate projects with separate lengths. Multiple lines of two or more pipes will be considered a “major structure” if the clear distance between the outer walls is more than the radius of the smaller pipe (or half the width of arch or elliptical pipes) of any two adjacent pipes in the group combination. The Structure & Bridge Division should be consulted in instances where the application of this guideline requires interpretation. The stations and length used on the plans for such a culvert shall be based on the distance between the back of the outside walls, not on the distance between the faces of same. Separate quantities are to be shown on the plans and estimates for these structures. In cases where the roadway and surfacing is carried over but is not a part of the structure, the roadway and surfacing quantities are not separated on the plans and estimates, but are included in the roadway project.

If no work is proposed on an existing major structure, it should not be set up as a separate project, but shown as an exception to the roadway project. Minor structures of less than 6 m (20'), however, should never be shown as exceptions.

| "B" PREFIX | "D" PREFIX |
|---|---|
| Special Design Bridges | Standard Box Culverts |
| Standard Slab Span Bridges | Multiple Line Pipe Culverts |
| Special Design Box Culverts | |
| Special Design Rigid Frames | |
| Special Design Arches | |

The identification numbers are to be requested using Form LD-219 and will be assigned initially in sequence, without regard to the prefix "B" or "D"; i.e. B-601, B-602, D-603, D-604, B-605, etc. Construction Type Codes for roadway and surface type, bridge type (includes culverts - any type box or culvert), and miscellaneous type construction are required for each construction section on all projects, e.g., C-501, B-601, D-602, C-502, L-801, S-901, etc. The Type Codes, as noted in Figure 2E-14, are required on the plans and are to be shown on the title sheet in the project length tabulation block adjacent to the Federal-Aid Project number block (regardless of whether the project is federally funded) for the applicable Section Number.

No Plan and Minimum Plan project Type Codes are to be shown on the title or cover sheet and are to be handled in variations of the above procedure, as required. This is also to apply to project plans, such as Landscape, Signs, etc., prepared by other divisions, that do not require road plans.

The Bridge Type Code is noted on the bridge plan cover sheet in the upper right hand border beside the project block and also on their final review transmittal Form B-45A or B-45B adjacent to the copy transmittal listing to the FHWA as - Bridge Type Code: X.

The Type Code is also to be shown in the Engineering Estimate.

## FUNCTIONAL CLASSIFICATION - TRAFFIC DATA

A block is to be shown in the upper right corner below the project number block listing the class or type of road, whether divided or undivided roadways and type of terrain (level, rolling, or mountainous). See IIM LD-110 for further instructions. Traffic data is listed below this information, in the same block, as furnished to this Division by the Traffic Engineering Division on Form No. TS-25, or from the Transportation Planning Division on Form No. TPD-1A. Exceptions to design speed are to be noted as shown in Section 2D-8 DESIGN EXCEPTIONS.

## NOTES

Notes are to be shown in the lower left corner of each title sheet furnishing curve superelevation data, specifications and standards data, and the "design features" note as shown in Section 2D-10.

A note is to be shown directly above the length tabulation block detailing the method used in computing project lengths, such as:

"Note: Lengths are based on Route 00 Survey baseline between Sta. 00+00.00 and Sta. 10+00.00 and on Off. Rev. baseline between Sta. 10+00.00 and Sta. 20+00.00."

A note is to be shown in a conspicuous location, within municipality boundaries, showing the name of the municipality, population, and census year.

**Project Location Map (Secondary Projects)**

On Secondary Projects the project location map is to be shown in the upper right corner and is to show sufficient surrounding area to provide obvious location of the proposed project. (See Figure 2E-12)

## WORK CLASS

| | | | |
|---|---|---|---|
| P | Planning (HPR/PR) | 1 | Preliminary Engineering |
| R | Research (HPR/PR) | 2 | Right of Way |
| T | Transit Related or Training | 3 | Construction |

## 2/ ROADWAY AND SURFACE WORK TYPES

| | | | |
|---|---|---|---|
| A000 | Primitive | G000 | Mixed Bituminous |
| B000 | Unimproved | H000 | Bituminous Penetration |
| C000 | Graded and Drained Earth | I000 | Bituminous Concrete |
| D000 | Soil Surface | J000 | Portland Cement Conc. |
| E000 | Gravel or Stone | K000 | All others |
| F000 | Bituminous Surface Treatment | | |

Notes: All bituminous Surface Types to be Asphalt in Virginia

## 2/ BRIDGE WORK TYPE

X_ _ _ The first digit (code X) indicates bridge class
The second digit indicates nature of structure

XO_ _ Highway over waterway
X1_ _ Highway over railroad
X2_ _ Highway project over highway
X3_ _ Highway over waterway and railroad
X4_ _ Highway over waterway and highway
X5_ _ Highway project over railroad and highway
X6_ _ Highway under railroad
X7_ _ Highway project under highway
X8_ _ Highway project under railroad and highway
X9_ _ Other combination, including Highway over waterway, RR and highway also 3- and 4- level grade separations and miscellaneous.

The third digit identifies the material of principal supporting members of the span.

X_0_ Timber
X_1_ Masonry
X_2_ Concrete, not prestressed
X_3_ Steel
X_4_ Steel and concrete
X_5_ Timber and steel
X_6_ Timber and concrete
X_7_ Composite steel and concrete
X_8_ Concrete, prestressed
X_9_ Aluminum

The fourth digit identifies type of span (identifies main span type
f bridge comprises 2 or more span types)

X_ _0 Slab
X_ _1 Girder
X_ _2 Truss (except cantilever)
X_ _3 Rigid frame
X_ _4 Arch
X_ _5 Cantilever truss
X_ _6 Movable
X_ _7 Suspension
X_ _8 Box Culvert (bridge length) (any type Box or Pipe Culvert)
X999 Highway tunnel

2/ Roadway and surface type and bridge types:
First digit is alpha, remaining digits are numeric

## SUPERVISING AGENCY

S – State
D – FHWA Direct Federal Construction

## 1/ MISCELLANEOUS WORK TYPE CODES

| | |
|---|---|
| Y000 | Miscellaneous (must have approval from FHWA, Washington Office) |
| Y002 | Traffic Signs |
| Y003 | Landscaping (planting and related work) |
| Y004 | All clearing (includes acquisition or removal of advertising signs, acquisition of property rights-junk yards, removal or relocation) |
| Y005 | Planting of Wildflowers |
| Y007 | Minor structure, (storm sewers, culverts, snowshed, etc.) |
| Y008 | Channelization of traffic |
| Y009 | Slope stabilization/slide protection |
| Y010 | Coal Ash |
| Y021 | Safety rest areas and scenic overlooks |
| Y022 | Comfort and convenience facilities |
| Y023 | Screening unsightly areas |
| Y024 | Recreational facility |
| Y025 | Fringe parking |
| Y026 | Carpool facility (HOV) |
| Y028 | Vanpool acquisition |
| Y030 | Highway lighting |
| Y031 | Traffic signals |
| Y032 | Freeway traffic surveillance and control systems |
| Y033 | Computerized traffic signal system |
| Y034 | Motorist and system |
| Y035 | Highway information |
| Y036 | Computerized matching program |
| Y041 | Special relocations (rivers, channels, etc.) |
| Y050 | Frontage road |
| Y051 | Independent Pedestrian Walkways |
| Y052 | Independent Bicycle Facilities |
| Y060 | Utility adjustment |
| Y070 | Archeological salvage |
| Y071 | Paleontological salvage |
| Y072 | Historical, archeological or scientific site |
| Y080 | Training (construction contracts) |
| Y081 | Training (NHI) |
| Y102 | Fencing |
| Y108 | Transit passenger facilities |
| Y109 | Truck loading facility |
| Y110 | MCSAP (Development Code) |
| Y111 | MCSAP (Enforcement Program) |
| Y112 | CDL (Developmental) |
| Y113 | CDL (Testing operators) |
| Y200 | Bus purchases |
| Y205 | Purchase of rolling stock (fixed rail) |
| Y210 | Administrative expenses |
| Y215 | Operating expenses (net) |
| Y219 | Ferry boats |
| Y220 | Noise abatement |
| Y222 | Truck scales, fixed |
| Y223 | Truck scales, portable |
| Y224 | Auto restricted zone |
| Y225 | Terminal and transfer facilities |
| CENG | Construction Engineering |
| GMKR | Geodetic markers |
| INSP | Bridge inventory, inspection and classification and other special bridge projects |
| MAIN | Maintenance |
| PCON | Post construction |
| PENG | Preliminary engineering |
| PE-1 | Route planning, location studies (Appalachian funds only) |
| PE-2 | Engineering design and construction plans (Appalacian) |
| PLAN | Planning (HPR, PR and PL funds) |
| RESH | Research (HPR, PR, and PL funds) |
| ROWA | Right-of-Way |
| R/WS | Acquisition of scenic strips outside of ROW |
| RW/O | Replacement Housing Payments – Owners |
| RW/T | Replacement Housing Payments – Tenants |
| R-MP | Residential Moving Payments |
| RW/B | Business and Farm Payments |
| R-SC | Relocation Services Costs |
| SFTY | Safety Related Work |
| UPLN | Urbanized Planning |
| YHOV | HOV Facility |

1/ Y – Miscellaneous types first digit alpha. remaining digits numeric:
Beginning with “CENG” the “O” s are alpha

# FIGURE 2E-14 CONSTRUCTION TYPE CODE FOR HIGHWAY IMPROVEMENTS LINE ITEM CODES

**INDEX OF SHEETS**

An index showing each sheet number and description is typically shown on a separate plan sheet and assigned sheet number 1B. The index of sheets can be shown on the Title sheet when practical and the sheet numbers adjusted accordingly.

Sheet No. 1 is always assigned to the Title Sheet.

Sheet No. 1A is typically assigned to the Project Location Map , Sheet No. 1B is assigned to the Index of Sheets and Sheet 1C is usually assigned to the Right of Way Data Sheet. (Note: Numbering in the "1" series for Secondary projects must be adjusted to allow for exclusion of the Project Location Map).

Some plans are broken into smaller projects with two, three, or more projects using the same title sheet.

A proposed method for the index of sheets is shown in Figure 2E-15.

Sheet No. 1D is assigned to the Revision Data Sheet.

Sheet No. 1E is assigned to the Stream Flow Hydrograph Sheets, as provided by the Hydraulics Designer, when applicable.

Sheet Nos. 1F, 1G, etc., are assigned to the Alignment Data Sheet, when applicable.

Sheet No. 1H is assigned to the CADD Level Structure Sheet.

Sheet Nos. 1I, 1J etc., (picking up from the last applicable number) are assigned to Maintenance of Traffic and Sequence of Construction Sheets, where applicable.
Sheet No. 2 is assigned to the main Typical Section Sheet. General notes are to be shown on this sheet, if feasible, e.g. Secondary projects or other projects that do not require multiple typical sections.

Sheet Nos. 2A, 2B, etc., are assigned to other Typical Section Sheets, Detail Sheets, Summary Sheets and the Hydrologic Data Sheet, where applicable.

Sheet Nos. 3, 4, etc., are assigned to Plan Sheets.

Sheet Nos. 3A, 4A, etc., are assigned to Profile Sheets following each corresponding plan sheet.
Sheets which only pertain to Right of Way (i.e. R/W Data Sheet, Revision Data Sheet) are to be denoted with an asterisk as shown below:

| | |
|---|---|
| SHEET NO. 1 | TITLE SHEET |
| SHEET NO. 1A | PROJECT LOCATION MAP |

| | |
|---|---|
| SHEET NO. 1B | INDEX OF SHEETS |
| *SHEET NO. 1C | RIGHT OF WAY DATA SHEET |
| *SHEET NO. 1D | REVISION DATA SHEET |
| *SHEET NO. 1K | METES & BOUNDS |

*Denotes sheets which are not to be printed for construction.

The sheet no. following the last profile sheet is assigned to Bridge Plans, where applicable. All bridge plan sheets (for each bridge) are assigned one number with the total number of sheets afterwards in parentheses, such as: Sheet No. 8 (1 thru 10). The "B" number and bridge plan number is to be shown in the sheet description.

The next sheet number is assigned to Sign Plans, where applicable, similar to "Bridge Plans."

The next sheet number is assigned to Lighting Plans, similar to "Bridge Plans".

Signal Plans are numbered next, similar to "Bridge Plans".

The next sheet number is assigned to Utility Adjustment Plans, see IIM LD-140 where applicable, similar to above.

Any remaining sheets will follow, in order, those listed.

For Federal Projects, the complete Federal Project Number(s) is to be shown on <u>all</u> title sheets.

The total number of cross section sheets is shown below the last listed sheet.

The following notes are to be shown in the upper left portion of the Title Sheet:

For Index Sheets see Sheet 1B.

For IGrds Projects:

> THIS PROJECT WAS DEVELOPED UTILIZING THE DEPARTMENT'S INTERACTIVE GRAPHIC ROADWAY DESIGN SYSTEM (IGrds).
> IGrds COMPUTER IDENTIFICATION NO. (PPMS NUMBER) ___________.

For <u>non</u> IGrds Projects:

> COMPUTER JOB NO. (DRD JOB NUMBER) ________________.

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

| REVISED | FHWA REGION | STATE | FEDERAL AID PROJECT | STATE ROUTE | STATE PROJECT | SHEET NO. |
|---|---|---|---|---|---|---|
| 1/12/99 | 3 | VA. | | | U000-114-117, RW-201, C-501 | 1A - 1 |

## INDEX OF SHEETS

Project U000-114-117, RW-201, C - 501

| | |
|---|---|
| SHEET NO. 1 | TITLE SHEET |
| SHEET NO. 1A | INDES OF SHEETS |
| SHEET NO. 1B | PROJECT LOCATION MAP |
| SHEET NO. 1C | RIGHT OF WAY DATA |
| * SHEET NO. 1C-2 | RIGHT OF WAY ACQUISITION |
| SHEET NO. 1D | REVISION DATA SHEETS |
| SHEET NO. 1E | MAINTENANCE OF TRAFFIC/SEQUENCE OF CONSTRUCTION |
| SHEET NO. 1F & 1G | ALIGNMENT DATA |
| SHEET NO. 2, 2A-1, 2B, 2B-1 | TYPICAL SECTIONS |
| SHEET NO. 2C | GENERAL NOTES |
| SHEET NO. 2D | RADIAL OFFSET DATA |
| SHEET NO. 2E | GRADING SUMMARY |
| SHEET NO. 2F THRU 2F(7) | DRAINAGE SUMMARY |
| SHEET NO. 2G | PAVEMENT SUMMARY |
| SHEET NO. 2H | INCIDENTAL SUMMARY |
| SHEET NO. 2I | ROADSIDE DEVELOPMENT SUMMARY |
| SHEET NO. 2J | DITCH TABULATIONS |
| SHEET NO. 2K THRU 2L (1), 2M | DETAIL AND INSERTABLE SHEETS |
| SHEET NO. 2M (1) THRU 2M (3) | SOUNDWALL FOUNDATION BORINGS |
| SHEET NO. 2N, 2O, 2Q THRU 2X 2Z THRU 2JJ | DETAIL AND INSERTABLE SHEETS |
| SHEET NO. 10 - 10A | PLAN & PROFILE SHEET STA. 51+00 TO STA. 59+00 |
| SHEET NO. 11 - 11A | PLAN & PROFILE SHEET STA. 59+00 TO STA. 67+00 |
| SHEET NO. 12 - 12A | PLAN & PROFILE SHEET STA. 67+00 TO STA. 75+00 |
| SHEET NO. 13 - 13G | PLAN & PROFILE SHEET STA. 75+00 TO STA. 83+00 ℄, TEMP. ACCESS ROAD PLANS & PROFILES, AND CONNECTION PROFILES |
| SHEET NO. 14 - 14A | PLAN & PROFILE SHEET STA. 83+00 TO STA. 91+00 |
| SHEET NO. 15 - 15A | PLAN & PROFILE SHEET STA. 91+00 TO STA. 99+00 |
| * SHEET NO. 15 RW | RIGHT OF WAY ACQUISITION SHEET |
| SHEET NO. 16 - 16A | PLAN & PROFILE SHEET STA. 99+00 TO STA. 106+00 |
| SHEET NO. 17 - 17A | PLAN & PROFILE SHEET STA. 106+00 TO STA. 114+00 |
| SHEET NO. 18 - 18A, 18B | PLAN & PROFILE SHEET STA. 114+00 TO STA. 121+00 ℄ AND TEMPORARY X-OVER PROFILE |
| * SHEET NO. 18 RW | RIGHT OF WAY ACQUISITION SHEET |
| SHEET NO. 19 - 19B | PLAN & PROFILE SHEET STA. 121+00 TO STA. 129+00 |
| SHEET NO. 19C - 19E | DRAINAGE DESCRIPTION SHEETS |
| SHEET NO. 19K | ENTRANCE PROFILES |
| SHEET NO. 19L | SOUNDWALL PROFILE |
| SHEET NO. 20(1) - 20(28) | BRIDGE PLANS (B-607) |
| SHEET NO. 21(1) - 21(5) | SIGNAL PLANS |
| SHEET NO. 22(1) THRU 22(4), 22(4B), 22(5), 22(6) | UTILITY PLANS |
| SHEET NO. 23(1) - 23(11) | LANDSCAPE PLANS |

* SHEETS NOT TO BE INCLUDED WITH CONSTRUCTION PLANS

67 SHEETS CROSS SECTIONS
31 THRU 75, 75 (1) THRU 75 (2), 94 THRU 112
JOB NO. R-35
MAINLINE EARTHWORK VOLUMES (LIST 8A) 12 SHEETS
STATION 58+52.08 TO 121+56.93
SEQUENCE NUMBER 1114 TO 1240
TEMP. ACCESS RD. IGRDS EARTHWORK QUANTITY REPORT 3 SHEETS
STATION 166+00 TO 185+00

U000 - 114 - 117. 1A - 1

**FIGURE 2E-15 INDEX SHEET FOR MULTI-PROJECT PLANS**

## PROJECT LOCATION MAP (SEE FIGURE 2E - 16)

A project location map sheet is to be included on all projects other than Secondaries, and is to show sufficient surrounding area to provide obvious location of the proposed project.

Applicable project numbers (right of way and construction) are to be shown in the proper blocks and Supervisor's and Designer's name and phone number (including area code) are to be shown in the left border.

The project construction baseline is to be made conspicuous by use of a heavy line, dashed line, etc., so that it will stand out over other items on the sheet. Lines are to be extended (usually upward) from the ends of the project and expanded, if necessary, so that the project numbers can be shown along longitudinal lines similar to those on the Title Sheet.

Tie-in project numbers are to be shown on each end of the project, where applicable.

## RIGHT OF WAY DATA SHEET (SEE FIGURE 2E - 17)

A Preliminary Right of Way Data Sheet is to be included in each applicable set of plans. These sheets are available from the Engineering Services Section’s Insertable Sheet directory.

The "RW" project number is to be shown in the appropriate blocks (construction project numbers are not applicable to this sheet), and Supervisor's and Designer's names and phone numbers (including area code) are to be shown in the left border. No other information is necessary on the sheet at this time.

When the field inspection plans are sent out, the set to the District Right of Way Manager shall include a blank print of this sheet. As the parcel numbers are assigned, the District Right of Way Office will tabulate the parcel numbers, landowners, proffers, and corresponding plan sheet numbers on the print and return it to the Central Office Right of Way Division with the plans that accompany the Field Inspection Report. (For further instructions on proffers, See IIM LD-189). On projects designed in the Central Office, this tabulation will then be forwarded to the Location and Design Division for inclusion in subsequent plan submissions. The tabulation will be furnished directly to the District Design Engineer on projects designed in the District Design Sections.

This sheet must be kept current by making the changes indicated by the Right of Way Division. Changes made subsequent to submission of approved Right of Way plans will be considered "formal" revisions. The Preliminary Right of Way Data Sheet will be used from field inspection time until it is replaced by the Right of Way Division's "Posted Right of Way Data Sheet."

Right of Way Division's Building Data Report will be furnished to the Designer ninety days prior to advertisement. This report will confirm regular demolition numbers (D-1, D-2, etc.) as well as furnish special "D" series numbers for any underground storage tanks, "non-significant" signs or real personal property on the project (See page 2F-1, PARCEL NUMBERS AND DEMOLITION NUMBERS ON PLANS).

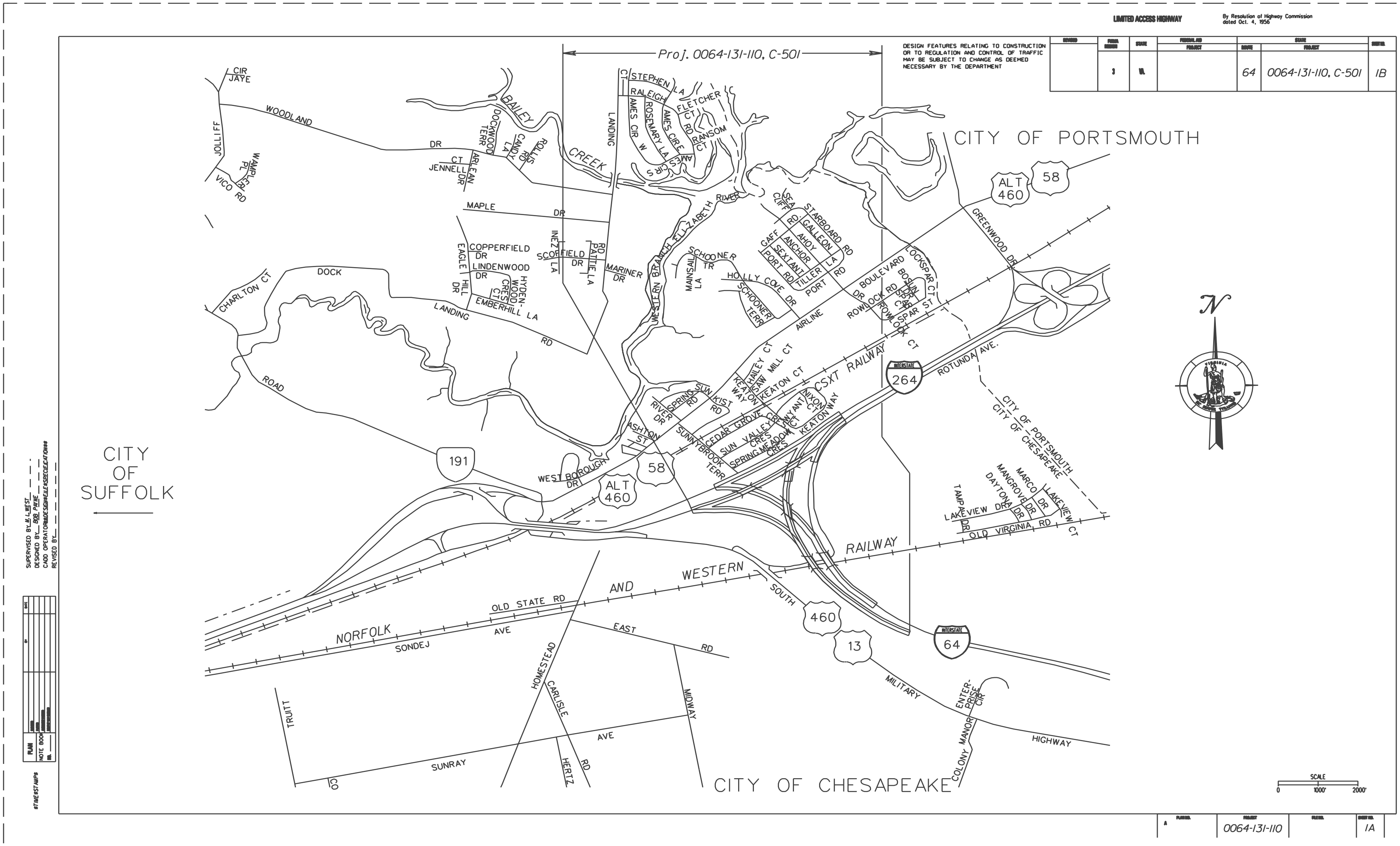



FIGURE 2E-16 SAMPLE PROJECT LOCATION MAP

PRELIMINARY

RIGHT OF WAY DATA SHEET

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

| REVISED | FHWA REGION | STATE | FEDERAL AID PROJECT | STATE ROUTE | STATE PROJECT | SHEET NO. |
|---|---|---|---|---|---|---|
| | 3 | VA. | | | | I-C |

ROUTE: PROJECT: 0001-127-104, RW-201
COUNTY/CITY: CITY OF RICHMONE PPMS NO.:
COMPILED BY: K.H.P. DATE: 01-30-89
REVISED BY: DATE:
REVISED BY: DATE:

| PARCEL NO. | LANDOWNER | SHEET NO. | AREA | | | | | | | | | | | PROFFERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TOTAL | FEE TAKING | | FEE REMAINDER | | EASEMENTS: PERMANENT | | EASEMENTS: UTILITY | | EASEMENTS: TEMPORARY | | |
| | | | ACRES OR SQUARE FEET | ACRES OR SQ.FEET | HECTARES/ OR SQ.METERS | ACRES OR SQ.FEET | HECTARES/ OR SQ.METERS | ACRES OR SQ.FEET | HECTARES/ OR SQ.METERS | ACRES OR SQ.FEET | HECTARES/ OR SQ.METERS | ACRES OR SQ.FEET | HECTARES/ OR SQ.METERS | YES / NO |
| 001 | LIGHTING AND SUPPLY COMPANY, INC. | 1-D | 0.808 | 0.257 | | 0.551 | | | | | | 0.049 | | NO |
| 002 | C. DOUGLAS SPENCER | 6-D | 0.413 | 0.224 | | 0.189 | | | | | | | | NO |
| 003 | OZZIE AND MARIE THOMAS | 6-F | 0.096 | 0.021 | | 0.075 | | | | | | 0.018 | | NO |

IMPERIAL/METRIC

SPECIAL DESIGN SECTION DRAWING NO. A 9

**FIGURE 2E-17 SAMPLE RIGHT-OF-WAY DATA SHEET**

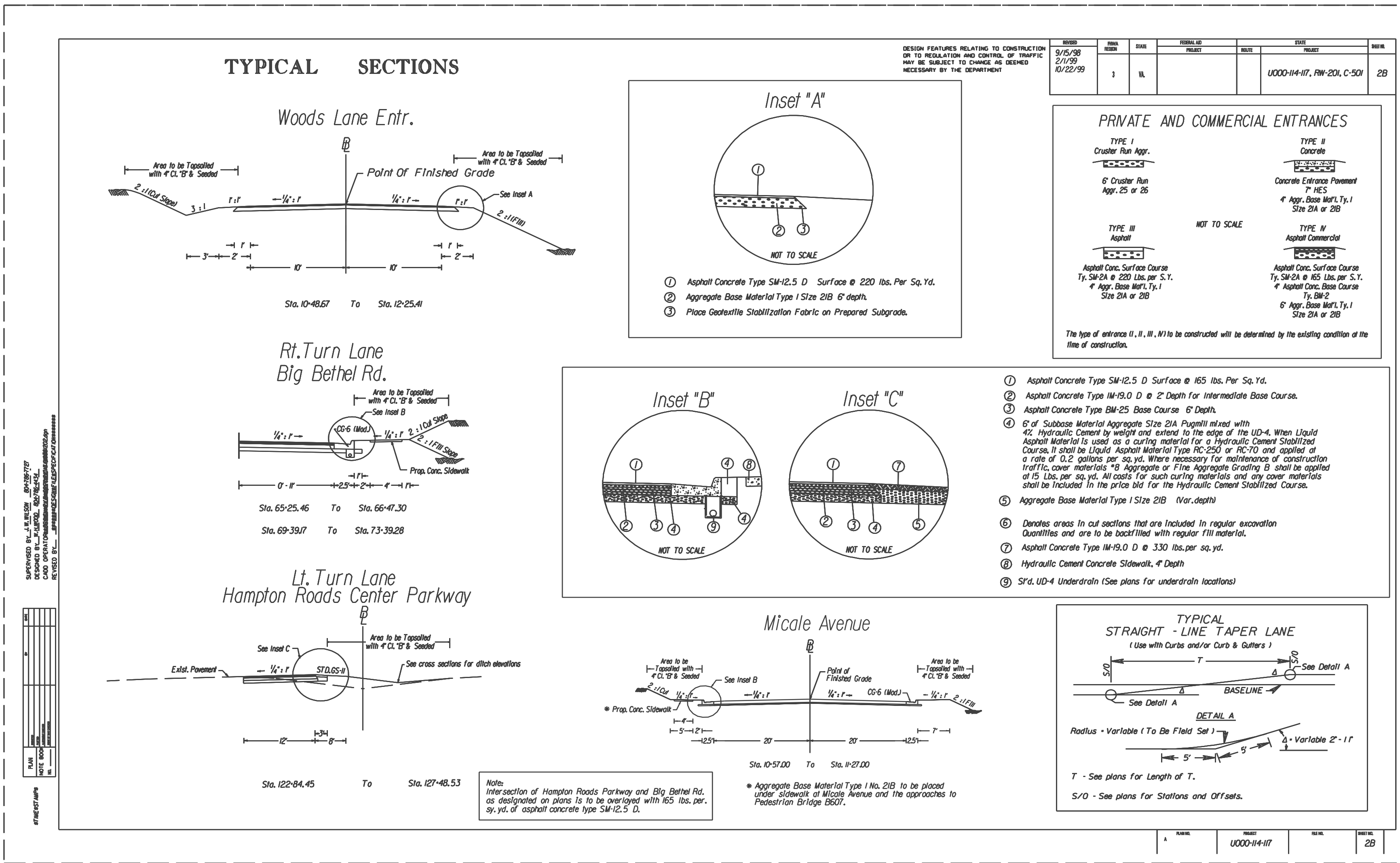



FIGURE 2E-18 SAMPLE TYPICAL SECTION SHEET

**TYPICAL SECTION SHEET(S) (SEE FIGURE 2E - 18)**

All applicable typical sections (mainline, connections, bikeways, ramps, frontage roads, etc.) are to be shown as a half section cut and half section fill, where applicable.

Applicable project numbers (right of way and construction) are to be shown in the proper blocks and Supervisor's and Designer's name and phone number (including area code) are to be shown in the left border.

The construction baseline is to be shown and labeled and the point of finished grade is to be clearly labeled with an arrow to the actual point.

If necessary (due to dual lanes, etc.), show existing roadway in dashed lines and label clearly. The existing baseline is to be depicted and labeled.

All slopes (pavement, shoulder, recoverable area, sidewalk space, side slopes, etc.) are to be shown immediately above the applicable line with arrows directed down grade to the slope. Pavement cross slopes for concrete and high type flexible pavement are to be 2%. Shoulder and ditch slopes are to conform to Design Guidelines (See Appendix A). Sidewalk or sidewalk space slopes are generally to be 2%. Side slopes, unless specifically recommended otherwise, are to conform to "CS" Standards for the particular roadway classification.

Dimensions are generally shown below the typical section with the first line showing dimensions of pavement, shoulder, recoverable area, ditch, curb and gutter, buffer strip, sidewalk space, etc., widths. The second line generally shows the roadway width.

Station to station for each typical section is to be shown beneath the dimension lines. The stations are to be broken for various projects and contracts.

Pavement courses are to be shown in accordance with the latest recommendations. If preliminary recommendations are used, this is to be brought to the attention of the field inspection party with the understanding that the pavement design will be updated accordingly once the soil survey and final pavement design recommendations have been received.

The depths of the various courses will be shown in an enlarged section, if necessary, to show detail.

Symbols are to be used to provide an obvious delineation of the courses. Pavement courses are to be shown in accordance with the CADD Manual.

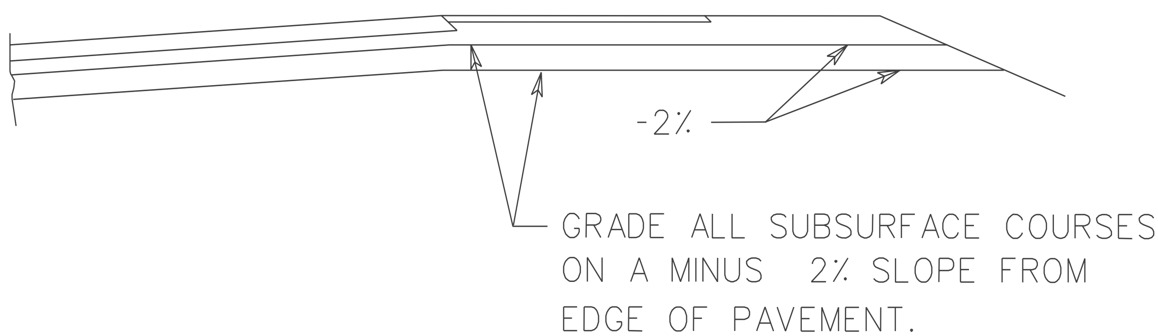
Pavement courses, prime coats, incidentals, etc., are to be denoted with a number within a circle with a line to the denoted item. A legend is to be shown on each typical section sheet with complete descriptions of each item.

Ultimate sections are to be shown and clearly noted and delineated where applicable.

When placing and rolling flexible pavements, it is impossible to construct sides in a vertical plane without using forms. To make our drawings more realistic, show the side slopes at 1:1 as shown below. Do <u>not</u> denote the slope or the horizontal dimension (D) on the Typical Section. When computing quantities, no adjustment is to be made.

Projects without paved shoulders require a 0.3 m (1') wide "wedge" in accordance with IIM LD-158.

Typical Method of Grading Subsurface Material at High Side of Superelevated Curves with Shoulders Graded in Accordance with St'd. GS-11.




Bottom line of grading below pavement is to be parallel to pavement slope.

**HYDROLOGIC DATA SHEET (SEE FIGURE 2E - 19 AND 2E - 20)**

A Hydrologic Data Sheet is to be included in each applicable set of plans. The blank sheet is available in the Insertable Sheet directory. The drainage designer will furnish the project designer the data needed to fill in the Hydrologic Data Sheet at field inspection stage and again upon final completion of the drainage design. The project designer shall check with the drainage designer at this time to verify that the required water level information is shown on the profile sheets of the roadway plans.

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

| REVISED | FHWA REGION | STATE | FEDERAL AID PROJECT | STATE ROUTE | STATE PROJECT | SHEET NO. |
|---|---|---|---|---|---|---|
| | 3 | VA. | | | U000-121-110, RW-201, C-501 | 2L |

## HYDROLOGIC DATA

The data presented herein was statistically derived by empirical methods and from field observations. It is presented as an estimate of the hydraulic performance of these facilities during the passage of actual flood events.

1. Estimated 100 year frequency flood data (unless otherwise noted.) This magnitude of flooding may pass through the proposed facility or it may obtain the necessary hydraulic conveyance by partial inundation of roadways and/or partial by pass of the facility.

2. Specified frequency flood data. It is anticipated that this magnitude of flooding will be conveyed through the proposed hydraulic facility under estimated conditions which satisfy the design criteria applicable to the site.

3. This data was obtained from observations by persons familiar with the area and/or official records combined with an evaluation by empirical methods. The reliability of this data is relative to the accuracy of the source. A future flood of the same magnitude may achieve a significantly different stage elevation from that shown due to changes in the physical characteristics of the watershed.

FIELD INSPECTION STAGE ☐ FINAL DESIGN STAGE ☒

| | | | | | BASE FLOOD 1. | | DESIGN FLOOD 2. | | | OVERTOPPING FLOOD | | HISTORICAL DATA 3. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sheet No. | Station | Stream Name | Drainage Area | Structure Size | Discharge (C.F.S.) | Stage Elevation (Ft.) | Discharge (C.F.S.) | Estimated Exceedance Probability % | Stage Elevation (Ft.) | Stage Elevation (Ft.) | Estimated Exceedance Probability % | Date | Stage Elevation (Ft.) | Estimated Exceedance Probability % |
| 10 | 57+55 | Newmarket Creek | 2.16 sq. mi. | 49' | 1367 | 22.0 | 746 | 10 | 19.5 | N/A | N/A | See Remarks | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

REMARKS — Source of Information and Other Related Data

The historical high water mark and date shown on the bridge situation survey could not be substantiated. The calculated elevation for the ordinary high water discharge is higher than the high water mark for 1969. This historical high water mark should not be used. This crossing of Newmarket Creek is at a new location and therefore an accurate high water mark was not available.

SURVEYED BY
SUPERVISED BY
DESIGNED BY
CADD OPERATOR
REVISED BY

9-19-1987

SPECIAL DESIGN SECTION
DRAWING NO. 2-A

| PLAN NO. | PROJECT | FILE NO. | SHEET NO. |
|---|---|---|---|
| A | U000-121-110 | | 2L |

**FIGURE 2E-19 SAMPLE HYDROLOGIC DATA SHEET**

HYDROLOGIC DATA

The data presented herein was statistically derived by empirical methods and from field observations. It is presented as an estimate of the hydraulic performance of these facilities during the passage of actual flood events.

1. Estimated 100 year frequency flood data (unless otherwise noted.) This magnitude of flooding may pass through the proposed facility or it may obtain the necessary hydraulic conveyance by partial inundation of roadways and/or partial by pass of the facility.

2. Specified frequency flood data. It is anticipated that this magnitude of flooding will be conveyed through the proposed hydraulic facility under estimated conditions which satisfy the design criteria applicable to the site.

3. This data was obtained from observations by persons familiar with the area and/or official records combined with an evaluation by empirical methods. The reliability of this data is relative to the accuracy of the source. A future flood of the same magnitude may achieve a significantly different stage elevation from that shown due to changes in the physical characteristics of the watershed.

FIELD INSPECTION STAGE ☐ FINAL DESIGN STAGE ☐

| | | | | | BASE FLOOD 1. | | DESIGN FLOOD 2. | | | OVERTOPPING FLOOD | | HISTORICAL DATA 3. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sheet No. | Station | Stream Name | Drainage Area | Structure Size | Discharge (C.F.S.) | Stage Elevation (Ft.) | Discharge (C.F.S.) | Estimated Exceedance Probability % | Stage Elevation (Ft.) | Stage Elevation (Ft.) | Estimated Exceedance Probability % | Date | Stage Elevation (Ft.) | Estimated Exceedance Probability % |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| REMARKS Source of Information and Other Related Data |
|---|
| |
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| |

FIGURE 2E-20 SAMPLE HYDROLOGIC DATA SHEET (NO PLAN PROJECT)

**DESIGN FEATURES NOTE**

A "Design Features" note is to be shown on all sheets, except cross sections:

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT.

On the title sheet, the note is to be shown in the lower left corner as previously discussed in Section 2E-6 under "Notes".

On all other sheets, the note is to be shown to the left of the project identification block that is located in the upper right corner of the sheet. (See Figures 2E-18 and 2E-19).

## SECTION 2E-7- CONSTRUCTION COST ESTIMATE

### ESTIMATING QUANTITIES - PREPARATION OF ESTIMATE

Quantities for drainage (and minor structure excavation), pavement and incidental items as depicted on plans or work sheets, and total regular excavation and borrow or embankment quantities, along with estimated mobilization, clearing and grubbing, field offices, etc., are included in the project cost estimate.

When the estimate is received, a copy is to be sent to the Programming Division with the construction cost noted for field inspection stage. This applies to projects to be constructed with other than Urban or Secondary funds. For both Urban-funded projects and Secondary projects, a copy is to be sent to the Local Assistance Division. The estimate is to be entered into the P/PMS data bank.

A copy of the project cost estimate is kept in the appropriate file and the total cost is noted on the office copy of the field inspection prints for quotation at the inspection.

When not in use, cost estimates are to be placed in secure files and not left lying around for casual observation or possible copying by someone.

Cost Estimates made available outside of this division, such as to the Programming Division, the news media, etc., are the "total dollar cost" and are generally rounded off to the nearest thousand dollars. The construction cost estimate includes mobilization, construction engineering and contingencies.

The Project Manager reviews estimates (Preliminary Engineering and Construction) in PPMS at Scoping, Public Hearing, Field Inspection, Right of Way and Construction Stages, as well as at 90-day intervals between these milestones, for accuracy. If a project is significantly modified between these stages, the estimate must be adjusted and entered into PPMS and CES.

ALL Engineer's Estimates (Preliminary Engineering and Construction) will be reviewed by the Project Manager and updated, if necessary, for use by the Programming Division and Local Assistance Division in preparing the SYIP. At this time it is imperative that ALL estimates be reviewed for accuracy before incorporation into the new SYIP.

To obtain a cost estimate (total dollar cost), the freedom of Information Act requires written requests from persons outside the Department. The request is to be responded to within ten days of receipt.

Information indicating the specific unit cost for the various items in the estimate are to be retained by the project designer and secured when not being utilized. This information is available only through the Freedom of Information Act.

# SECTION 2E-8- CONSTRUCTABILITY QUALITY REVIEW

## CONSTRUCTABILITY QUALITY REVIEW

Constructability review is defined as the review of plans, specifications, and contract documents from a construction perspective to assure the documents propose an operation that is efficient, cost effective, and buildable. Its emphasis is primarily focused on “how” the documents propose the operation to be built and not on ”what” gets built.

AASHTO defines constructability review as “a process that utilizes construction personnel with extensive construction knowledge early in the design stages of projects to ensure that the projects are buildable, while also being cost-effective, biddable, and maintainable”.

This analysis is normally performed at the Preliminary Field Inspection, Public Hearing, Field Inspection and Pre-Advertisement stage of plan development. Additional reviews can be performed as needed when the plans are further developed.

The constructability review includes the report of findings, a completed checklist, and cost savings report. This report is a detailed tabulation of any anticipated savings identified during the review. The Scheduling & Contract Division or its project team member will conduct the constructability review.

# SECTION 2E – 9 - DISTRIBUTION OF FIELD INSPECTION PRINTS

## PROCEDURE AND SCHEDULING

The field inspection is scheduled by the District Administrator who will arrange to have the plans reviewed, appropriate staff attend, and reports submitted by the appropriate divisions. A Project Engineer or Senior Inspector and a maintenance representative should be present to address project constructability and maintenance aspects and submit written reports.

Field inspections on urban projects will be scheduled by the Local Assistance Division in conjunction with the district office. A memorandum of confirmation is then sent to the Local Assistance Division. All appropriate parties will be advised by memorandum as to the time and location of the field inspection. Always advise the State Scheduling and Contract Division Engineer.

Copies of the applicable form (LD-99-I for rural projects, LD-99U for urban projects, or LD-103(SEC) for secondary projects) are attached to the field inspection prints and distributed in accordance with IIM LD-68. Form LD-99-I/(NV), LD-99-U(NV) or LD-103(NV)(SEC) are available for use on projects designed for the Northern Virginia District. Notice of the location and availability of prints should be furnished at least two weeks prior to the scheduled field inspection.

## PLAN ASSEMBLY

The following is a general guideline of items to be included in the field inspection plan assembly and additional items may be required at times:

1. VDOT standard plan, profile and cross section sheets must be used (no rolls);

2. The title sheet should have a project layout with individual plan sheets indicated, a project description (must agree with PPMS description), the traffic data and functional classification block completely filled in, and a length tabulation for project numbers at bottom center;

3. Project location map sheet showing the project limits;

4. Right of way data sheet (blank);

5. Index of Sheets

6. Survey Data Sheet (horizontal survey alignment, reference data, bench marks);

7 Maintenance of traffic and sequence of construction sheets;

8. General Note Sheet with specific general notes for project;

9. Typical section sheets - mainline and all connections;

10. Underground utilities test hole information sheet;

11. Plan sheets (Nos. 3,4,5,6,7,etc.) must show:

    a. Complete survey - topo, right-of-way, property lines, existing drainage elevations, invert elevations of existing sanitary manholes property owners, underground utilities, etc.;

    b. Proposed horizontal alignment - bearings, curve data, superelevation, design speed;

    c. Proposed right-of-way and easements - Pluses and distances; Show adequate right-of-way or permanent easements for all proposed permanent drainage items;

    d. Proposed construction baseline, edge of pavements, medians, curbs, curb and gutter, sidewalk, construction limits, guardrail, etc.;

    e. Proposed private entrances and tie-in points, grades are to be shown on profile sheets;

    f. All required items should be labeled - St'd. CG-6 Req'd., St'd. MS-2 Req'd., St'd. CG-9D Req'd., St'd. RW-2 Req'd., etc.;

    g. Required drainage - all pipes, drop inlets, end sections, etc., drawn to scale, complete drainage descriptions including elevations; Ditch typical sections should be shown for all nonstandard ditches;

    h. Required erosion control items.

    i. Tentative traffic control devices structures.

    j. Tentative sound wall locations.

    k. Tentative bridge design.

12. Profile sheet (Nos. 3A, 4A, 5A, 6A, 7A, etc.) must show:

    a. Existing profile;

    b. Proposed grades - gradient percents, vertical curves, vertical sight distances, design speeds;

c. Proposed grades for all private entrances;

d. Drainage descriptions (required or existing) are <u>not</u> to be shown on profile sheets;

13. Cross sections with proposed design templates - mainline and connections; Show all proposed ditches with grade elevations;

14. Completed computer estimate forms are needed at this time.

# SECTION 2E – 10 - FIELD INSPECTION

## HOLDING THE FIELD INSPECTION

The Field Inspection is presided over by the District Administrator or his/her representative, usually the District Construction Engineer.

A representative from the Design and Hydraulics Sections will attend every applicable field inspection with a set of prints reflecting all questions shown on the set supplied the District Administrator and any additional specific questions or comments necessary. The number of representatives is to be held to a minimum.

An experienced project inspector should be present to review a project for constructability and plan clarity. Also, someone should be in attendance who can address the maintenance aspects.

Review comments received prior to Field Inspection (e.g. Transportation & Mobility Planning, Mobility Management, Rail, etc.) are to be addressed at the Field Inspection or in a subsequent report.

All questions are to be completely legible and concisely answered on the office prints. The Location and Design representative is to return to the office with a complete understanding of all items discussed.

If an item is not addressed or a question not answered to the representative's satisfaction, it is his/her responsibility to make this known and to bring all items and questions to a satisfactory conclusion.

If any controversial item remains unresolved, the Location and Design Division representative, upon his/her return to the office, is to prepare a memorandum to the appropriate Assistant Location and Design Engineer and District Construction Engineer giving complete details of the situation.

All projects shall be reviewed on the site. All necessary safety equipment and precautions shall be utilized.

Reports from the District Materials, Mobility Management, Right of Way and Environmental Divisions, letters from municipalities, etc., are to be submitted to the District Administrator's representative, usually the District Location and Design Engineer. For projects managed in the Central Office the District Administrator/District Construction Engineer forwards the reports and a set of prints marked with comments to the State Location and Design Engineer within fourteen days in accordance with Form LD-99.

The Local Assistance Division submits a report on urban projects to the State Location and Design Engineer.

On consultant designed projects, the consultant shall prepare minutes of the Field Inspection and forward copies to individuals responsible for preparing reports.

The Project Manager will respond to the District Administrator or Urban Engineer outlining how plan development will proceed.

After the various Field Inspection reports are received, all necessary rulings on controversial questions are to be resolved and recommendations incorporated into the plans.

The Project Manager will respond to the Local Assistance Division Administrator for Urban Projects and the District Administrator or District Construction Engineer for all other projects with a resolution of all field inspection comments. Copies of this response which should include an explanation of reasons recommendations were not included in plans should be sent to all concerned.

## SAFETY ITEMS AND SEQUENCE OF CONSTRUCTION

The safety of motorists, pedestrians, and construction workers during roadway construction must be carefully considered by the designer during the development of the road plans.

Safety during construction, sequence of construction, and maintenance of traffic are so closely related that they should be considered as one element.

"The Virginia Work Area Protection Manual" (See IIM LD- 93) is to be used as a reference to determine if barricades or channelizing devices need to be included in the contract plans.

In addition to determining the need for barricades and/or detours, the designer is to review the plans carefully for the possibility of shifting traffic lanes away from the normal position during construction. If this operation is necessary to construct the project, a sequence of construction is to be considered by the designer in conjunction with the appropriate Assistant Construction Engineers and/or appropriate Assistant District Engineer.

The Local Assistance Division, Asset Management Division, Structure and Bridge Division, and Mobility Management Division should be consulted on projects in their respective area of responsibility. The sequence of construction is to include diagrams and appropriate notes to inform the contractor as to how this operation is to be accomplished and advise of traffic problems that may be encountered. These shifts in traffic flows are to be designed to conform to the geometrics shown in the standards for detours (St'd. GS-10) and/or as indicated in the "Safety Guidelines for Construction Zones" (See IIM LD- 93).

When a sequence of construction plan is considered necessary, it shall be included in the plans that are distributed for review at the Field Inspection and it shall be of sufficient detail to present the basic concept and to reflect environmental, traffic, safety, and right of way requirements.

A copy of the sequence of construction plan with the accepted Preliminary Field Inspection recommendations incorporated, is to be furnished to the Traffic Engineer prior to the public hearing/right of way stage. If detours and/or right of way (including easements) will be required for the maintenance of traffic, the sequence of construction must be completed in sufficient detail for the right of way requirements to be incorporated into the public hearing right of way plans.

Where a sequence of construction plan is considered unnecessary for a particular project, the file shall be documented accordingly with the listing of the names of those involved in the decision and the reasons for the decision.

The Field Inspection prints must also indicate that a sequence of construction plan is not necessary and that only such items as flagging, warning lights, etc., will be required.

All of the above items are to be discussed thoroughly at the Field Inspection and recommendations included in the Field Inspection Report.

## REQUEST FOR SPECIAL DESIGN PLANS

After the Field Inspection questions have been resolved, requests shall be made to the Standards/Special Design Section, by memorandum, to prepare the necessary special design roadway drawings for inclusion in the plans. This process is explained in Chapter 2G of this manual. The scheduled advertisement date, the project charge number, and prints of the pertinent plan sheets are to accompany the request. The designer is to furnish any required additional data and/or instructions to the Engineering Services Section to assure that correct specifications are incorporated in the drawing(s).

If circumstances dictate a change in the plans that would alter or eliminate the need for a special drawing that is in the process of being prepared, the Engineering Services Section is to be notified immediately.

The Hydraulics Engineer shall submit all requests for special design drainage items by

transmittal slip (copy to the Road Designer) to the Engineering Services Section. When the design is completed, the Engineering Services Section is to review the final design with the Hydraulics Section before furnishing the road designer with the drawing for insertion in the project assembly
.

**REQUEST FOR SOUND BARRIER WALL DESIGNS**

Sound Barrier Wall requirements for location and profile elevations are determined by the Environmental Division who will provide the roadway designer with the requirements. An explanation of this procedure is in Chapter 2G of this manual.

**BRIDGES**

When Field Inspections are held on projects involving new or existing bridges, particular attention must be paid to all discussions concerning these structures. The Structure and Bridge Division shall be notified of any decisions affecting a bridge design. A copy of the Field Inspection Report and any other applicable correspondence must be forwarded to them.

**REQUEST FOR SPECIAL PROVISIONS**

When a Project Manager is aware of the need for a Special Provision, the Project Manager will coordinate with the Scheduling and Contract Division as soon as possible.

If any doubt exists as to whether a given decision affects a bridge, the Structure and Bridge Division should be contacted informally and if a bridge is affected, a copy of the Field Inspection Report shall be sent them by memorandum explaining the facts.

## SECTION 2E - 11 - REQUEST FOR ADDITIONAL SURVEY DATA

### PROCEDURE FOR REQUEST

Necessary additional survey data is to be requested after the field inspection. A list of all additional survey needed is to be kept during plan development. Unless certain information is critical for plan development before this time, all items are to be held until one request for data can supply all information needed. Survey data is to be requested using Form LD-261.

The designer should check on site plan construction, and request additional survey for that portion of site plan affecting project design, when construction is completed or near completion.

## SECTION 2E – 12- DISTRIBUTION OF PRINTS

### PROCEDURE

Whenever major changes occur as a result of the field inspection and/or Design or Combined Location and Design Public Hearing, such as interchange configuration, intersection design, etc., distribution is to be made in accordance with IIM LD- 68.

## SECTION 2E-13 UTILITY FIELD INSPECTION

After field inspection recommendations have been resolved and incorporated into the plans, and the designer has evaluated any applicable test hole data (See IIM LD- 140) prints are to be submitted for Utility Field Inspection. Include the test hole data sheet and any available preliminary plans for bridges, retaining walls, traffic signals and lighting. (See IIM LD- 68)

The District Utility Engineer, or a representative, shall conduct the Utility Field Inspection. On complex projects, the Designer may be requested to attend the Utility Field Inspection in order to provide an explanation of the design requirement. A Utility Field Inspection Report will be prepared with a copy to the Location and Design Engineer.

As soon as practicable after the Utility Field Inspection, the District Utility Engineer shall obtain replacement utility easement requirements from the affected utility companies. After review and approval of the utility easements, the District Utility Engineer shall transmit marked prints to the Transportation Engineer in charge of the project for addition to the Right of Way plans. The necessary utility easements shall be shown in accordance with Section 2E-5 -"UTILITY EASEMENTS".

The Utility Field Inspection Report will indicate which utility relocations will be placed in the highway contract. Usually a separate set of utility adjustment plans will be prepared and made a part of the project assembly. Screened reproducibles of the plan sheets and/or profiles are normally requested by the Utility Section for use in designing the utility adjustment plans.

## CHAPTER 2F - RIGHT OF WAY PLAN DEVELOPMENT

### SECTION 2F - 1 - REVIEW OF PLANS

**Page**



### SECTION 2F - 2 - COST ESTIMATE

**Page**



### SECTION 2F - 3 SUBMISSION OF PLAN ASSEMBLY

**Page**



### SECTION 2F - 4 - PROJECT APPROVAL

**Page**

**SECTION 2F- 5 - DISTRICT PROJECTS**

**Page**



**SECTION 2F- 6 - RIGHT OF WAY REVISIONS- CENTRAL OFFICE & DISTRICT PROJECTS**

**Page**

# CHAPTER 2F - RIGHT OF WAY PLAN DEVELOPMENT

## SECTION 2F - 1 - REVIEW OF PLANS

### CHECK FOR ACCURACY AND COMPLETENESS

Prior to submitting the plans for approval for right of way acquisition, the designer is to carefully review the plans for accuracy and completeness. This is to include, but not be limited to, a check of construction limits, right of way lines, alignments, grades, typical sections, drainage, etc. All public hearing and field inspection recommendations accepted are to be included on the plans.

### RIGHT OF WAY DATA SHEET

A Right of Way Data Sheet will be included with all projects requiring right of way for construction. Projects must include data indicating the total area, fee taking, fee remainder, and the area of permanent and temporary easements. This information is furnished by the Right of Way and Utilities Division and is recorded on a Preliminary Right of Way Data Sheet (See Figure 2E-17).

All proffers will be denoted (Yes or No) on the Right of Way Data Sheet in the "Proffers" column.

### PARCEL NUMBERS AND DEMOLITION NUMBERS ON PLANS

Each parcel from which right of way or easement to be acquired must be assigned a parcel number and each building, well, "significant" sign or other "significant" improvement to be removed must be assigned a demolition number (D-1, D-2, etc.). A sign or other improvement is deemed "significant" if equipment other than that normally required to clear the parcel will be needed to demolish or remove the structure. This will be determined by the Right of Way and Utilities Division with assistance from other divisions as necessary.

Parcel numbers are three-digit numbers beginning with 001 and are shown on the plan sheets in a 15 mm (0.6 inch) diameter circle. When subdivision lots are numbered, the lot numbers are to be shown in a fine line circle of 6 mm (0.25 inch) diameter in order to differentiate them from parcel numbers.

Demolition numbers begin with D-1 and are shown on the plans adjacent to, or within, the building, well or other significant structure. These numbers are not to be circled.

After a parcel or demolition number has been assigned, the same numbers are not to be reassigned to another parcel or building. For example, if the plans are revised to eliminate the need for right of way from a particular parcel, the parcel number will be removed from the plans, and not reassigned to another parcel.

Parcel and demolition numbers are furnished by the Right of Way and Utilities Division at field inspection stage.

**WELLS**

Wells to be closed are to be located and described (diameter and depth if available from Right of Way and Utilities Division) on the plans and the assigned demolition number (D-1, D-2) shown adjacent to the well. Wells are to be summarized as "Closing Well" on an "Each" basis (reference VDOT's Road and Bridge Specifications). Any well house to be demolished is to be assigned a separate demolition number, although it may be attached to the well, and summarized as "Demolition of Building". (See Figure 2G-4)

**BUILDING DATA REPORT**

The Right of Way and Utilities Division will furnish a Building Data Report ninety days prior to advertisement. This report will confirm the regular demolition numbers (D-1, D-2, etc.) as well as furnish special "D" series numbers for underground storage tanks, "non-significant" signs or "non-significant" improvements/personal property on the project.

**UNDERGROUND STORAGE TANKS**

Underground storage tanks to be removed are assigned D500 series numbers. The location of the tank is to be plotted on the plans with the D500 series number (D500, D501, etc.) and the capacity of the tank shown adjacent to it. Underground storage tanks are to be summarized as “Underground Storage Tank Removal (Type). Removal of the tank is paid for on an each basis, based on the size of the tank. (See Figure 2G-4).

| | TYPE A | TYPE B | TYPE C | TYPE D |
|---|---|---|---|---|
| METRIC | 0-2840 L | 2841-5680 L | 5681-18930 L | 18931 L & above |
| IMPERIAL | 0-750 gals. | 751-1500 gals. | 1501-5000 gals. | 5001 gals. & above |

**OUTDOOR ADVERTISING SIGNS**

Outdoor advertising signs are to be located and described on the plans and the assigned number shown adjacent to it. Signs deemed "non-significant" by the Right of Way and Utilities Division are assigned "D700" series numbers (D700, D701, etc.) and summarized under "Clearing of Parcel". Any signs deemed "significant" will be assigned a demolition number (D-1, D-2, etc.) and summarized under "Demolition of Buildings" (See Figure 2G-4). Permit (OA) numbers are to be shown adjacent to the sign. Construction Limits are to encompass the sign.

**NON-SIGNIFICANT IMPROVEMENTS / PERSONAL PROPERTY**

Non-significant improvements/personal property will be assigned D900 series numbers (D900, D901, etc.), shown in or adjacent to the item and summarized under "Clearing of Parcel" (See Figure 2G-4).

**ITEMS NOT IN CONTRACT**

Items to be removed by others are to be shown in the summary in order that bidders be made aware of the scope of work required. Show items only for parcels where payment is to be made under "Clearing of Parcel" (See Figure 2G-4).

**COMPLIANCE WITH FEDERAL REGULATIONS**

Because the department is operating under the Certification Acceptance Plan for most projects, it is extremely important that the Designer be thorough in the review for compliance with federal regulations. There are numerous federal directives with which the Designer must be familiar, along with AASHTO design criteria. The current FHWA Program Manual is kept on file in the Plan Coordination Section.

**PLAN PROCESS-PARTIAL TAKE PARCELS (NO TOTAL TAKE PARCELS)**

The District Right of Way Manager will be responsible for providing the information for the Right of Way Data Sheet. The Location and Design Division will be responsible for obtaining the Federal Identification Base Numbers from the PPMS Data Screen (PF11). The Location and Design Division will also be responsible for submitting requests for “partial takes” immediately after Design Approval.

The Title Sheets will show one Right of Way Authorization Signature Block and the Right of Way Data Sheet will show only one Tabulation Block.

The estimates in PPMS, RUMS and PCES must be verified to agree.

When both Partial and Total Takes are required an additional title sheet signature block should be added to the title sheet.

See the example below.

| RECOMMENDED FOR APPROVAL FOR RIGHT OF WAY ACQUISITION (PARTIAL TAKES) | |
|---|---|
| | |
| DATE | PROGRAMMING DIVISION DIRECTOR |
| | |
| DATE | STATE LOCATION AND DESIGN ENGINEER |
| | |
| DATE | CHIEF FINANCIAL OFFICER |
| | |
| DATE | CHIEF ENGINEER |

| APPROVED FOR RIGHT OF WAY | |
|---|---|
| | |
| DATE | COMMISSIONER |

The Title Sheet Signature Block should be modified to accommodate the “Total Take” parcel numbers as follows:

| RECOMMENDED FOR APPROVAL FOR RIGHT OF WAY ACQUISITION | | | | |
|---|---|---|---|---|
| TOTAL TAKE FOR PARCELS: | | | | |
| 094 | 095 | 096 | 097 | 098 |

| | |
|---|---|
| | |
| DATE | PROGRAMMING DIVISION DIRECTOR |
| | |
| DATE | STATE LOCATION AND DESIGN ENGINEER |
| | |
| DATE | CHIEF FINANCIAL OFFICER |
| | |
| DATE | CHIEF ENGINEER |

| APPROVED FOR RIGHT OF WAY | |
|---|---|
| | |
| DATE | COMMISSIONER |

For additional information on Title Sheet preparation see “TIPS FOR PREPARING TITLE SHEET FOR SIGNATURES”, available at:
<http://www.virginiadot.org/business/locdes/reference-guides.asp>

## PROGRAM / PROJECT MANAGEMENT SYSTEM (CERTIFICATION ACCEPTANCE)

The Program/Project Management System (P/PMS) is used to insure that projects are in compliance with federal certification acceptance (CA) requirements and is to be used for all projects. At the Right of Way stage, the P/PMS should contain entries to show that public hearing requirements have been satisfied (the date of the LD-419 requesting an estimate for the public hearing stage is the beginning date for Activity 44 and the date of the PCES Right of Way and Utilities estimate is the ending date for Activity 44), the environmental document has been approved and that location and design features have been approved, by the Commonwealth Transportation Board and the Chief Engineer. There are numerous other entries, but the aforementioned are some of the more important. All dates are to be recorded within one week of the completion of any Activity. The PPMS activities are to reflect the appropriate elements (i.e. element 51P (partial take), 52P and 60P).

## PERMIT ASSEMBLY

The project designer will forward the entire permit assembly to the Environmental Division. This should occur after the public hearing requirements have been met and approximately one year prior to the project advertisement date. (See Appendix C, Section C-4)

## DETERMINING CONSTRUCTION QUANTITIES

Alignments and grades are well established when the project reaches the right of way stage. Also, all reports affecting the design should have been received by the Location and Design Division. The designer should be able to prepare an accurate estimate of construction quantities.

## SECTION 2F - 2 - COST ESTIMATE

### REQUEST FOR COST ESTIMATES

Estimates for traffic signs, signals, bridges, etc. are requested the total construction estimates can be completed. For more instructions on cost estimates (See VDOT Manual TRNS*PORT).

# SECTION 2F - 3 SUBMISSION OF PLAN ASSEMBLY

## DATA REQUIRED

The plan assembly to be furnished to the Central Office Plan Coordination Section consists of:

- Project title sheet
- Completed Form LD-113 (Data Sheet)
- Completed Form LD-404 (Scoping Certification)
- Original and one yellow copy of:

  Form LD-95 (for Limited Access projects)
  or
  Form LD-96 (for all other projects)

  (These are standard form letters used by the Commissioner to authorize the State Right of Way and Utilities Engineer to acquire right of way.)

Forms LD-95, LD-96, and LD-113 show the right of way description. If the Department is to purchase the right of way, the estimated right of way cost is to be shown on the front of Form LD-113 (Data Sheet) along with the estimated construction cost. This information is needed by the officials approving the plans.

## REQUEST FOR RIGHT OF WAY AUTHORIZATION FROM FHWA

In order to expedite the obtaining of FHWA R/W authorization, the Programming Division has requested that L&D provide the following information in the frame time indicated.

Applicable Projects - all projects where right of way acquisition or utility adjustments will be federally funded. This includes those rare occasions where a federally funded Secondary project will have a separate R/W project number for R/W acquisition or utility adjustment.

Time Frame for Submission - immediately after the Environmental Document has been approved by the FHWA. The Project Manager is responsible for submitting plans to the Programming Division thirty days prior to the scheduled turn in date for Right of Way approval.

Submission Procedure - District personnel will submit information to the Programming Division. The Central Office designers will mail or email R/W authorization information to the Programming Division.

Information Required in Submission for FHWA R/W Authorization:

1. - Complete set of R/W plans.
2. - Copy of Form RW-238 (Estimate shall not be more than 6 months old).
3. - Updated R/W and utility estimate.
4. - Right of Way Data Sheet properly filled in with all the acreage. The number of parcels shown must agree with the R/W estimate.
5. - Beginning and End R/W termini must be shown on plans. The R/W termini must agree with the full parcels - this means from the beginning of the first parcel to the end of the last parcel.
6. - The date that the FHWA approved the Environmental Document and the type of document. If it is an EIS rather than EA or CE then the document number must be provided.

The purpose of this FHWA R/W Authorization process is to obtain federal authorization as soon as possible so that as soon as the Commissioner authorizes R/W authorization, FHWA authorization will already be on hand and the R/W Division can begin acquisition procedures immediately.

# SECTION 2F - 4 - PROJECT APPROVAL

## RECOMMENDATION FOR APPROVAL

Before the Commissioner signs the plans giving approval to acquire right of way, signatures recommending approval are required. Spaces are provided for the signatures in the lower right corner of the title sheet.

## APPROVAL

Following the recommendation for approval for acquisition of right of way, the Commissioner will approve the project by signing the title sheet. He will also sign the form letter LD-95 or LD-96 which the designer has prepared for his signature.

## ORIGINAL RIGHT OF WAY PLANS

Immediately upon the signing of the title sheet for Right of Way acquisition and/or for construction, the title sheet will be filed in the VDOT Central Office Plan Library. The type written names of the signers, and date signed, will be inserted into the signature blocks of the .dgn version of the title sheet.

## DISTRIBUTION OF PRINTS OF PLANS

Distribution of the approved plans to the Right of Way and Utilities Division for property acquisition will be made by the Plan Coordination Section or by the district for projects designed in the district. This will be done via email to inform the various parties.

The assembly provided to the Plan Coordination Section shall include:

- complete original Right of Way plans
- original cross sections
- Form LD-113
- Form LD-95 or LD-96 (printed on original letterhead)

For District projects, Form LD-95 or LD-96 is submitted to the State Right of Way and Utilities Engineer by the Central Office Plan Coordination Section.

## SECTION 2F- 5 - DISTRICT PROJECTS

### RIGHT OF WAY PLANS

A set of .tif files is kept on file. These plans are to be considered as a set of the official right of way plans. During the course of completing the original plans for construction, it is incumbent upon the district designers to process plan revisions for any changes (described in Section 2F-6, FORMAL REVISIONS-MAJOR CHANGES) made to the original plans that affect right of way or utilities so that revised plans can be distributed to the District Right of Way and Utilities Section. A set of .tif files of the revised sheets is to be furnished to the Central Office District Coordination Section via updating Falcon and creating .tif files after the revisions have been made. This will maintain an up-to-date official set of right of way plans on Falcon Web. The proper steps are outlined in this reference guide on the Internet, Electronic Submission of Right of Way Plans. The link to this guide is www.virginiaDOT.org/business/locdes/reference-guides.asp.

## SECTION 2F- 6 - RIGHT OF WAY REVISIONS- CENTRAL OFFICE & DISTRICT PROJECTS

### FORMAL REVISIONS-MAJOR CHANGES

Ideally, a project should not require revisions or changes after receiving approval for right of way acquisition. Realistically, most projects do require revisions and some are revised numerous times. It is important that each plan revision be properly documented as to the reason for the change. It is preferable that all revisions affecting the right of way line, will be requested by letter; but in some situations, time limitation requires that the revision be made on a verbal request. In all cases, however, this type of revision is to be processed formally. Revisions in alignments, grades, side slopes, and/or drainage require formal plan revisions, even though the right of way lines may not have changed. Whenever a change is made and the designer has any doubts as to whether the Right of Way and Utilities Division has an interest in the change, a revision is to be made.

Before making a change that requires a formal revision, the designer should contact the District Right of Way and Utilities Manager to determine the status of negotiations on affected parcels. This may forestall negotiations with erroneous plans. If negotiations have been completed, review the revision again to make sure the change is absolutely necessary. (See Section 2E-5, Plan Revisions)

If a change is made affecting the limits of a Construction project (or projects) within the original Right of Way project termini, that would affect the Right of Way Acquisition, Utility Adjustments or Railroad Agreements, the Right of Way and Utilities Division should be advised accordingly as soon as possible in order that they can arrange to clear the desired segment and subsequently certify to the Scheduling and Contract Division that a project is clear for advertisement.

If one set of plans is being used for both Right of Way Acquisition and Construction, a Right of Way Revision is to be submitted providing them with the new construction project termini.

When a separate set of plans is being used for Acquisition, it will be necessary to furnish the Right of Way and Utilities Division, by memorandum, with the revised construction termini, including the full project description and Federal construction numbers (if applicable). In addition, a list of those parcels within each segment on complex projects must be furnished in order that those parcels can be cleared for construction. A careful check should be made to be sure that all parcels are listed including any easements. Should a temporary connection, parcels for borrow or placing materials for temporary detours be required outside the limits of project termini, then the parcels affected should be included in the list.

Formal plan revisions can be made in the district offices when requests are received from the District Right of Way and Utilities Manager. All plan revisions shall be reviewed to determine if any utilities are affected by the changes. If utilities are affected, determine how many utility companies are affected and on Form LD-36 (Revision Data), indicate in the proper space how many revised prints are required. This will enable the Central Office Plan Coordination Section to send out emails informing the necessary parties of the revision.

Utilities are affected by items such as right of way lines, fences, property lines, property owners' names, crossovers, easements, service roads, ramps, construction limits, entrances, project termini and numbers, alignment changes, grade or profile changes, guardrail, drainage ditches, storm drainage systems, location of existing utilities, new utility work being included in the plans, location of bridge abutments and pier footings, box culverts, sequence of construction, etc. Items that do not usually affect utilities are pavement designs, types of materials, etc. When in doubt, revised prints are to be sent to utility companies. The inclusion in plans of utility easement information shall be treated as a major change and the revision processed through the Plan Coordination Section.

Revisions to any project geometrics may affect environmental regulations, hazardous materials, or archaeology concerns. Revised prints are to be provided to the Environmental Division except for designation type revisions (i.e. property owner names, parcel number changes, etc.).

## PROCESSING OF PLAN REVISIONS

A Revision Data Sheet is used by the designer to describe all revisions. Care must be taken to be concise but explicit in filling out this sheet. List each revised sheet with a concise but explicit description of the change. The description should be detailed enough that anyone reading the revision could determine exactly what is being changed. Use parcel numbers and/or stations as references for the change. Make sure the revision is carried though all involved sheets (including cross sections and profiles) and items affected by the revision. It is permissible to list a series of sheets in some instances (e.g. cross section sheet numbers 14 though 29) and describe the change on the Revision Data Sheet. Each sheet in the plan assembly that is revised will also shows the revised date in the revision block at the upper right corner of the sheet. When a revision is made affecting the computer data of a project, distribute computer listings along with revised plans as detailed in IIM LD- 68 "Distribution of Prints".

The Revision Data Form LD-36 is used to transmit the revision to the Plan Coordination Section. After the project has been let to contract, a list of the quantity changes (increases and decreases along with any new items, if applicable) are to be shown on the Revision Data Sheet. Plan summaries are not to be changed.

When a plan revision is requested by a memorandum, reference is to be made to that memorandum when filling out the Revision Data sheet. If requested verbally, note this on the data sheet. Plan distribution shall be marked in the lower left corner of the Revision Data Form LD-36 which is to accompany the Data Sheet.

Before a plan revision is made, the designer should be certain that the revision does not conflict with Federal (or State) regulations or does not substantially alter the location or design as presented at the public hearing. If a revision is of substantial nature, such as a location change or addition to the scope of the work, it may be necessary to repeat the public hearing process.

Submit revised plan sheets, Form LD-36, and the Revision Data Sheet to the Plan Coordination Section for processing and distribution in accordance with Form LD-405. Title sheet should be turned in only when it is revised (not with each revision).

## INFORMAL REVISIONS - MINOR CHANGES

The Location and Design Division has a working agreement with the Right of Way and Utilities Division whereby certain types of plan changes can be made without a written request and without formal processing. This type of plan change includes changes in names, property lines, parcel numbers, building and sign numbers. Make sure changes are made on all sheets and that any pluses and distances shown for easements are accurate.

Informal revisions are handled verbally and the Right of Way and Utilities Division is responsible for obtaining the prints.

If the need for a plan change is determined by someone other than from the Right of Way and Utilities Division, the revised plans are to be distributed formally, regardless of whether the revision is considered to be a major or minor change.

Verbal requests for informal revisions can be initiated by the Central Office or District Right of Way and Utilities personnel.

## PROPOSED CONVEYANCES OF RESIDUE PARCELS

When the Right of Way and Utilities Division requests that the Location and Design Division determine the need to retain residue parcels of Right of Way for future highway purposes or to make them available for sale, the appropriate designer will forward Form LD-397.

## CHAPTER 2G - CONSTRUCTION PLANS

### SECTION 2G-1-FINALIZING PLANS



### SECTION 2G-2-SUMMARY SHEETS



### SECTION 2G-3-REVIEW OF PLANS



### SECTION 2G-4-COST ESTIMATE



### SECTION 2G-5-CONSTRUCTABILITY QUALITY REVIEW

**SECTION 2G-6-QUALITY CONTROL CHECKING**



**SECTION 2G-7-PRE-ADVERTISEMENT MEETING**



**SECTION 2G-8-PREPARATION OF PLAN ASSEMBLY FOR CONSTRUCTION**



**SECTION 2G-9-PROJECT APPROVAL**



**SECTION 2G-10-BIDDABILITY REVIEW**



**SECTION 2G-11-FINAL SUBMISSION OF APPROVED PLANS**



**SECTION 2G-12- CONTACT WITH CONSTRUCTION PERSONNEL**



**SECTION 2G-13-CONSTRUCTION PLAN REVISIONS**



**SECTION 2G-14-PROJECT ROUTE FILES AND DESIGN FILES**

**SECTION 2G-15-PREPARATION OF FINAL ESTIMATE**



**SECTION 2G-16-POST CONSTRUCTION REVIEW**



## LIST OF FIGURES

# CHAPTER 2G - CONSTRUCTION PLANS

## SECTION 2G-1-FINALIZING PLANS

### REVIEWING REPORTS - PROGRAM/PROJECT MANAGEMENT SYSTEM

A thorough review of all correspondence and reports relative to summaries must be made to insure incorporation of applicable items into the plans. Usually, appreciable time has elapsed between the date of the Field Inspection and incorporation of the recommendations into the plans. Therefore, current nomenclature, basis of payment, and items affected by Instructional & Informational Memoranda are to be checked. Type code number(s), federal numbers (for Federally funded projects), bridge plan numbers, etc., on the title sheet should be verified.

If a change is made in the latter stages of plan development that affects the limits of a construction project or projects within the original right of way project termini, it can affect right of way acquisition, utility adjustments or railroad agreements. The Right of Way and Utilities Division should be advised accordingly, as soon as possible, in order that they can arrange to clear the desired segment and subsequently can certify to the Scheduling and Contract Division that a project is clear for advertisement. The methods of required notification (Plan Revision or Memorandum) are outlined in Section 2F-6-FORMAL REVISIONS-MAJOR CHANGES.

The designer should review the parameters of the project's classification, size, and geographic location as shown on the report for the Program/Project Management System. The correct alignment length, numbers, and elements of work should be reviewed for correctness.

### RESOLUTION OF PENDING CONSTRUCTION DETAILS

Few problems occur during construction of standard items. When special design or modified items are called for in the plans, it would be prudent to review these with the Scheduling and Contract Division for inclusion of proper notes or special provisions. Minor construction problems resolved at this stage may prevent the need for major revisions later.

On complex projects, a sequence of construction plan is required to guide the contractor (See Section 2E-10-SAFETY ITEMS AND SEQUENCE OF CONSTRUCTION and Road Design Manual, Volume 2, Section A-8). Safety devices and/or barriers must be provided for the protection of the traveling public and construction personnel during the life of the project. "Safety Guidelines for Construction Zones" (See IIM LD-93) delineate fully the warrants and treatment of potentially unsafe areas.

**SPECIAL DESIGN DRAWING REQUEST PROCEDURES**

When road plans have been developed to the stage of right of way acquisition, requests shall be made to the Standards/Special Design Section, by memorandum, to prepare the required special design drawings for minor structures and roadside appurtenances not included in the standard drawings for inclusion in the plan assembly. Exceptions to this procedure are requests for special design box culverts and special wing details, which are to be made to the Structure and Bridge Division.

All requests are to be made a minimum of nine (9) months to one (1) year prior to the date of Advertisement Quality Control Review of the project. The Hydraulics Engineer shall submit all requests for required special design drainage drawings (copy of memo to the Road Designer) to the Engineering Services Section. Completed special design drainage drawings will be furnished to the Hydraulics Engineer for their review and approval. The Hydraulics Engineer will submit the final drawing to the road designer for insertion in the plan assembly. Non-drainage drawing requests shall be made by the Road Designer. All requests shall include the scheduled advertisement date, complete project charge number and the name and telephone number of the Road Designer. Requests under specific time restraints should include a date desired. Special Design drainage structure drawing requests shall include the following:

1. Structure number, height, length, width, top elevation, invert elevation
2. Pipe size entering and exiting the structure
3. Prints of the pertinent plan, profile and x-sect sheets with structure clearly located

Retaining Wall drawing requests are made to the Engineering Services Section. When appropriate, standard walls will be recommended. Reviews requiring special designs will be forwarded to the Structure and Bridge Division, with a copy of the request sent to the road designer making the original request. The Structure and Bridge Division will respond directly to the original road designer. Retaining Wall drawing requests shall include the following:

1. Plans depicting the horizontal and vertical location of the wall
2. Road station for wall beginning and end
3. Boring log data for foundation design
4. Retaining wall and boring locations should be marked clearly on plan sheets

Impact Attenuator requests shall include the following:

1. Design speed
2. Propose location of the required attenuator, profile, and cross-section sheets with structure clearly located.

The Road Designer shall furnish the Engineering Services Section any additional data or information necessary for the design and preparation of the special design drawings. Special Design drawings must be in sufficient detail to construct the item and contain the basis of payment, reference to specifications and materials required for construction. Special design drawings normally follow the typical section sheets in the plan assembly.

Sound Barrier Wall requirements for location and profile elevations are determined by the Environmental Division who will provide the roadway designer with the requirements. The roadway designer will coordinate with the Environmental Division and include horizontal locations and profiles of the walls in the roadway plans. When sound barrier wall locations are determined, the roadway designer will immediately request foundation data from the Materials Division. A Boring Log Data Sheet is required for all projects having retaining walls and sound barrier walls whenever boring log data is available. Boring Log Data Sheet (in MicroStation format) will be furnished to the project designer by the Materials Division. The District Material Section will prepare these sheets or they will forward a request to the Geologist Supervisor at Elko. If assistance is needed in preparing these sheets, contact Location and Design Division's Engineering Services Section. The project contractor is responsible for the design and construction of the wall based on Special Provisions. These Special Provisions contain design and construction requirements, which become part of the roadway project specifications.

The request for special provisions should have the following information:
"Subject: Order No: A12 Project No. U000-1000-101, C501, AD Feb 2001 PPMS No. XXXX
PS&E-YES".

Special Provisions for sound barrier walls (designed by VDOT) are prepared by the Scheduling and Contract Division. The Project Manager will request Standards/Special Design Section to provide the Scheduling and Contract Division with a suggested draft of the provisions.

When sound barrier walls are designed by a consultant, the Consultant Services Section will advise the consultant to contact Engineering Services Section for input and direction prior to initiating the development of Special Provisions. When Engineering Services Section is made aware of the need for a Special Provision, it will coordinate with the Scheduling and Contract Division and provide Consultant Services a suggested draft of the provisions.

## PLANS PREPARED BY OTHER DIVISIONS

Plans prepared by other divisions are to be available approximately seven months prior to the scheduled advertisement date in accordance with the "Contract Document and Processing Cut-Off Dates for Advertisement" and are to follow the last roadway profile sheet in the plan assembly (See Section 2E-6).

## SECTION 2G-2-SUMMARY SHEETS

### GENERAL

Normal roadway construction projects prepared by the Location and Design Division are summarized into five categories: Grading, Drainage, Incidental, Pavement and Roadside Development/Temporary Erosion and Siltation Control. Each category must be separated with individual totals for each project and contract number. Projects with more than one type of financing will require separate totals for applicable items. These summaries are usually shown in tabular form.

An example of this is the case of a storm sewer system in an urban area wherein financing responsibilities are based on the run-off ratio, to be shared jointly with city, state, and/or federal funds.

Small projects or those of less complexity may be summarized in a list or "Streamline" summary. These projects will generally be limited to Minimum, No Plan, Safety, and Plant Mix Projects.

The items shown in summaries must agree with the description and pay unit shown in VDOT'S Road and Bridge Specifications as amended by contract provisions and plans. To alleviate the inconsistencies in denoting the use of Regular and Alternate Designs or Design Options on the plans, the following policy is to be adhered to:

1. When more than one design is shown on plans and it is practical to establish the same units of measurement to provide equitable payment for construction of either design, such designs are not to be designated as Regular, Alternate, or Option. The successful bidder will then be permitted to select the design he prefers, without having to designate which design he has selected at the time of bidding. As an example: separate designs are shown for guardrail consisting of concrete posts, and wood posts; however, one bid price is furnished for guardrail on a meter (L.F.) basis and the successful bidder constructs the design he prefers.

2. When more than one design is shown on the plans and it is not practical to establish the same units of measurement to provide equitable payment for construction of either design, such designs are to be designated as Design Option A, Design Option B, etc. The Scheduling and Contract Division will then incorporate a provision in the proposal, which advises that bidders have the option of bidding on any one of the design options and that award will be made on the basis of the lowest bid submitted.

3. Designs are not to be designated as Regular and Alternate except on those occasions when such designs are not considered to be equal or one is considered to be questionable, either from a performance standpoint or from a competitive cost standpoint. In such an event, the designation of Regular and Alternate designs must be approved by the Scheduling and Contract Division Engineer well in advance of plans being sent to the Scheduling and Contract Division for advertisement. When the Regular and Alternate design concepts are approved, the Scheduling and Contract Division will incorporate a provision in the proposal which advises that the Department will, at its option, award to the bidder submitting the lowest Regular or Alternate total bid, whichever is in the best interest of the State.

Pay item totals in summaries shall be shown to the nearest whole number, except in the following situations:

1. Concrete to be measured for payment by the $m^3$ (cubic yard), in which case the concrete total shall be computed to two decimal places and shown to one decimal in the summaries.

2. Metric culvert and storm sewer pipe lengths are shown to the nearest 0.5 m

3. Metric manhole and drop inlet heights are shown to the nearest 0.01 m.

4. Metric pipe cover is shown to the nearest 0.1 m.

## GRADING DIAGRAM AND SUMMARY

The notes shown in the legend should be used to clarify the method of arriving at the individual earthwork totals. Pay items should be designated and plan quantity items specified in accordance with Instructional and Informational Memorandum LD- 135. Show the plan quantity symbol for "Roadway Cut" as well as other applicable measured cut quantities in the Grading Summary. Because the "Total Regular Excavation" quantity is subject to change during construction as well as inclusion of some non-plan quantity times, do not show the plan quantity symbol with the "Total Regular Excavation" in the Grading Summary. The plan quantity symbol should not be shown on the "Regular Excavation" quantity in the engineer's estimate if any part of the total includes non-plan quantity items.

For instructions on computing and summarizing earthwork quantities see IIM LD- 138.

## DRAFTING FINAL GRADING DIAGRAM & SUMMARY

A base Grading Diagram and Summary Sheet is available as a CADD file. This sheet has all the applicable notes and symbols for a typical Grading Diagram and Summary. Designers should use only notes, which are applicable to their project.

## DRAINAGE SUMMARY

The Drainage Summary is usually set up with the identifying stations and lane down the left column, the description of the item including the pay unit across the top, and a "Remarks" column down the right side.

On projects where an agreement has been reached between the Department and city/county that the city/county will participate in the cost of storm sewer construction (See IIM LD-146), the following note must be shown under the drainage summary and the items referenced by an asterisk. *Denotes items to be paid for on the run-off ratio basis according to Commonwealth Transportation Board Policy.

" % <u>City/County Cost</u>"

Separate quantity summaries (including all structure related items) are to be shown on the plans and estimates for structures, measuring over 6.1 m (20 feet) along the centerline, that are classed as major structures and assigned a separate project number, e.g., B-601, D-603, (See Section 2E-6-Project Length Tabulation). In cases where the roadway fill and pavement is carried over but is not a part of the structure, the roadway quantities are not to be segregated on the plans and estimates but are to be included in the roadway project summary.

## PAVEMENT SUMMARY

The Pavement Summary is usually prepared with identifying stations and lane down the left column, the description of the item and pay unit across the top, and a "Remarks" column down the right side (where necessary).

Instructional and Informational Memoranda must be checked for inclusion of all pertinent notes relative to pavement designs.

**PUG MILL MIX AGGREGATES**

The following criteria must be observed when summarizing quantities:

Imperial Projects:

1. Aggregate base or subbase materials:
   The pavement recommendation will show an in-place dry weight of aggregate to be used in pounds per cubic foot.

   For example: 145 lbs. per cubic foot

   $$\frac{145 \times \text{Volume (Cu. Ft.)}}{2000} = \text{tons of Aggregate (dry weight)}$$

   Add 6% to tons of aggregate for moisture correction.

2. If cement stabilized:
   To determine the amount of cement required (tons): Compute *4% of the total dry weight of the aggregate in pounds and divide by 2000.

   *4% cement by weight is the usual rate but should another rate be recommended in the pavement design, it is to be used.

Metric Projects:

1. Aggregate base or subbase materials:

   The pavement recommendation will show an in-place dry weight of aggregate to be used in kilograms per square meter per millimeter of depth.

   For example: 2.4 $kg/m^2/mm$

   $$\frac{2.4 \times \text{Area}(m^2) \times \text{Depth(mm)}}{1000} = \text{Metric Tons of Aggregate (dry weight)}$$

   Add 6% to metric ton(s) of aggregate for moisture correction.

2. If cement stabilized:

   To determine the amount of cement required (metric ton):

Compute *4% of the total dry weight of the aggregate in metric ton.

*4% cement by weight is the usual rate, but, should another rate be recommended in the pavement design, it is to be used.

**CRUSHER RUN AGGREGATE**

Where either No. 25 or 26 aggregate is recommended, both gradations shall be shown on the plans and summaries.

**AGGREGATE BASE MATERIAL**

Whenever a material usually used as a base course is used in the subbase position (reference Section 101 of VDOT's Road and Bridge Specifications for definitions of "Base Course" and "Subbase"), it must be noted on the typical sections, summaries, and estimate as follows:

Aggregate Base Material Type (used as subbase)

If there is any question about the usage of nomenclature of a material, the designer is to contact the Materials and Scheduling and Contract Divisions for clarification.

**WEIGHTS OF ASPHALT CONCRETE**

In computing weights of asphalt concrete, the weights in $kg/m^2/mm$ (pounds per sq. yd. per inch) of depth shall be used unless otherwise directed by the Materials Division. (Use rate provided by the Materials Division, when available.) See IIM LD-158 for specific weights used by each district.

**COAL TAR PITCH EMULSION**

Due to damage done to asphalt concrete parking areas, it is necessary to provide a protective coating resistant to the deteriorating effect of gasoline and oil. The parking and maneuvering area of all rest areas and weigh stations being constructed with asphalt concrete surface, are to receive this treatment. The plan portion of the facility is to have a line drawn delineating the limits of the coating as in the example below. It is not to include exit and entrance roadways. This item is to be entered into the pavement summary under the heading of "Coal Tar Pitch Emulsion" in $m^2$ (Square Yards). A special provision will be included in the project assembly by the Scheduling and Contract Division.


## INCIDENTAL SUMMARY

The Incidental Summary is usually prepared with identifying stations and lane down the left column, the description of the item and pay unit across the top, and a remarks column down the right side.

## SPECIALTY SUMMARIES

## ROADSIDE DEVELOPMENT

Quantities relative to Roadside Development and Temporary Erosion and Sediment Control are summarized on the Roadside Development Sheet provided as a CADD file. This is a multi-purpose sheet providing types of seed mixtures, rates of application, and quantities. Quantities relative to temporary Erosion and Siltation Control, shall be summarized on the Roadside Development Sheet, with the exception of any necessary outfall pipe, which will be summarized in the drainage summary.

## STORMWATER MANAGEMENT

Quantities relative to stormwater management are summarized in a separate summary on or adjacent to the drainage summary sheet(s). See IIM LD- 195.

## DEMOLITION OF BUILDINGS AND CLEARING OF PARCELS

A Building Data Report lists buildings to be removed and parcels to be cleared and is furnished by the Right of Way and Utilities Division, when applicable, for inclusion in the contract. Appropriate identification and description of the buildings are to be included in the summary. These summaries may be combined.

**UTILITY ADJUSTMENTS**

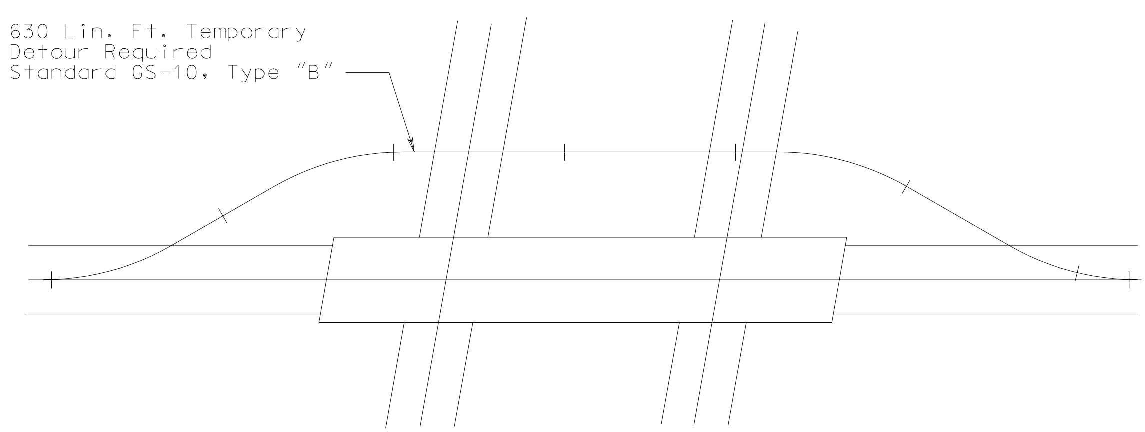
Sewer, water, or other utility adjustments which are not included in Utility Plans (Section 2G-1-PLANS PREPARED BY OTHER DIVISIONS) are summarized separately.

**SPECIAL DESIGN BRIDGES**

All special design bridges applicable to the contract are to be listed. This will include project number, description, plan number, sheet number, clear roadway, and minimum vertical clearance, where applicable. Although this is not a summary of quantities, it helps to define the scope of the project. Bridge approach slabs are included in road plans with quantities summarized on the detail sheets.

**TEMPORARY DETOURS**

Each Standard GS-10 detour road, Type "A" and Type "B", is to be shown on the plans by means of a construction baseline as noted below:




Detours on crossroads carrying over 750 ADT should have the complete alignment, grades, typical sections, drainage, etc., shown on the plans. Additional temporary construction easement lines should also be shown, if necessary.

If a type "A" or "B" Detour <u>can</u> be constructed within existing right of way, it will be necessary to only show the baseline of the detour.

If a type "A" or "B" Detour <u>cannot</u> be constructed entirely within the existing right of way, it will be necessary to show both line and grade of the detour, together with the temporary construction easement lines necessary to construct it.

The detours are to be set up in separate summaries as follows:

Type A and B

Temporary Detours, Standard GS-10

| Location | Type "A" (Meters) | Type "B" (Meters) |
|---|---|---|
| Route 601 (Sta. 100+00) | 165 | |
| Route 602 (Sta. 150+00) | | 190 |
| Route 604 (Sta. 250+00) | 200 | |
| Route 605 (Sta. 300+00) | 170 | |
| Totals | 535 | 190 |

Type C through F

Temporary Detour St'd. GS-10 Type "E"
Route 606 (Sta. 350+00)

| | |
|---|---|
| 943 $m^3$ | Regular Excavation |
| * 68 m | 450 mm Pipe |
| * 34 m | 750 mm Pipe |
| 170 $m^3$ | Aggregate Base Mat'l. Ty. I No. 21 or 21A (150 mm Depth) |
| 91 Metric Tons | Asphalt Concrete Type SM-2A @ 100 $kg/m^2$ |

*Set up pipes for payment only when recommended by the Drainage Section.

The quantities for a Type "C", "D", "E", or "F" detour are to be shown separately, as above, but are to be combined with the mainline quantities on the estimate and bidding proposal.

# SECTION 2G-3-REVIEW OF PLANS

## CHECK FOR ACCURACY AND COMPLETENESS

When the summaries have been completed, the computations are to be checked for accuracy and completeness. If conflicts in quantities are discovered, they are not to be changed until the discrepancies have been mutually resolved by compiler and checker.

Check plans for most recent insertable sheets. Review items on Quality Control Checklist.

The Hydrologic Data Sheet is to be reviewed to determine if all information contained thereon is up-to-date.

The traffic data on the title sheet should be reviewed and if it is over two years old, an update should be requested. (See Section 2A-4-REQUEST FOR TRAFFIC DATA and Section 2E-6-Functional Classification - Traffic Data.)

Computer Listings must be reviewed in accordance with IIM LD- 68.

Detailed instructions regarding checking, labeling, etc., can be found in IIM LD- 68.

## PROGRAM/PROJECT MANAGEMENT SYSTEM

By this stage, most entries on the Program/Project Management System (P/PMS) have been completed. A review is to be made to assure that the project limits shown in P/PMS are in agreement with those shown on the title sheet. After final submission of the project to the Scheduling and Contract Division, forward a copy of the Project Status Report (P/PMS POP 109) to the Central File.

## RIGHT OF WAY NOTE ON TITLE SHEET

In some instances, the proposed construction will be within existing Right of Way. Such is the case with some intersection improvements for the addition of turning lanes or on safety projects. When this situation occurs, the following note is to be shown on the title sheet in the area adjacent to the Right of Way Approval signature block:

"All construction is to be performed within existing right of way."

# SECTION 2G-4-COST ESTIMATE

## PREPARATION OF CONSTRUCTION COST ESTIMATE

A Project Cost Estimate is required for each project to be advertised for construction. Each project must be coded separately, just as the summaries were split, e.g., C-501, C-502, D-601 (Box Culvert).

The Location and Design Division has the responsibility of compiling all project estimates. Prior to final submission to the Scheduling and Contract Division, estimates furnished to anyone outside of the Department are to be taken from the current Six Year Improvement Program (SYIP). If the scope of the project has drastically changed the estimate since the SYIP was updated, the designer must get approval from the Assistant State Location and Design Engineer before furnishing an estimate that differs from the SYIP. Exceptions are projects such as, but not limited to, roadway bridge maintenance, sign, signal, lighting, landscape, etc., developed exclusively by other divisions. (See IIM LD -183)

All estimates furnished outside of Location and Design prior to final submission to the Scheduling and Contract Division are to be approved estimates (by the applicable Assistant State Location and Design Engineer) for the applicable stage of project development. (See Section 2E-7-CONSTRUCTION COST ESTIMATE)

The Project Manager reviews estimates (Preliminary Engineering and Construction) in PPMS at Scoping, Public Hearing, Field Inspection, Right of Way and Construction Stages, as well as at 90-day intervals between these milestones, for accuracy. If a project is significantly modified between these stages, the estimate must be adjusted and entered into PPMS and CES.

ALL Engineer's Estimates (Preliminary Engineering and Construction) will be reviewed by the Project Manager and updated, if necessary, for use by the Programming Division and Local Assistance Division in preparing the SYIP. At this time it is imperative that ALL estimates be reviewed for accuracy before incorporation into the new SYIP.

After final submission of the plans has been made to the Scheduling and Contract Division Engineer for project advertisement, any request for estimate information or any inquiries regarding project estimates from the press or others outside the department, are to be referred to the Scheduling and Contract Division's Estimate Engineer (Ph-804-786-2939).

The final construction estimate, prepared by the Scheduling and Contract Division for the purpose of determining whether or not acceptable bids are received, is not provided to anyone.

# SECTION 2G-5-CONSTRUCTABILITY QUALITY REVIEW

## CONSTRUCTABILITY QUALITY REVIEW

Constructability review is defined as the review of plans, specifications, and contract documents from a construction perspective to assure the documents propose an operation that is efficient, cost effective, and buildable. Its emphasis is primarily focused on “how” the documents propose the operation to be built and not on ”what” gets built.

AASHTO defines constructability review as “a process that utilizes construction personnel with extensive construction knowledge early in the design stages of projects to ensure that the projects are buildable, while also being cost-effective, biddable, and maintainable”.

This analysis is normally performed at the Preliminary Field Inspection, Public Hearing, Field Inspection and Pre-Advertisement stage of plan development. Additional reviews can be performed as needed when the plans are further developed.

The constructability review includes the report of findings, a completed checklist, and cost savings report. This report is a detailed tabulation of any anticipated savings identified during the review.

# SECTION 2G-6-QUALITY CONTROL CHECKING

## QUALITY CONTROL CHECKING PROCEDURE

This review of the completed construction plans is conducted when all items have been checked in the Advertisement column of the checklist (approximately 60 days prior to the submission to the Scheduling and Contract Division). This review will be conducted by the Transportation Engineer Senior. There may be situations in which the Transportation Engineer Senior's peers will conduct this review.

It is the Project Manager's responsibility to coordinate with other disciplines involved (Structure and Bridge, Mobility Management, etc.) to insure complete plan assemblies for checking. It will be the other disciplines' responsibility to conduct their own internal plan reviews before submitting plans to the Project Manager for review.

See Chapter 1E for Quality Control Checking Procedures.

# SECTION 2G-7-PRE-ADVERTISEMENT MEETING

## PRE-ADVERTISEMENT MEETING

The Pre-Advertisement Meeting is an inter-disciplinary team milestone that allows managers from different disciplines to review the final plans. When plans are adequately complete and within a reasonable proximity to the advertisement date (approximately 90 days prior to submission to the Scheduling and Contract Division), the Project Manager (or Local Assistance Division) will schedule a Pre-Advertisement Meeting. All concerned parties are advised of time and location. The Project Manager will inform all parties of the location, in Falcon, of the plans and how prints can be obtained. The EEO Manager is to always be invited to the Pre-Advertisement Meeting.

While the Scheduling and Contract Division Engineer is generally advised of this meeting by copy of the notification memorandum, the appropriate Scheduling and Contract Division person is to be contacted by the respective project manager to see if he/she plans to attend the meeting or send a representative. The project file is to be documented accordingly.

The meeting is held to determine if right of way and utilities will be cleared in time for the scheduled construction advertisement, to review maintenance of traffic during construction and items to be provided therefore, to discuss sequence of construction, time of construction, special provisions, and any other items pertinent to the anticipated advertisement of the project. The Project Manager (or Local Assistance Division representative) shall write a report on the findings of the meeting and distribute copies to all concerned.

The Project Manager shall discuss the report with the appropriate Scheduling and Contract Division person and obtain agreement or suggested revisions. This is done by the Local Assistance Division, on applicable projects, prior to their writing the report.

Following the Pre-Advertisement Conference the Environmental Division will conduct an Environmental Re-evaluation of the NEPA documents and certify that all environmental activities are complete (Federally Funded Projects). The Project Manager on Form LD-442 requests this Re-evaluation.

# SECTION 2G-8-PREPARATION OF PLAN ASSEMBLY FOR CONSTRUCTION

## FINAL PREPARATION OF PLANS FOR CONSTRUCTION

The following procedure is to be adhered to by the Project Manager to ensure that the project complies with the advertisement schedule. After the Quality Control Review has been completed, and all necessary adjustments have been accomplished, the Project Manager is to proceed as follows:

1) Ensure that the project cost estimate and the estimate shown in PPMS are current.
2) Check the plans provided by other divisions/sections (Signs, Signals, Utilities, Landscaping, etc.) for correlation to the roadway plans (including sheet numbers, references, file names, etc.).
3) Make any necessary additions/corrections to the Index of Sheets. The Structure and Bridge Division will provide the designer with the number of sheets included in the bridge assembly to be shown in the Index of Sheets (the bridge plans, then the cross sections, are the last two assemblies in the total plan package). The bridge plans will be made available by the Structure and Bridge Division.
4) Remove the note that reads "THESE PLANS ARE UNFINISHED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION."

## DATA REQUIRED FOR PRE-ADVERTISEMENT CONFERENCE

Submit the following to the Plan Coordination Section in accordance with the Contract Processing Cut off Dates:

a) Original Title Sheet, and all other original title sheets (Structure & Bridge, Environmental, etc.) for signatures approving the project for construction.
b) Form LD-114 Completed Plans Form
c) Form LD-426 (Federal Aid Interstate and Primary Projects)
d) Form C-99, 2 copies (Minimum and No Plan Projects)
e) Copy of Soil Analysis and Pavement Design
f) List of any Government Bench Marks to be reset
g) Copy of all correspondence pertinent to construction
h) Copy of Pre-advertisement Report
i) 3 Copies of the Cost Estimate
j) Form LD-406 Certification of Plan Correctness (District Projects only)

Immediately upon signing, the original Title Sheet (right of way and construction stage) will be filed in the VDOT Central Office Plan Library. The **type written** names of the signers, and date signed (i.e. John W. Doe, signed October 29, 2003), will be inserted into the Signature Blocks of the .dgn version of the Title Sheet.

The complete official electronic .tif version of the plan assembly will be available through VDOT's Plan File Room internal Falcon web page.

For instructions on creating .tif files, see the "REFERENCE GUIDES" on the Location and Design Division website at http://www.virginiadot.org/business/locdes/reference-guides.asp.

The Project Manager is to ensure that the final electronic construction files on appropriate projects are made accessible through Falcon at final submission of the plan assembly to the Scheduling and Contract Division. The following files, in accordance with VDOT's CADD Manual, Chapter 8, "Electronic Deliverables" are required:

1) IGrds Files, if applicable
2) CAICE Files, if applicable
3) Microstation DGN files
4) Reports
5) Index of Files
6) . tif files
7) GEOPAK files, if applicable

All scanned signatures inserted into a .dgn file, or attached as a reference file to an existing .dgn file title sheet, must be removed.

The electronic .dgn version of the Title Sheet (including the typed names of the signers) will depict the latest version of the Title Sheet, from which the designer will create a .tif file for the "current drawings" folder on Falcon. At no point should a scanned signature be attached to a MicroStation file.

> Note: In exceptional circumstances, applicable plans from other divisions may not be available at Pre-advertisement stage. In these circumstances, if permitted by the L&D Engineer/District L&D Engineer, the availability of these plans will be coordinated between the applicable Division Manager and the Plan Coordination Section. If plans for bridges, signs, signals, utilities, landscaping, etc. are not available, their absence must be called to the attention of the staff in the Plan Coordination Section by the Project Manager. It is the Project Managers responsibility to see that the necessary plans are submitted.

The Environmental Division will submit environmental documents and permits to the Scheduling and Contract Division. The Department of Rail and Public Transportation will submit any railroad agreements to the Scheduling and Contract Division.

## BRIDGE ONLY CONTRACT

When a bridge contract is to be let separately from the road contract, sufficient road plans must be included to establish the line and grade of the bridge.  In some instances, such as widening of an existing bridge, road plans may not be necessary.

The road plan designer should coordinate the submission of the plan assembly with the Bridge Engineer according to the guidelines in the section on "DATA REQUIRED FOR PLAN SUBMISSION".

## GOVERNMENT STREAM GAGING STATIONS

If U.S. Geological Survey, Weather Bureau, Virginia Department of Conservation and Development, or other government stream gaging stations are located within the limits of construction, or will be destroyed or disturbed by construction, arrangements must be made to have these gaging stations moved before construction is started.

When plans have been submitted to the Scheduling and Contract Division for advertisement on which government stream gaging stations will be disturbed by construction, the Hydraulics Section must be notified by memorandum.  The memorandum, accompanied by a print of each plan sheet on which such a gaging station occurs, shall give the description and location of each gaging station that has to be adjusted.  Upon receipt of this data, the Hydraulics Section will notify the appropriate governmental agencies of the pending highway construction and of the necessity for the adjustment of the stream gaging stations.

## PRE-ADVERTISEMENT CONFERENCE PLAN CHANGES

During the review of the plans by the Scheduling and Contract Division (prior to Final Submission), "changes" may be made to the plans (with no formal revision) if there is sufficient time to make the changes and furnish prints of the sheets involved to the Scheduling and Contract Division prior to Final Submission.

# SECTION 2G-9-PROJECT APPROVAL

## APPROVAL

At this stage, the Plan Coordination Section will coordinate approval of the plan assembly through the office of the State Location and Design Engineer. Before the Chief Engineer signs the plans giving approval to construct the project, signatures recommending approval are required. The signature block should be located in the lower right corner of the title sheet. The Plan Coordination Section will record the date of approval.

## BID PROPOSAL

The Scheduling and Contract Division will check the cost estimate, prepare a Bid Proposal and review, with the designer, any discrepancies discovered during their review of the plans to insure total agreement between plans and specifications. The designer will make the changes on the plans requested by the Scheduling and Contract Division and revise the original computerized estimate in the Scheduling and Contract Division to indicate the revised quantity or material correction(s).

Each change to the estimate should be made with a different colored pencil and dated. Proper input forms with those changes for revising the estimate should be provided.

# SECTION 2G-10-BIDDABILITY REVIEW

## BIDDABILITY REVIEW

The Biddability Review is conducted at the Pre-Advertisement stage of the project development. This review looks at the details of the drawings and the quantities for the major cost items. The quantities stated in the summaries will be compared to the project special provisions and cost estimate to ensure that payment for all required work is addressed.

The goal is to insure that the project can be constructed for the bid amount by ensuring through biddability analysis that complete and accurate contract line items contain sufficient quantities to construct the project, thus preventing work orders and overruns. An estimate of the required quantities to perform the work is made from the Construction Plans. The plan quantities are then compared to the contract quantities to ensure accuracy.

The Specifications, Standards, Special Designs and Special Provisions are also reviewed to make sure they are appropriate and correct for the work to be performed.

A report is created after the review. It summarizes the review findings and gives recommendations as to adding or rewording notes to clarify pay items, working hours, specifications, etc.

# SECTION 2G-11-FINAL SUBMISSION OF APPROVED PLANS

## PROCEDURES FOR FINAL SUBMISSION OF PLAN ASSEMBLY

1) Project Manager makes any approved adjustments to the plans.
2) Project Manager submits the following to the Plan Coordination Section in accordance with the Contract Processing Cut Off Dates:
   a) Form LD-377
   b) Design Listings.
3) No revisions may be made to the plans between final submission and the project showing, generally 10 days after advertisement, unless approved by the Scheduling and Contract Division.
4) Project Manager makes any approved adjustments to the plans.
5) Project Manager submits the following to the Plan Coordination Section in accordance with the Contract Processing Cut Off Dates:
   c) Form LD-377
   d) Design Listings.
6) No revisions may be made to the plans between second submission and the project showing, generally 10 days after advertisement, unless approved by the Scheduling and Contract Division.

# SECTION 2G-12- CONTACT WITH CONSTRUCTION PERSONNEL

## CONTACT WITH CONSTRUCTION PERSONNEL

Communication between the designer and construction personnel should promote a superior product. Therefore, to avoid conflicts during construction, it is recommended that the project designer/coordinator contact the residency soon after the project is awarded to determine a field contact person. On large projects, an on site meeting held prior to construction, may be beneficial in answering questions regarding design intent that may prevent future revisions.

## SECTION 2G-13-CONSTRUCTION PLAN REVISIONS

### FORMAL CONSTRUCTION REVISIONS

After prints of approved plans have been made available at final submission, any change on the plans will require a formal revision and approval of Scheduling and Contract Division. When a proposed revision involves a change in quantities and the project has been turned in to the Scheduling and Contract Division but has not been advertised, the Scheduling and Contract Division may agree that the changes or revisions can be made before advertisement. If so, the summary sheet and estimate should be changed to reflect the revised quantity. Do not show a change in quantity on the Revision Data Sheet.

The designer or district/consultant coordinator will prepare the proper input forms to revise the computerized Engineering Estimate by coordinating all changes in the estimate with the Scheduling and Contract Division.

The designer or district/consultant coordinator must check all original plans to verify that the latest changes coordinated with the Scheduling and Contract Division have been made correctly prior to submitting the plan assembly to the Plan Coordination Section.

The Contract Engineer must always be notified of any proposed plan revision that is required between the time plans are received in the Scheduling and Contract Division (final submission) and the award of the project.

After advertisement of the project, and prior to bids being received, a "project showing" will be held. Any plan revisions requested at this time must be approved by the Scheduling and Contract Division, prior to incorporation into the plans.

After the contract has been awarded, the estimate or summaries will not be changed. The addition of new items and increases or decreases of current contract items are to be shown on the Revision Data Sheet only, with the revision data as shown in Figure 2G-3.

Electronic plan submission of formal construction revisions must follow the Electronic Plan Submission Process. See diagram on the web at: http://www.virginiadot.org/business/locdes/e-plan-submission-index.asp .

All revisions are submitted to the Plan Coordination Section for processing, accompanied by the Revision Data sheet and Revision Data Form LD-36. The appropriate blanks on Form LD-36 must be marked in the lower left corner to designate who is to receive prints of the revised plans.

The "Reason for Revision" part of the form should state: "See Revision Data Sheet No ____. The person responsible for making the revision is to sign the form and show his/her telephone extension at the bottom. Revisions should be submitted electronically in accordance with the Electronic Plan Submission Process.

The Plan Coordination Section will request the Plan Library to print and distribute the necessary copies of the revision. Revisions are updated electronically in the Falcon Plan File Room.

The changes must be described clearly and fully on the Revision Data Sheet. State and Federal Project numbers (including P.E. numbers), project descriptions, and P/PMS numbers are to be shown at the top of the sheet. For each revision, list the following information:

1. Revision date
2. State Project number
3. Sheets revised (excluding Bridge sheets)
4. Description of change to each sheet
5. Authorization for making the revision

For illustration, see Figure 2G-3.

In addition to the above, all instructions noted in Section 2F-6-FORMAL REVISIONS-MAJOR CHANGES relating to utilities are applicable to this section.

During the life of a construction project, all construction revisions that will affect the final contract cost must be approved by the Scheduling and Contract Division before revising the plans.

In order to avoid plan revisions to work already under construction, the project designer/coordinator should contact the project engineer or inspector prior to making any formal plan revisions. Advance copies of revisions may be beneficial to field personnel and should be provided.

# SECTION 2G-14-PROJECT ROUTE FILES AND DESIGN FILES

## ROUTE FILES AND CORRESPONDENCE

One year after acceptance of a completed construction project, the route file may be discarded, except for original survey data.

For applicable projects:
All field books, original topography, profile, and property rolls are to be delivered to the Plan Library to be prepared for warehouse storage. Original rolls are not to be cut for printing but are to be delivered to the files intact.

All correspondence is to be discarded at this time. A final check should be made for any remaining originals, which should be forwarded to the Central File.

## RETENTION OF DESIGN FILES

From the preliminary to the final stages of a roadway design project, it is not unusual to have several design schemes developed utilizing the computer. Only one design scheme may be retained in computer storage. Alternate design schemes and studies will not be permanently stored, but may be reprocessed for the desired computer listing.

If/when it is necessary to use one of the alternate design schemes in lieu of the stored data or another copy of a listing is needed, the file can be retrieved and the desired output recreated to replace the existing data on file. If multiple design schemes, such as alternate sub-grade designs, must be considered at construction advertisement stage, the alternate design files will be retained.

The designer will be notified on Form C-5 when construction of the project has been completed.

Correspondence, computations, reports, etc. are to be retained in accordance with the table shown in Table 2G-10-1.

## FINAL NOTEBOOK AND PROJECT RECORDS RETENTION

The District Location and Design Engineer will retain all source documents, "project inspector" notebooks and/or project records for a period of five years, following payment of the final voucher, on all Federally funded, State, and Revenue Bond financed projects. Microfilming of these notebooks or records is not necessary.

At a time convenient to the district, the "As Built" plan assembly shall be sent to the State Location and Design Engineer with a request that the project records be microfilmed. After microfilming, the "As Built" assembly will be returned to the district for verification and filing.

If no audits, litigation or claims are in progress, all source documents, notebooks and/or project records can be disposed of after the five-year retention period. Otherwise, the retention period should be extended until such cases are resolved.

## SECTION 2G-15-PREPARATION OF FINAL ESTIMATE

### PROCEDURE

The review and preparation of final estimates, while requiring the coordinated effort of many divisions in the Central Office, is basically a responsibility of the District Administrator utilizing the District Design Units as focal points in fulfilling this obligation.

The primary objective during the review and preparation of the final estimate is to determine that the final records present a factual representation of the work performed by the contractor on the project.

Guidelines for review and preparation of final estimates may be found in the Post Construction Operations manual.

Completed final estimates are kept on file at the District Headquarters.

# SECTION 2G-16-POST CONSTRUCTION REVIEW

## POLICY

A Post Construction Field Review will be conducted on completed projects to evaluate the effectiveness of the various roadway designs and current design policy and to identify potential improvements.

This review should be held six to twelve months after completion so that the facility's operation and condition can be assessed. The Location and Design Division will schedule the review and notify the appropriate divisions.

The review team shall consist of the project engineer, representatives from appropriate divisions involved in the project's development, and others as necessary. On Federal Aid project's, a FHWA representative shall be requested to attend. The District Administrator should designate a representative familiar with the project's construction, operations, and maintenance.

The evaluation shall be for the purpose of determining the effectiveness of current design policy and to detect design features, which can be improved.

## SCOPE

The review process shall include the major component items of the project selected. The normal complete components would be:

A. Roadway Design
B. Safety Features
C. Bridge Design
D. Traffic Control Devices/Lighting

The review shall evaluate the functional/operational aspect of the items above contained in the project. Each of the items shall be evaluated in accordance with the current list attached that breaks the item into the component parts. These lists shall be revised at any time to add or delete items.

## REPORTS

A Post Construction Review Report, Form LD-416, shall be completed by the Location and Design Division. Other participating divisions may prepare reports relevant to their area of involvement and submit them to the Location and Design Division. A supplemental report may be necessary. The reports should be formatted in a consistent manner by referencing to component (e.g. Safety), item number, and sub-letter for long term evaluation purposes (see Form LD-416).

The main focus of the evaluation process and the contents of the report should be safety, economy, and effectiveness of the features constructed.

Copies of the completed reports shall be provided to the District Administrator (and other applicable Division Administrators) for the review of policies, guidelines, procedures, etc. to determine if changes are necessary.

**EVALUATION**

Each Division Administrator will review the reports to determine and implement necessary changes in policy and/or guidelines used to design and construct projects.

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

U000-154-102,RW-201 C-501 | 2X

## DRAINAGE SUMMARY

| SHEET NO. | STRUCTURE NUMBER | COVER (FT.) | CONCRETE PIPE 12" (LF.) | CONCRETE PIPE 15" (LF.) | CONCRETE PIPE 18" (LF.) | CONCRETE PIPE 21" (LF.) | CONCRETE PIPE 24" (LF.) | CONCRETE PIPE 30" (LF.) | CONCRETE PIPE 36" (LF.) | CONCRETE PIPE 48" (LF.) | CONCRETE PIPE 66" (LF.) | C.M.PIPE 12" (LF.) | C.M.PIPE 15" (LF.) | C.M.PIPE 18" (LF.) | C.M.PIPE 24" (LF.) | C.M.PIPE 54" (LF.) | ELLIP. CONC. PIPE 60"X38" (LF.) | ELLIP. CONC. PIPE 68"X43" (LF.) | (X) Minor Structure Excav. (CY.) | (X) Bedding Mat'l. Aggr. 25 or 26 (TON) | END-SECTION STD.ES-1,15" (EA.) | END-SECTION STD.ES-1,18" (EA.) | END-SECTION STD.ES-1,36" (EA.) | HEIGHT OF INLETS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 7-1 | 2 | | | | | | | | | 208 | | | | | | | | 341 | | | | | |
| 7 | 7-2 to 7-8 | 2 | | 32 | | | | | | | | | | | | | | | | | | | | 4.4 |
| 7 | 7-3 to 7-12 | 2 | | 58 | | | | | | | | | | | | | | | | | | | | 3.9 |
| 7 | 7-5 | 1 | | | | | | | 4 | | | | | | | | | | | | | | 1 | |
| 7 | 7-6 to 7-9 | 3 | | | | | | | 147 | | | | | | | | | | | | | | | 5.7 |
| 7 | 7-7 to 7-14 | 2 | | 101 | | | | | | | | | | | | | | | | | | | | 3.0 |
| 7 | 7-8 | | | | | | | | | | | | | | | | | | | | | | | 4.0 |
| 7 | 7-10 to 7-14 | 1 | | 41 | | | | | | | | | | | | | | | | | | | | 2.5 |
| 7 | 7-11 to 7-12 | 3 | | | 54 | | | | | | | | | | | | | | | | | | | 4.4 |
| 7 | 7-12 to 7-4 | 3 | | | 16 | | | | | | | | | | | | | | | | | 1 | | 4.8 |
| 7 | 7-13 to 7-10 | 1 | | 8 | | | | | | | | | | | | | | | | | 1 | | | |
| 7 | 7-14 to 7-11 | 2 | | 46 | | | | | | | | | | | | | | | | | | | | 3.5 |
| 7 | 7-8 to 7-11 | 2 | | 64 | | | | | | | | | | | | | | | | | | | | |
| 7 | 7-15 | | | | | | | | | | | | | | | | | | | | | | | |
| | SHEET 2V SUBTOTAL | | | 640 | 461 | 404 | 92 | | | 960 | | 35 | 40 | 23 | | 16 | 156 | 194 | 3,212 | 278 | 1 | | | |
| | SHEET 2W SUBTOTAL | | 28 | 1,292 | 290 | | 140 | 115 | 1,062 | 160 | | | | | 4 | | 32 | | 470 | 165 | | | | |
| | SHEET 2X SUBTOTAL | | | 350 | 70 | | | | 151 | | 208 | | | | | | | | 341 | | 1 | 1 | 1 | |
| | GRAND TOTAL | | 28 | 2,282 | 821 | 404 | 232 | 115 | 1,213 | 1,120 | 208 | 35 | 40 | 23 | 4 | 16 | 188 | 194 | 4,023 | 442 | 2 | 1 | 1 | |

DROP INLETS (EA.):

| STRUCTURE NUMBER | DI-1 | DI-2A | SPECIAL DESIGN | DI-3A | DI-2B L-8' | DI-2B L-12' | DI-2B L-16' | DI-2D | DI-2E L-8' | DI-2E L-10' | DI-2E L-20' | DI-3B L-4' | DI-3B L-6' | DI-3B L-8' | DI-3B L-10' | DI-3B L-12' | DI-3B L-14' | DI-3B L-20' | DI-3C L-6' | DI-3C L-20' | DI-4B L-16' | DI-4A | DI-4AA | DI-4B L-6' | DI-4BB L-6' | DI-4D | DI-4E L-8' | DI-7 | DI-7A | DI-12 L-4' |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-2 to 7-8 | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| 7-3 to 7-12 | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| 7-5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-6 to 7-9 | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | |
| 7-7 to 7-14 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-8 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-10 to 7-14 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| 7-11 to 7-12 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-12 to 7-4 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| 7-13 to 7-10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-14 to 7-11 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | |
| 7-8 to 7-11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7-15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHEET 2V SUBTOTAL | 3 | | 1 | 3 | | | 1 | | 1 | | | | 1 | | 2 | 1 | | 3 | | | | 1 | 1 | 2 | 1 | 2 | 2 | 5 | | 1 |
| SHEET 2W SUBTOTAL | 3 | 1 | | 1 | 1 | 1 | | 1 | | 1 | 2 | 1 | 2 | 4 | 3 | 2 | 1 | | | 1 | | 1 | 1 | 1 | | | | 2 | 1 | |
| SHEET 2X SUBTOTAL | 1 | | | 2 | | | | | | | | | 1 | 1 | 2 | | | | 1 | | 1 | | | | | | | | | |
| GRAND TOTAL | 7 | 1 | 1 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 4 | 5 | 7 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 7 | 1 | 1 |

| STRUCTURE NUMBER | DI-12C L-4' (EA.) | DI-12C L-6' (EA.) | MOD.DI 2E-L-8' (EA.) | MOD.DI 3B-L-8' (EA.) | MOD.DI 3C-L-6' (EA.) | MANHOLE MH-1OR 2 (LF.) | FRAME & COVER MH-1 (EA.) | SPEC.DES. TRENCH INLETS L-20' (EA.) | SPEC.DES. TRENCH INLETS L-40' (EA.) | EROSION CONTROL STONE EC-1 (CLASS I) (TON) | EROSION CONTROL STONE EC-1 (CLASS II) (TON) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-1 | | | | | | | | | | 67 | 59 | 2 ST'D.EW-7S ENDWALLS 2:1 SLOPES |
| 7-2 to 7-8 | | | | | | | | | | | | ST'D.IS-1 REQ'D. |
| 7-3 to 7-12 | | | | | | | | | | | | |
| 7-5 | | | | | | | | | | | | |
| 7-6 to 7-9 | | | | | | | | | | | | ST'D.IS-1 REQ'D.- 36"X66" WYE JOINT |
| 7-7 to 7-14 | | | | | | | | | | | | |
| 7-8 | | | | | | | | | | | | ST'D.IS-1 REQ'D. |
| 7-10 to 7-14 | | | | | | | | | | | | ST'D.IS-1 REQ'D. |
| 7-11 to 7-12 | | | | | | | | | | | | ST'D.IS-1 REQ'D. |
| 7-12 to 7-4 | | | | | | | | | | 3 | | ST'D.IS-1 REQ'D. |
| 7-13 to 7-10 | | | | | | | | | | | | |
| 7-14 to 7-11 | | | | | | | | | | | | ST'D.IS-1 REQ'D. |
| 7-8 to 7-11 | | | | | | | | | | | | |
| 7-15 | | | | | | | | | | | | SEE S M W SUMMARY |
| SHEET 2V SUBTOTAL | 1 | 1 | 1 | 1 | 1 | 39.9 | 7 | 1 | 1 | | | |
| SHEET 2W SUBTOTAL | | | | | | 20 | 3 | 1 | | | | |
| SHEET 2X SUBTOTAL | | | | | | | | | | 70 | 59 | |
| GRAND TOTAL | 1 | 1 | 1 | 1 | 1 | 59.9 | 10 | 2 | 1 | 70 | 59 | |

### STORMWATER MANAGEMENT SUMMARY

| SHEET NO. | STRUCT. NO. | HEIGHT OF COVER | 24" CONC. PIPE (LF.) | SWM RISER PIPE 48" (LF.) | REMARKS |
|---|---|---|---|---|---|
| 7 | 7-15 | 2 | 17 | 4 | SEE SHEET 20 FOR ADDITIONAL DETAILS |

### 425' TRIPLE 5' X 4' BOX CULVERT SUMMARY
### STRUCTURE 3-23 & 3-14,3B-2
### PROJ. U000-154-102

| | | | |
|---|---|---|---|
| CONCRETE CLASS A4 BOX CULVERT | (X) | CU.YDS. | 604.6 |
| EPOXY COATED REINFORCING STEEL | (X) | LBS. | 97,710 |
| MINOR STRUCTURE EXCAVATION BOX CULVERT | (X) | CU.YDS. | 1,379 |
| BEDDING MAT'L. AGGREGATE NO.25 OR 26 | (X) | TONS | 334 |

### UNDERDRAIN SUMMARY

| STATION | CD-1 (LF.) | CD-2 (LF.) |
|---|---|---|
| 11+40 LT. | 38 | |
| 11+55 RT. | 55 | |
| 18+45 LT. | 38 | |
| 19+40 RT. | 38 | |
| 26+30 | 78 | |
| 40+30 | | 53 |
| TOTAL | 247 | 53 |

(X) Denotes Items to be paid for on basis Of Plan Quantities In accordance with current Road And Bridge Specifications.

U000-154-102 | 2X

FIGURE 2G-1 DRAINAGE SUMMARY

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

U000-154-102,RW-201 C-501 | 2Z

Depot Street Extension

# PAVEMENT SUMMARY

| LOCATION | STA. | TO STA. | PAVEMENT AREA | SURFACE: ASPHALT CONCRETE TYPE SM-2B @ 165 LBS. PER S.Y. | BASE: ASPHALT CONCRETE TYPE BM-2 (10" DEPTH) | BASE: ASPHALT CONCRETE TYPE BM-2 (4" DEPTH) | BASE: ASPHALT CONCRETE TYPE BM-2 (6" DEPTH) | SUBBASE: AGGR. BASE MAT'L. TYPE I NO.21B (4" DEPTH) | SUBBASE: AGGR. BASE MAT'L. TYPE I NO.21B (8" DEPTH) | RESURFACING: ASPHALT CONCRETE TYPE SM-2B @ 165 LBS. VARIABLE DEPTH | ENTRANCES: ASPHALT CONCRETE SURFACE COURSE TYPE SM-2B @ 220 LBS. PER S.Y. | ENTRANCES: ASPHALT CONCRETE SURFACE COURSE TYPE SM-2B @ 165 LBS. PER S.Y. | ENTRANCES: ASPHALT CONCRETE BASE COURSE TYPE BM-2 (4" DEPTH) | ENTRANCES: ⓧ CONCRETE ENTRANCE PAVEMENT 7" | ENTRANCES: AGGR. BASE MAT'L. TYPE I NO.21B (4" DEPTH) | ENTRANCES: AGGR. BASE MAT'L. TYPE I NO.21B (6" DEPTH) | CRUSHER RUN AGGR. NO. 25 or 26 | CRUSHER RUN AGGR. NO. 25 or 26 PE-1 | ⓧ FLEXIBLE PAVEMENT PLANING |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SQ.YDS. | TONS | TONS | TONS | | TONS | TONS | TONS | TONS | TONS | TONS | S.Y. | TONS | TONS | TONS | TONS | S.Y. |
| DEPOT ST. EXT. | 10+45.76 | 46+34.28 | 20,700 | 1,708 | 12,006 | | | 6,388 | | | | | | | | | | | |
| FRANKLIN STREET | 17+05.00 | 30+00.00 | 1,277 | 105 | 740 | | | 521 | | | | | | | | | | | |
| RADFORD STREET | 57+11.00 | 69+50.00 | 7,452 | 593 | 4,322 | | | 2,275 | | | | | | | | | | | |
| COLLEGE ST.(N) | 10+24.00 | 10+75.00 | 279 | 23 | | 64 | | | 137 | | | | | | | | | | |
| BETTY DRIVE | 10+34.10 | 11+00.00 | 259 | 21 | | 60 | | | 127 | | | | | | | | | | |
| NEW STREET | 10+24.28 | 11+10.00 | 279 | 23 | | 64 | | | 135 | | | | | | | | | | |
| SHELTMAN ST. | 10+23.48 | 11+10.00 | 293 | 24 | | 68 | | | 141 | | | | | | | | | | |
| SULLIVAN ST. | 10+04.22 | 11+53.00 | 476 | 39 | | 110 | | | 230 | | | | | | | | | | |
| BRACKENS ST. | 10+18.36 | 11+28.00 | 351 | 29 | | 81 | | | 110 | | | | | | | | | | |
| SCHOOL ENTR. | 10+50.93 | 11+80.00 | 495 | 41 | | 115 | | | 239 | | | | | | | | | | |
| TAYLOR ST. | 10+30.24 | 12+00.00 | 471 | 39 | | 109 | | | 139 | | | | | | | | | | |
| JAMES ST. | 10+26.41 | 11+00.00 | 277 | 24 | | 66 | | | 121 | | | | | | | | | | |
| LEE-HY COURT DR. | 10+22.96 | 10+87.00 | 237 | 20 | | 55 | | | 185 | | | | | | | | | | |
| HILLCREST DR. | 10+02.99 | 11+25.00 | 378 | 31 | | 88 | | | 311 | | | | | | | | | | |
| COLLEGE ST.(S) LT.SIDE | 37+00.00 | 38+83.56 | 617 | 51 | | 143 | | | 297 | | | | | | | | | | |
| CHERRY LANE | 9+90.33 | 12+00.00 | 592 | 49 | | 137 | | | 311 | | | | | | | | | | |
| COLLEGE ST.(S) RT.SIDE | 39+63.39 | 41+14.00 | 603 | 50 | | 139 | | | 227 | | | | | | | | | | |
| MAIN ST.(RTE 8) | | | 1878 | | | | | | | 155 | | | | | | | | | 1300 |
| ENTRANCES | | | | | | | | | | | 22 | 115 | 327 | 270 | 23 | 539 | 226 | 43 | |
| MAINTENANCE of TRAFFIC | | | | | | | 525 | | | | | | | | | | 1,000 | | |
| PARKING LOT (023) | | | | | | | | | | | | 92 | 67 | | | 372 | | | |
| GRAND TOTAL | | | | 2,870 | 17,068 | 1,299 | 525 | 9,184 | 2,710 | 155 | 22 | 207 | 394 | 270 | 23 | 911 | 1,226 | 43 | 1300 |

# INCIDENTAL SUMMARY

| SHEET NO | COMBINATION CURB & GUTTER CG-6 ⓧ St'd. | COMBINATION CURB & GUTTER CG-6 ⓧ Radial | CURB CG-2 ⓧ St'd. | CURB CG-2 ⓧ Rad. | ⓧ ENTR. GUTTER CG-9D | ⓧ ENTR. GUTTER CG-13 | EXPOSED AGGR. SIDEWALK ⓧ 4" | EXPOSED AGGR. SIDEWALK ⓧ 7" | HYD. CEMENT CONC. SIDEWALK 4" ⓧ | GUARDRAIL GR-2 St'd. | GUARDRAIL GR-2 Radial | GUARD RAIL TERMINAL GR-7 | FIXED OBJECT ATTACHMENT GR-FOA-2 TYPE I | R/W MON. RM-1 | ⓧ DEMOLITION OF PAVEMENT | ⓧ OBSCURING ROADWAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L.F. | L.F. | L.F. | L.F. | S.Y. | S.Y. | S.Y. | S.Y. | S.Y. | L.F. | L.F. | EA. | EA. | EA. | S.Y. | Unit |
| 3 | 656 | 325 | | 37 | 75 | 217 | 16 | 39 | 648 | | | | | 18 | 2893 | |
| 3B | 259 | 14 | | | 155 | | 4 | | 169 | | | | | 2 | | |
| 3C | 320 | | | | 63 | | 9 | | 209 | | | | | 2 | | |
| 4 | 862 | 189 | 5 | 63 | 299 | 222 | 11 | 61 | 904 | | | | | 12 | 3472 | |
| 5 | 1,161 | 323 | 50 | | 129 | 111 | 16 | 17 | 1,225 | | | | | 12 | 4214 | |
| 6 | 1,516 | 564 | 10 | | 156 | | 35 | | 1,604 | | | | | 27 | 4875 | 1 |
| 6B | 665 | 52 | 20 | | 43 | | 6 | | 537 | | | | | 7 | 1868 | |
| 6C | 174 | 163 | | 10 | 114 | 146 | 10 | 34 | 224 | | | | | 13 | 2104 | |
| 7 | 940 | 117 | | | 20 | | 8 | | 811 | 288 | 30 | 2 | 1 | 17 | 488 | 1 |
| 8 | 283 | 188 | | | | | 8 | | 228 | | | | | 10 | 500 | |
| IGJH | | | | | | | | | | | | | | | 1,510 | |
| TOTAL | 6,836 | 1,935 | 85 | 110 | 1,054 | 696 | 123 | 151 | 6,559 | 288 | 30 | 2 | 1 | 120 | 21,924 | 2 |

| SHEET NO | REMOVE EXIST. BOX CULV. 215 FT. 5X5.5 STA. 11+50 Rt. DEPOT ST. | REMOVE EXIST. BOX CULV. 75 FT. 3.3X2.5 STA. 13+00 Rt. DEPOT ST. | REMOVE EXIST. BOX CULV. 36 FT. 5.5X4 STA. 22+75 Lt. FRANKLIN | STRUCTURE TO BE REMOVED EXIST. BRIDGE STA. 20+30 Lt. FRANKLIN | STRUCTURE TO BE REMOVED EXIST. BRIDGE STA. 21+70 Lt. FRANKLIN | REMOVE EXISTING GUARDRAIL | REMOVE EXISTING DROP INLET | ADJUST EXISTING MANHOLE | PIPE PLUGGING CONC.CL. A3 MISC. | STEPS CONC.CL. A3 MISC. | STEPS REINF. STEEL | HANDRAIL HR-1 | CONC. RETAINING WALL ⓧ POROUS BACK-FILL | CONC. RETAINING WALL ⓧ RET. WALL EXCAV. | CONC. RETAINING WALL ⓧ BEDDING MAT'L. AGGREG. NO. 25 OR 26 | CONC. RETAINING WALL ⓧ RETAINING WALL RW-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L.S. | L.S. | L.S. | L.S. | L.S. | L.F. | EA. | EA. | C.Y. | C.Y. | LBS. | L.F. | C.Y. | C.Y. | TON | C.Y. |
| 3 | 1 | 1 | 1 | | | 40 | 4 | | 1.4 | | | | | | | |
| 3B | | | | 1 | 1 | | | | | | | | | | | |
| 3C | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | 1.2 | 1.2 | | 5 | | | | |
| 5 | | | | | | | | | 0.5 | 0.6 | | 5 | | | | |
| 6 | | | | | | | | | | 3.8 | 230 | 25 | 1 | 24 | 6 | 17 |
| 6B | | | | | | | | 1 | | 1.3 | | 12 | | | | |
| 6C | | | | | | | | | 0.6 | 1.2 | | 14 | | | | |
| 7 | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | 1.0 | 63 | 18 | | | | |
| IGJH | | | | | | | | | | | | | | | | |
| TOTAL | L.S. | L.S. | L.S. | L.S. | L.S. | 40 | 4 | 1 | 3.7 | 9.1 | 293 | 79 | 1 | 24 | 6 | 17 |

| SHEET NO | PAVED DITCH PG-2A ⓧ | PAVED DITCH PG-5 ⓧ | PAVED FLUME PG-4 ⓧ | DRY RIP-RAP CL.I 18" | FENCE ⓧ FENCE FE-CL | FENCE CORNER BRACE UNIT FE-CL | FENCE LINE BRACE UNIT FE-CL | FENCE GATE FE-CL L-14 | MOBILIZATION | CONST. SURVEYING | ⓧ DIRECTIONAL ISLAND CURB SI-3 | CLEARING AND GRUBBING | FIELD OFFICE TYPE II | ALLAYING DUST | GROUP 2 CHANNELIZING DEVICES | ELECTRONIC ARROW | FLAGGER SERVICE | WARNING LIGHT TYPE A | TRAFFIC BARRIER SERVICE CONC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S.Y. | S.Y. | S.Y. | TON | L.F. | EA. | EA. | EA. | L.S. | L.S. | L.F. | L.S. | Mo. | Hr. | Day | Hr. | Hr. | Day | L.F. |
| 3 | | | | | | | | | | | | | | | | | | | |
| 3B | | | | | | | | | | | | | | | | | | | |
| 3C | | | | | | | | | | | | | | | | | | | |
| 4 | 27 | | | | | | | | | | | | | | | | | | |
| 5 | 37 | | 3 | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | |
| 6B | | | | | | | | | | | | | | | | | | | |
| 6C | | 23 | | | | | | | | | | | | | | | | | |
| 7 | | | | 64 | 298 | 4 | 2 | 1 | | | 122 | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | |
| IGJH | | | | | | | | | | | | | | | | | | | 300 |
| TOTAL | 64 | 23 | 3 | 64 | 298 | 4 | 2 | 1 | L.S. | L.S. | 122 | L.S. | MO. | 1500 | 18,500 | 500 | 2,500 | 4,000 | 300 |

ⓧ Denotes items to be paid for on basis of plan quantities. In accordance with current Road & Bridge Specification.

SAMPLE

U000-154-102 | 2Z

**FIGURE 2G-2 PAVEMENT AND INCIDENTAL SUMMARY**

# REVISION DATA SHEET

| | |
|---|---|
| STATE PROJECT: | 0168-131-F04, PE-103, RW-202 |
| FEDERAL PROJECT: | M-5403 (217) (PE), M-RRS-5403 (242) (RW) |
| FROM: | 0.011 Mi. S. Int. Buckland Ave. |
| TO: | NCL City of Chesapeake |
| PPMS: | 1945 |

Continued 4-28-95

| | |
|---|---|
| Sheet 8: | Name change on parcels 058,060,128,176. |
| | Added new parcel numbers 177,178,179,181. |
| | Prop. u.g. utility ease. was added along west and east side of Campostella Rd. |
| | Added the wording "Proposed Acquisition Line" to parcel 058. |
| | P/L deleted on parcel 056. |
| | P/L symbol added to parcel 154. |
| Sheet 9: | Name change on parcels 026,069. |
| | Adjusted P/L on parcel 069. |
| | Prop. u.g. utility ease. was added along west side of Campostella Rd. |
| | Dwelling removed on parcel 073. |
| | Conveyance symbol removed on parcel 026. |
| | Replaced P/L symbol with 'Z' mark symbol on parcel 068 |
| Sheet 10: | Adjusted plus and distance for prop. R/W and prop. temporary construction easement on parcel 075. |
| | This revision is made in accordance with various phone conversations with and memos from Mr. William Beamon, Suffolk District Right-of-Way Section. |
| Date: | May 25, 1995 Proj. 0168-131-F04, RW-202 |
| Sheet 1: | Sheet numbers revised. |
| Sheet 1D: | Name change on parcels 008,034,036. |
| Sheet 1E: | Name change on parcel 074. |
| Sheet 3: | Name change parcel 008. |
| Sheet 4B: | Revised location of existing bldg. on parcel 082. |

Continued 6-28-95

| | |
|---|---|
| Sheet 7: | Revised P/L to "Z" marks on former parcels 048,049,050,051,126. |
| | Added tax numbers to the former parcels. |
| Sheet 8: | Proposed permanent utility easement pluses were adjusted to match utility easement line on parcel 061. |
| | This revision is made in accordance with various phone conversations with and memos from Mr. William Beamon, Suffolk District Right-of-Way Section. |

**THIS IS A PORTION OF A SAMPLE INSERTABLE SHEET, FOR A CURRENT VERSION, ACCESS THE CADD INSERTABLE DIRECTORY**

**FIGURE 2G-3 REVISION DATA SHEET**

| DEMOLITION OF BUILDINGS / CLEARING OF PARCEL / CLOSING WELL / UNDERGROUND STORAGE TANK REMOVAL SUMMARY | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0058-070-103,RW-201 | | | | | | | | | | | |
| | | | | | | INCLUDED IN CONTRACT | | | | | NOT IN CONTRACT |
| Sheet Number | Parcel Number | Demolition Number | Landowner | Station Rt. or Lt. | Description | Demolition of Buildings | Clearing of Parcel | Closing Well | Underground Storage Tank Removal Type A | Underground Storage Tank Removal Type B | Items To Be Removed By Others |
| | | | | | | Lump Sum | Lump Sum | Each | Each | Each | |
| 3 | 001 | D-1 | Vaxy, Tom Q. | 103+40 Lt. | 2 Story Frame Dwelling | L.S. | | | | | |
| 3 | 001 | D-2 | " | 104+58 Lt. | 1 Story Frame Garage | L.S. | | | | | |
| 3 | 001 | D-3 | " | 104+71 Lt. | Well - 30" X 40' | | | 1 | | | |
| 3 | 001 | D-4 | " | 104+71 Lt. | Well House | L.S. | | | | | |
| 3 | 001 | D-5 | " | 105+05 Lt. | Shed | | L.S. | | | | |
| 4 | 002 | D-6 | Tiger Oil Co. | 109+62 Rt. | 1 Story Brick Building | L.S. | | | | | |
| 4 | 002 | D700 | " | 109+68 RT. | Sign | | | | | | 1 |
| 4 | 002 | D500 | " | 109+72 Rt. | Underground Tank -700 Gal. | | | | 1 | | |
| 4 | 002 | D900 | " | 109+75 Rt. | 2 Lights | | | | | | 1 |
| 4 | 002 | D-7 | " | 109+84 Rt. | 10' X 20' Metal Sign | L.S. | | | | | |
| 4 | 002 | D-8 | " | 109+95 Rt. | Well | | | 1 | | | |
| 4 | 002 | D701 | " | 110+14 Rt. | 2' X 2' Sign | | L.S. | | | | |
| 4 | 002 | D501 | " | 110+72 Rt. | Underground Tank - 1000 Gal. | | | | | 1 | |
| 0008-070-106,RW-201 | | | | | | | | | | | |
| 7 | 019 | D-9 | Roe, Roger L. | 138+94 Lt. | 1 Story Stucco Dwelling | L.S. | | | | | |
| 7 | 019 | D901 | " | 139+02 Lt. | Fence | | | | | | 1 |
| 7 | 019 | D902 | " | 140+14 Lt. | Mobile Home | | L.S. | | | | |
| 7 | 019 | D-10 | " | 140+16 Lt. | Well - 30" X 55' | | | 1 | | | |
| TOTALS | | | | | | LUMP SUM | LUMP SUM | 3 | 1 | 1 | (N.I.C.) |

**FIGURE 2G-4 DEMOLITION OF BUILDINGS/CLEARING OF PARCEL/CLOSING WELL/UNDERGROUND STORAGE TANK REMOVAL SUMMARY**

# REVISION DATA SHEET

Date June 12, 1999 0091-095-102 , RW-201 , C-501

Changes in quantities as a result of revision dated June 12, 1999

Increases

| | |
|---|---|
| 403 | Tons Asphalt Concrete Type SM-9.5A |
| 2250 | Cubic Yards Borrow Excavation |
| 96 | Tons Asphalt Concrete Type IM-19.0A |
| 85 | Lin. Ft. 24" Pipe |

Decreases

| | |
|---|---|
| 1 | Each Guardrail Terminal St'd. GR-7 |
| 63 | Lin. Ft. GR-2A, 2B or 2C |
| 238 | Lin. Ft. 48" Pipe |

New Items

| | |
|---|---|
| 9 | Lin. Ft. St'd. MH-2A |
| 1 | Eeach Frame and Cover, St'd. MH-1 |

Sheet 8 Revised to lengthen project limits from Sta. 368+50 to Sta. 384+78

This revision was done in accordance with a memorandum from Mr. A. B. Carter District Eng. dated June 4, 1999.

THIS IS A PORTION OF A SAMPLE INSERTABLE SHEET, FOR A CURRENT VERSION, ACCESS THE CADD INSERTABLE DIRECTORY

**FIGURE 2G-5 REVISION DATA SHEET**

| RECORDS RETENTION | | | | | | |
|---|---|---|---|---|---|---|
| | Until Revised Or Voided | 1 Year | 2 Years | 3 Years | Permanent | Comments |
| | | After Completion of Project | | | | |
| **SURVEY** | | | | | | |
| Aerial Photography | | | | | X | |
| Aerial Survey Records | | | | X* | | * Retained until audit or 3 yrs., whichever is longer |
| Airport Clearance Files | | | | | X* | * Retained 20 years / longer if needed |
| Contour Mapping | | | | | X | |
| Flight Records | | | | | X* | * Retained 6 years / longer if needed |
| Photo. Mosaics | X | | | | | |
| Subsurface Utility Requests | | | | X | | |
| Survey Books/Control Files/Disks | X* | | | | | * Retain as long as Administratively necessary |
| Survey Files | | | | | X | |
| Survey Progress Reports | | X | | | | |
| Survey Requests | | | X | | | |
| Survey Rolls / U.S.G.S. Mapping | X | | | | | |
| **DESIGN** | | | | | | |
| Design Route Files | X | | | | | |
| Dist. Coordination Project Files | X | | | | | |
| IGAES Testing Material | X | | | | | |
| Microfilmed Plans | | | | | X | |
| Preliminary Field Rev. / F.I. Plans | | | | | X* | * In accordance with Falcon, Retain copies 5 yrs. |
| Paper Plan Files | | | | | X* | * Paper copies may be destroyed after scanning |
| Project CADD Files | | | | | X | |
| Project Computations | | X* | | | | * Retained until project is Route Filed |
| **ESTIMATES** | | | | | | |
| Appalachian Cost Estimates | | | | | X | |
| Appalachian Estimate Backup | X | | | | | |
| Interstate Cost Estimates | | | | | X | |
| Interstate Estimates Backup | X | | | | | |
| Project Estimates | | X* | | | X* | * Originals retained in Central File, See IIM 183 |
| **CORRESPONDENCE** | | | | | | |
| Non-Project Correspondence | | | X | | | |
| Project Correspondence | | X* | | | X* | * Originals retained in Central File, See Sec. 2G-12 |
| **RECORDS/FORMS** | | | | | | |
| A.E.S. Help Rec./Purchase Files | | X | | | | |
| Engineering Publications | | X | | | | |
| Budget Reports | | | | X* | | * Retained 3 years beyond applicable biennium |
| Committee minutes | X | | | | | |
| Consultant Files | | | | X* | | * Non-short-listed Expressions of Interest-30 days |
| Consultant Perform. Reports | | | | X | | |
| Consultant Vouchers/Invoices | X* | | | | | * Most recent three |
| Dist. Coordination Year Books | | | | | X* | * Retained until scanned at Quality Control Review |
| Leave Records | | | | | X* | * Retained in FMS |
| LD Form Backup | X | | | | | |
| Personnel Files | | X* | | | | * May be destroyed 6 months after separation |
| Publications/Photo Sales Records | | | | X | | |
| Training Records | | | | X | | |
| **MANUALS** | | | | | | |
| CADD/Survey Man./Support Data | X | | | | | |
| IIM / RDM/Support Data | | | | | X | |
| **ST'D/SPEC. DESIGN** | | | | | | |
| Special Designs / Shop Drawings | | | | | X | |
| St'd. /Insert. Sheets/Backup Data | | | | | X | |

**TABLE 2G-1-1**

# APPENDIX A

## SECTION A-1-GEOMETRIC DESIGN STANDARDS



## SECTION A-2-CLEAR ZONE GUIDELINES



## SECTION A-3-TRAFFIC BARRIER INSTALLATION CRITERIA

**Page**



**SECTION A-4-GUIDELINES FOR RRR PROJECTS**

**Page**

**SECTION A-5-BICYCLE FACILITY GUIDELINES**

**SECTION A-6 AIRPORT CLEARANCE REQUIREMENTS**

**Page**



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# APPENDIX A

## SECTION A-1-GEOMETRIC DESIGN STANDARDS

### INTRODUCTION

Highway improvement plans are based on established geometric design standards for various elements of the roadway under design. The tables on the following pages provide the **minimum** geometric standards which are to be used for development of VDOT projects except those projects which can be developed using the Guidelines for RRR Projects located in Appendix A, Section A-4 of this manual. Note that there are no specific RRR standards for Interstate projects. If the designer has determined that Guidelines for RRR Projects do not apply to the project in question, the Geometric Design Standard tables on pages A-4 to A-13 should be used for project development.

The Geometric Standard Tables were developed using the 2001 edition of A Policy on Geometric Design of Highways and Streets published by the American Association of State Highway and Transportation Officials (AASHTO). These tables present basic practical guidelines compatible with traffic, topography and safety; however, due to the restrictive format, all variables could not be included. The designer is urged to refer to the above named publication and other related chapters in the Road Design Manual for further discussion of design considerations before selecting the proper design speed criteria for a given project.

**THE APPLICATION OF THE CRITERIA PROVIDED IN THE GEOMETRIC DESIGN STANDARD TABLES MUST BE MADE IN CONJUNCTION WITH SOUND ENGINEERING JUDGMENT TO EFFECT A PROPER DESIGN.** The economic, environmental and social factors involved in highway design shall also be considered. The designer should always attempt to provide for the highest degree of safety and best level of service that is economically feasible. The "minimum" design criteria shown in the tables should only be used when overriding economic or environmental considerations so dictate.

### ROADWAY WIDTH

Roadway width as referenced in this section is the portion of the highway, including graded shoulders, for vehicular use.

### DESIGN SPEED

Design speed is defined as a speed determined for design and correlation of the physical features of a highway that influence vehicle operation - the maximum safe speed maintainable over a specified section of highway when conditions permit design features to govern.

The geometric tables indicate a design speed range for each functional classification. The selection of the proper design speed to be used on a particular project is of primary importance in project development. The design speed selected should:

- be logical with respect to topography, anticipated operating speed, adjacent land use, and functional classification of the highway.

- be as high as practicable to attain a desired degree of safety, mobility and efficiency while under the constraints of environmental quality, economics, aesthetics and social or political impacts.

- be consistent with the speed a driver is likely to expect. Drivers do not adjust their speeds to the importance of the highway, but to their perception of the physical limitations and traffic.

Although the design speeds for rural highways are coupled with a terrain classification, terrain is only one of the several factors involved in determining the appropriate design speed of a highway.

Although the selected design speed establishes the maximum degree of curvature and minimum sight distance necessary for safe operation, there should be no restriction on the use of flatter horizontal curves or greater sight distances where such improvements can be provided as a part of economic design. However, if a succession of flatter curves or tangent sections would encourage drivers to operate at higher speeds, that section of highway should be designed for a higher speed and all geometric features, particularly that of sight distance on crest vertical curves and intersection sight distance should be related to it.

Table A-1-1 indicates the various speed ranges applicable to each functional classification.

## EXCEPTIONS

Where it is impractical or not economical to obtain the minimum design as shown in the Geometric Design Tables, an exception shall be secured from the State Location and Design Engineer on **all** projects. On all new or reconstruction Interstate projects deviations from AASHTO standards (desirable standards where specified) must obtain the written approval of the Federal Highway Administration regardless of funding source. For Interstate projects, other than new or major reconstruction, all deviations from minimum AASHTO standards (in place at the time of original construction of that portion of the Interstate) must be given written approval of the Federal Highway Administration regardless of funding source. For projects on the National Highway System with Federal Oversight, deviation from AASHTO Design standards must be given written approval by the Federal Highway Administration.

On State funded rural projects where design constraints require that the overall design speed selected for a project is less than the design speed which would be normally selected based on terrain, a design exception is not required if the speed falls within the range of design speeds shown in Table A-1-1 for that particular class of roadway.  The designer must fully document the necessity for the use of a reduced design speed (or any design exception) and have it approved in accordance with Design Exception Requirements Form LD-440.  For additional instructions on Design Exceptions, see Instructional and Informational Memorandum IIM-LD-227.  The designer should exercise care to avoid selecting a speed which may be lower than the speed the average driver would expect because of impacts on traffic operations and safety which may result.

**DESIGN SPEEDS FOR VARIOUS FUNCTIONAL CLASSIFICATIONS**

L=Min. for Level Terrain
R=Min. for Rolling Terrain
M=Min. for Mountainous Terrain (As defined by Section 23 of the Highway Capacity Manual)
CBD=Min. for Central Business District
S=Min. for Suburban Area
D=Min. for Developing Area

| ROADWAY CLASSIFICATION | | SPEED (MPH) 20 | 30 | 40 | 50 | 60 | 70 |
|---|---|---|---|---|---|---|---|
| RURAL ARTERIAL | Freeways<br>MIN. 50 MPH – M<br>MIN. 60 MPH – R<br>70 MPH - Desirable | | | X<br>M | X<br>R | X<br>L | X |
| RURAL COLLECTOR ROAD | ADT OVER 2000 | | | X<br>M | X<br>R | X<br>L | |
| | CURRENT ADT 400 TO 2000 | | X<br>M | X<br>R | X<br>L | | |
| | CURRENT ADT UNDER 400 | X<br>M | X<br>R | X<br>L | | | |
| RURAL LOCAL ROAD | CURRENT ADT OVER 400 | | X<br>M | X<br>R | X<br>L | | |
| | CURRENT ADT 400 OR UNDER | X<br>M | X<br>R | X<br>L | | | |
| URBAN ARTERIAL | <u>FREEWAYS</u><br>MIN. 50 MPH | | X<br>CBD | X<br>S | X | X<br>D | X |
| URBAN COLLECTOR STREET | | | X | X | X | | |
| URBAN LOCAL STREET | | X | X | | | | |

DESIRABLE VALUES, unless noted otherwise, are greater than or equal to MINIMUM + 10 MPH.

For Urban Local Streets: Desirable value is greater than or equal to minimum + 10 MPH, but less than 50 MPH.

**TABLE A-1-1**

## GEOMETRIC DESIGN STANDARDS FOR RURAL PRINCIPAL ARTERIAL SYSTEM (GS-1)

| | TERRAIN | **DESIGN SPEED (MPH)** | MINIMUM RADIUS | (6)(7) STOPPING SIGHT DISTANCE | | MIN. WIDTH OF LANE | (1) MINIMUM WIDTH OF GRADED SHOULDERS | | (2) PAVED SHOULDER WIDTH | | (3) WIDTH OF DITCH (FRONT SLOPE) | (4) SLOPE | (5) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Desirable | Min. | | FILL | CUT | RT. | LT. | | | |
| FREEWAYS | LEVEL | 70 | 1821' | 850' | 730' | 12' | 15' | 12' | 10' | 4' | 12' | CS-4B | 2 THRU LANES SAME DIRECTION = 6' + PAVE. WIDTH + 12' 3 OR MORE THRU LANES SAME DIRECTION = 12' + PAVE. WIDTH + 12' |
| | ROLLING | 60 | 1204' | 650' | 570' | | | | | | | | |
| | MOUNTAINOUS | 50 | 760' | 475' | 425' | | | | | | | CS-4E | |
| OTHER PRINCIPAL ARTERIALS | LEVEL | 70 | 1821' | 850' | 730' | 12' | 13' | 10' | 8' | 4' | 10' | CS-4 OR 4B | UNDIVIDED & DIVIDED 3 OR MORE THRU LANES SAME DIRECTION = 10' + PAVE. WIDTH + 10' |
| | | 60 | 1204' | 650' | 570' | | | | | | | | |
| | ROLLING | 60 | 1204' | 650' | 570' | | | | | | 6' | CS-4 OR 4E | |
| | | 50 | 760' | 475' | 425' | | | | | | | | |
| | MOUNTAINOUS | 50 | 760' | 475' | 425' | | | | | | | CS-3 OR 3B | DIVIDED 2 THRU LANES SAME DIRECTION 6' + PAVE. WIDTH + 10' |
| | | 40 | 465' | 325' | 305' | | | | | | | | |

## GENERAL NOTES

Freeways - A design speed of 70 mph should be used for Rural Freeways. Where terrain is mountainous a design speed of 60 mph or 50 mph, which is consistent with driver expectancy, may be used. All new and major reconstructed Interstate facilities will have a 70 mph design speed unless a lower design speed is approved by the Location and Design Engineer and FHWA.

Other Principal Arterials - A design speed of 40 to 70 mph should be used depending on terrain, driver expectancy and whether the design is constructed on new location or reconstruction of an existing facility. An important safety consideration in the selection of one of the lower design speeds in each range is to have a properly posted speed limit which is enforced during off peak hours.

Incorporated towns or other built-up areas, Urban Standard GS-5 may be used for design.

Standard TC-5.01R superelevation based on 8% maximum is to be used for all Rural Principal Arterials.

**RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS**

| TYPE OF TERRAIN | FREEWAYS | | | ARTERIALS | | | |
|---|---|---|---|---|---|---|---|
| | DESIGN SPEED (MPH) | | | | | | |
| | 50 | 60 | 70 | 40 | 50 | 60 | 70 |
| | GRADES (PERCENT) * | | | | | | |
| LEVEL | 4 | 3 | 3 | 5 | 4 | 3 | 3 |
| ROLLING | 5 | 4 | 4 | 6 | 5 | 4 | 4 |
| MOUNTAINOUS | 6 | 6 | 5 | 8 | 7 | 6 | 5 |

Clear Zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

If medians are included, see Section 2E-3 of Chapter 2E of the Road Design Manual.

## FOOTNOTES

(1) Shoulder widths shown are for right shoulders and independently graded median shoulders. An 8' graded median shoulder will be provided when the mainline is 4 lanes (both directions). For 6 or more lanes, the median shoulder provided will be the same as that shown for independent grading.

(2) When the mainline is 6 or more lanes, the left paved shoulder width should be the same as the right paved shoulder. On Freeways, if truck traffic exceeds 250 DDHV, the right paved shoulder width preferably should be 12', and on 6 or more lane Freeways, the left paved shoulder width should also preferably be 12' if truck traffic exceeds 250 DDHV.

(3) Ditch slopes to be 6:1 - 10' and 12' widths and 4:1 - 6' width.

(4) Additional or modified slope criteria to apply where shown on typical sections.

(5) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" (1' additional clearance required for non-vehicular overpasses).

(6) For intersection sight distance requirements see Appendix C, Table C-1-5.

(7) Use desirable value as minimum on Interstate system.

**FIGURE A - 1 – 1**

# GEOMETRIC DESIGN STANDARDS FOR RURAL MINOR ARTERIAL SYSTEM (GS-2)

| TRAFFIC VOLUME | TERRAIN | DESIGN SPEED (MPH) | MIN. RADIUS | (8) STOPPING SIGHT DISTANCE | | MINIMUM PASSING SIGHT DISTANCE | (2) MIN. WIDTH OF LANE | (3) MIN. WIDTH OF GRADED SHOULDERS | | (4) PAVED SHOULDER WIDTH | | (5) WIDTH OF DITCH (FRONT SLOPE) | (6) SLOPE | (7) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Desirable | Min. | | | FILL W/GR | CUT & FILL | RT | LT | | | |
| (1) ADT OVER 2000 | LEVEL | 70 | 1821' | 850' | 730' | 2500' | 12' | 13' | 10' | 8' | 4' | 10' | CS-4, CS-4A OR CS-4C | 10' PLUS PAVEMENT WIDTH PLUS 10' |
| | | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | ROLLING | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | | 50 | 760' | 475' | 425' | 1850' | | | | | | 6' | | |
| | MOUNTAINOUS | 50 | 760' | 475' | 425' | 1850' | | | | | | | CS-3 OR CS-3B | |
| | | 40 | 465' | 325' | 305' | 1500' | | | | | | | | |
| (1) ADT 1500 TO 2000 | LEVEL | 70 | 1821' | 850' | 730' | 2500' | 12' | 11' | 8' | 6' | 4' | 6' | CS-4, CS-4A OR CS-4C | 8' PLUS PAVEMENT WIDTH PLUS 8' |
| | | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | ROLLING | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | | 50 | 760' | 475' | 425' | 1850' | | | | | | | | |
| | MOUNTAINOUS | 50 | 760' | 475' | 425' | 1850' | | | | | | | CS-3 OR CS-3B | |
| | | 40 | 465' | 325' | 305' | 1500' | 11' | | | | | | | |
| ADT 400 TO 1500 | LEVEL | 70 | 1821' | 850' | 730' | 2500' | 12' | 11' | 8' | 6' | 4' | 6' | CS-4, CS-4A OR CS-4C | |
| | | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | ROLLING | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | | 50 | 760' | 475' | 425' | 1850' | 11' | | | | | | | |
| | MOUNTAINOUS | 50 | 760' | 475' | 425' | 1850' | | | | | | | CS-3 0R CS-3B | |
| | | 40 | 465' | 325' | 305' | 1500' | | | | | | | | |
| ADT UNDER 400 | LEVEL | 70 | 1821' | 850' | 730' | 2500' | 12' | 9' | 6' | 4' | 4' | 6' | CS-4, CS-4A OR CS-4C | 6' PLUS PAVEMENT WIDTH PLUS 6' |
| | | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | ROLLING | 60 | 1204' | 650' | 570' | 2150' | | | | | | | | |
| | | 50 | 760' | 475' | 425' | 1850' | 11' | | | | | | | |
| | MOUNTAINOUS | 50 | 760' | 475' | 425' | 1850' | | | | | | | CS-3 OR CS-3B | |
| | | 40 | 465' | 325' | 305' | 1500' | | | | | | | | |

## GENERAL NOTES

Rural Minor Arterials are designed with design speeds of 50 to 70 MPH, dependent on terrain features and traffic volumes, and occasionally may be as low as 40 MPH in mountainous terrain.

In incorporated towns or other built-up areas, Urban Standard GS-6 may be used for design.

Standard TC-5.01R superelevation based on 8% maximum is to be used for Rural Minor Collectors.
If medians are included, see Section 2E of the Road Design Manual.

Clear zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

| RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS | | | | |
|---|---|---|---|---|
| TYPE OF TERRAIN | DESIGN SPEED (MPH) | | | |
| | 40 | 50 | 60 | 70 |
| | GRADES (PERCENT) | | | |
| LEVEL | 5 | 4 | 3 | 3 |
| ROLLING | 6 | 5 | 4 | 4 |
| MOUNTAINOUS | 8 | 7 | 6 | 5 |

## FOOTNOTES

(1) Use current ADT for restoration type projects and use design year ADT for all other projects**.**

(2) Lane width to be 12' at all interchange locations. For projects not on the National Highway System, width of traveled way may remain at 22' on reconstructed highways where alignment and safety records are satisfactory.

(3) If graded median is used, the width of median shoulder is to be 8'.

(4) The Paved widths shown are the widths to be used if the Materials Division recommends the shoulders be paved. When the mainline is 4 lanes (both directions) a minimum 8' wide paved shoulder will be provided on the right of traffic and a minimum 4' wide paved shoulder on the median side. Where the mainline is 6 or more lanes, both right and median paved shoulders will be 8' in width. If paved shoulders are not recommended by the Materials Division the mainline pavement structure will be extended 1' at the same slope into the shoulder to eliminate raveling of the pavement edge.

(5) Ditch slopes to be 6:1 - 10' width, 4:1 - 6' width.

(6) Additional or modified slope criteria to be applied where shown on typical sections.

(7) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" (1' additional clearance required for non-vehicular overpasses).

(8) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 – 2**

## GEOMETRIC DESIGN STANDARDS FOR RURAL COLLECTOR ROAD SYSTEM (GS-3)

| TRAFFIC VOLUME | TERRAIN | **DESIGN SPEED (MPH)** | MINIMUM RADIUS | (9) STOPPING SIGHT DISTANCE | | MINIMUM PASSING SIGHT DISTANCE | (2) MIN. WIDTH OF LANE | (3)(4) MIN. WIDTH OF GRADED SHOULDERS | | (5) WIDTH OF DITCH (FRONT SLOPE) | (6) RECOMMENDED SLOPE | (7)(8) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Desirable | Min. | | | FILL W/GR | CUT & FILL | | | |
| (1) ADT OVER 2000 | LEVEL | 60 | 1204' | 650' | 570' | 2150' | 12' | 11' | 8' | 10' | CS-4, CS-4A OR CS-4C | APPROACH ROADWAY WIDTH |
| | ROLLING | 50 | 760' | 475' | 425' | 1850' | | | | | | |
| | MOUNTAINOUS | 40 | 465' | 325' | 305' | 1500' | | | | 6' | CS-3 OR CS-3B | |
| (1) ADT 1500 TO 2000 | LEVEL | 50 | 760' | 475' | 425' | 1850' | 11' | 9' | 6' | 6' | CS-4, CS-4A OR CS-4C | 4' PLUS PAVEMENT WIDTH PLUS 4' |
| | ROLLING | 40 | 465' | 325' | 305' | 1500' | | | | | | |
| | MOUNTAINOUS | 30 | 251' | 200' | 200' | 1100' | | | | 4' | CS-3 0R CS-3B | |
| CURRENT ADT 400 TO 1500 | LEVEL | 50 | 760' | 475' | 425' | 1850' | 11' | 7' | 5' | 6' | CS-4, CS-4A OR CS-4C | 3' PLUS PAVEMENT WIDTH PLUS 3' |
| | ROLLING | 40 | 465' | 325' | 305' | 1500' | | | | | | |
| | MOUNTAINOUS | 30 | 251' | 200' | 200' | 1100' | 10' | | | 4' | CS-3 OR CS-3B | |
| CURRENT ADT UNDER 400 | LEVEL | 40 | 465' | 325' | 305' | 1500' | 10' | 7' | 2' | 6' | CS-1 | 2' PLUS PAVEMENT WIDTH PLUS 2' |
| | ROLLING | 30 | 251' | 200' | 200' | 1100' | | | | 4' | | |
| | MOUNTAINOUS | 20 | 108' | 125' | 125' | 800' | | | | | | |

## GENERAL NOTES

Geometric design features should be consistent with a design speed appropriate for the conditions.

Low design speeds (40 MPH and below) are generally applicable to highways with curvilinear alignment in rolling or mountainous terrain and where environmental conditions dictate.

High design speeds (50 MPH and above) are generally applicable to highways in level terrain or where other environmental conditions are favorable.

Intermediate design speeds would be appropriate where terrain and other environmental conditions are a combination of those described for low and high design speed.

The designer should strive for higher values than the minimum where conditions of safety dictate and costs can be supported.

In incorporated towns or other built-up areas, Urban Standard GS-7 may be used.

Standard TC-5.01R superelevation based on 8% maximum is to be used for Rural Collectors.

| **RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS** | | | | | |
|---|---|---|---|---|---|
| TYPE OF TERRAIN | DESIGN SPEED (MPH) | | | | |
| | 20 | 30 | 40 | 50 | 60 |
| | GRADES (PERCENT) | | | | |
| LEVEL | 7 | 7 | 7 | 6 | 5 |
| ROLLING | 10 | 9 | 8 | 7 | 6 |
| MOUNTAINOUS | 12 | 10 | 10 | 9 | 8 |

Maximum grades of short length (less than 500'), on one-way downgrades and on low-volume Rural Collectors may be 2 percent steeper.

Clear zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

## FOOTNOTES

(1) Use current ADT for restoration type projects and use design year ADT for new construction.

(2) Lane width to be 12' at all interchange locations.

(3) Provide 4' wide paved shoulders when design year ADT exceeds 2000 VPD, with 5% or more truck and bus usage. All shoulders not being paved will have the mainline pavement structure extended 1' on the same slope into the shoulder to eliminate raveling at the pavement edge.

(4) When the mainline is four lanes, a minimum paved shoulder width of 6' right of traffic and 3' left of traffic will be provided.

(5) Ditch slopes to be 6:1 - 10' width, 4:1 - 6' width, 3:1 - 4' width.

(6) Additional or modified slope criteria to be applied where shown on typical sections.

(7) Where the approach roadway width (traveled way plus shoulder) is surfaced, that surfaced width shall be carried across all structures if that width exceeds the width shown in this table.

(8) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(9) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 – 3**

# GEOMETRIC DESIGN STANDARDS FOR RURAL LOCAL ROAD SYSTEM (GS-4)

| TRAFFIC VOLUME | TERRAIN | DESIGN SPEED (MPH) | MINIMUM RADIUS | (9) STOPPING SIGHT DISTANCE | | MINIMUM PASSING SIGHT DISTANCE | (2) MINIMUM WIDTH OF SURFACING OR PAVEMENT | (3)(4)(5) MIN. WIDTH OF GRADED SHOULDERS | | (6) WIDTH OF DITCH (FRONT SLOPE) | (7) RECOMMENDED SLOPE | (8) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Desirable | Min. | | | FILL W/GR | CUT & FILL | | | |
| (1) ADT OVER 2000 | LEVEL | 50 | 760' | 475' | 425' | 1850' | 24' | 11' | 8' | 6" | CS-4, 4A OR 4C | APPROACH ROADWAY WIDTH |
| | ROLLING | 40 | 465' | 325' | 305' | 1500' | | | | | CS-3, 3A OR 3B | |
| | MOUNTAINOUS | 30 | 251' | 200' | 200' | 1100' | | | | 4' | | |
| (1) ADT 1500 TO 2000 | LEVEL | 50 | 760' | 475' | 425' | 1850' | 22' | 9' | 6' | 6' | CS-4, 4A OR 4C | 3' PLUS PAVEMENT WIDTH PLUS 3' |
| | ROLLING | 40 | 465' | 325' | 305' | 1500' | | | | | CS-3, 3A OR 3B | |
| | MOUNTAINOUS | 30 | 251' | 200' | 200' | 1100' | | | | 4' | | |
| ADT 400 TO 1500 | LEVEL | 50 | 760' | 475' | 425' | 1500' | 20' | 7' | 5' | 6' | CS-1 | |
| | ROLLING | 40 | 465' | 325' | 305' | 1100' | | | | 4' | | |
| | MOUNTAINOUS | 30 | 251' | 200' | 200' | 800' | | | | | | |
| CURRENT ADT UNDER 400 | LEVEL | 40 | 465' | 325' | 305' | 1100' | 18' | 7' | 2' | 4' | CS-1 | 2' PLUS PAVEMENT WIDTH PLUS 2' |
| | ROLLING | 30 | 251' | 200' | 200' | 800' | | | | | | |
| | MOUNTAINOUS | 20 | 108' | 125' | 125' | | | | | | | |

## GENERAL NOTES

Low design speeds are generally applicable to roads with winding alignment in rolling or mountainous terrain where environmental conditions dictate.

High design speeds are generally applicable to roads in level terrain or where other environmental conditions are favorable.

Intermediate design speeds would be appropriate where terrain and other environmental conditions are a combination of those described for low and high speed.

Standard TC-5.01R superelevation based on 8% maximum is to be used.

In incorporated towns or other built-up areas, Urban Standard GS-8 may be used.

**RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS**

| TYPE OF TERRAIN | DESIGN SPEED (MPH) | | | | |
|---|---|---|---|---|---|
| | 20 | 30 | 40 | 50 | 60 |
| | GRADES (PERCENT) | | | | |
| LEVEL | 8 | 7 | 7 | 6 | 5 |
| ROLLING | 11 | 10 | 10 | 8 | 6 |
| MOUNTAINOUS | 16 | 14 | 13 | 10 | -- |

## FOOTNOTES

(1) Use current ADT for restoration type projects. Use design year ADT for new construction.

(2) Lane width to be 12' at all interchange locations.

(3) In mountainous terrain or sections with heavy earthwork, the graded width of shoulder in cuts may be decreased 2', but in no case shall the shoulder width be less than 2'.

(4) Minimum shoulder slope shall be 1":1' on low side and same slope as pavement on high side.

(5) Provide 4' wide paved shoulders when design year ADT exceeds 2000 VPD, with 5% or more truck and bus usage. All shoulders not being paved will have the mainline pavement structure extended 1' on the same slope into the shoulder to eliminate raveling at the pavement edge.

(6) Ditch slopes to be 4:1 - 6' width, 3:1 - 4' width.

(7) Additional or modified slope criteria to be applied where shown on typical sections.

(8) Vertical clearance at roadway underpasses for new and reconstructed bridges is 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(9) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 – 4**

# GEOMETRIC DESIGN STANDARDS FOR URBAN PRINCIPAL ARTERIAL SYSTEM (GS-5)

| | DESIGN SPEED (MPH) | MINIMUM RADIUS | | (13) STOPPING SIGHT DISTANCE | | MIN. WIDTH OF LANE | (1) MINIMUM WIDTH GRADED SHOULDERS | | (2) PAVED SHOULDER WIDTH | | (3) WIDTH OF DITCH (FRONT SLOPE) | (4) SLOPE | (7) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | ULS | Desirable | Min. | | FILL W/GR | CUT & FILL | RT. | LT. | | | |
| FREEWAYS | 70 | 1821’ | - | 850’ | 730’ | 12’ | 15’ | 12’ | 10’ | 4’ | 12’ | CS-4 OR CS-4B | 2 THRU LANES SAME DIRECTION = 6’ + PAVE. WIDTH + 12’ |
| | 60 | 1204’ | - | 650’ | 570’ | | | | | | | | |
| | 50 | 760’ | - | 475’ | 425’ | | | | | | | CS-4 OR 4E | 3 OR MORE THRU LANES SAME DIRECTION = 12’ + PAVE. WIDTH + 12’ |
| OTHER PRINCIPAL ARTERIAL WITH SHOULDER DESIGN | 60 | 1204’ | - | 650’ | 570’ | (12) 12’ | 13’ | 10’ | 8’ | 4’ | 10’ | CS-4 OR CS-4E | UNDIVIDED & DIVIDED 3 OR MORE THRU LANES SAME DIRECTION = 10’ + PAVE. WIDTH + 10’ |
| | 50 | 929’ | - | 475’ | 425’ | | | | | | 6’ | | |
| | 40 | 563’ | 539’ | 325’ | 305’ | (5)(6) (12) 11’ | | | | | | CS-3 OR CS-3B | 2 THRU LANES (DIVIDED) SAME DIRECTION 6’ + PAVE. WIDTH + 10’ |
| | 30 | 300’ | 249’ | 200’ | 200’ | | | | | | | | |

| | DESIGN SPEED (MPH) | MINIMUM RADIUS | | STOPPING SIGHT DISTANCE | | MIN. WIDTH OF LANE | (8) STANDARD CURB & GUTTER | BUFFER STRIP WIDTH | (9) MINIMUM SIDEWALK WIDTH | (10) SLOPE | (7) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | ULS | DES. | MIN. | | | | | | |
| OTHER PRINCIPAL ARTERIAL WITH CURB & GUTTER | 60 | 1204’ | - | 650’ | 570’ | (12) 12’ | CG-7 | (11) | 5’ | 2:1 | SAME AS CURB TO CURB OF APPROACHES |
| | 50 | 929’ | - | 475’ | 425’ | | | | | | |
| | 45 | 732’ | 738’ | 400’ | 360’ | | | | | | |
| | 40 | 563’ | 539’ | 325’ | 305’ | (5)(6) (12) 11’ | CG-6 | | | | |
| | 30 | 300’ | 249’ | 200’ | 200’ | | | | | | |

## GENERAL NOTES

Freeways - Urban Freeways should accommodate desired safe operating speeds during non-peak hours, but should not be so high as to exceed the limits of prudent construction, right of way and socioeconomic costs due to the large proportion of vehicles which are accommodated during periods of peak flow when lower speeds are necessary. The design speeds for Freeways should never be less than 50 mph.

On many Urban Freeways, particularly in suburban areas, a design speed of 60 mph or higher can be provided with little additional cost above that required for 50 mph design speed. The corridor of the mainline may be relatively straight and the character and location of interchanges may permit high speed design. Under these conditions, a design speed of 70 mph is most desirable because the higher design speeds are closely related to the overall quality and safety of the facility.

Other Principal Arterials - Design speeds for Urban Arterials generally range from 40 to 60 mph, and occasionally may be as low as 30 mph. The lower (40 mph and below) speeds apply in the central business district and intermediate areas. The higher speeds are more applicable to the outlying business and developing areas.

Standard TC-5.01R superelevation based on 8% maximum is to be used for all Freeways and other Principal Arterials with a design speed greater than or equal to 60 mph.

Standard TC-5.01U (Urban) superelevation based on 4% maximum is to be used on Other Principal Arterials with a design speed less than 60 mph.

| RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TYPE OF TERRAIN | FREEWAYS * | | | ARTERIALS | | | | |
| | DESIGN SPEED (MPH) | | | | | | | |
| | 50 | 60 | 70 | 30 | 40 | 45 | 50 | 60 |
| | GRADES (PERCENT) | | | | | | | |
| LEVEL | 4 | 3 | 3 | 8 | 7 | 6 | 6 | 5 |
| ROLLING | 5 | 4 | 4 | 9 | 8 | 7 | 7 | 6 |
| MOUNTAINOUS | 6 | 6 | 5 | 11 | 10 | 9 | 9 | 8 |

* Grades 1 percent steeper than the value shown may be used on Urban Freeways for extreme cases in urban areas where development precludes the use of flatter grades and for one-way downgrades, except in mountainous terrain.

Standard TC-5.01ULS (Urban Low Speed) superelevation based on 2% maximum is to be used on Other Principal Arterials with a design speed less than or equal to 45 mph (45 mph = 7° maximum).

Clear Zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

If medians are included, see Section 2E-3 of Chapter 2E of the Road Design Manual.

A minimum 30' width of surfacing or a minimum 30' face to face of curb is to be used within incorporated cities or towns to qualify for maintenance payments.

For guidelines on Interchange Ramp, see Standard GS-R.

## FOOTNOTES

(1) Shoulder widths shown are for right shoulders and independently graded median shoulders. An 8' graded median shoulder will be provided when the mainline is 4 lanes (both directions). For 6 or more lanes, the median shoulder provided will be the same as that shown for independent grading.

(2) When the mainline is 6 or more lanes, the left paved shoulder width should be the same as the right paved shoulder. On Freeways, if truck traffic exceeds 250 DDHV, the right paved shoulder width preferably should be 12', and on 6 or more lane Freeways, the left paved shoulder width should also preferably be 12' if truck traffic exceeds 250 DDHV.

(3) Ditch slopes to be 6:1 - 10' and 12' widths and 4:1 - 6' width.

(4) Additional or modified slope criteria to apply where shown on typical sections.

(5) Minimum lane width to be 12' at all interchange locations.

(6) If heavy truck traffic is anticipated, an additional 1 foot width is desirable.

(7) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" (1' additional clearance required for non-vehicular overpasses).

(8) Or equivalent City or Town design.

(9) Width of 8' or more may be needed in commercial areas.

(10) 3:1 and flatter slopes may be used when the right of way is behind the sidewalk (or sidewalk space) in residential or other areas where slopes will be maintained by the property owner.

(11) If a buffer strip is used between the back of curb and sidewalk, it should be 2' minimum.

(12) Situations having restrictions on trucks may allow the use of lanes 1 foot less in width.

(13) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 - 5**

## GEOMETRIC DESIGN STANDARDS-URBAN MINOR ARTERIAL STREET SYSTEM (GS-6)

| | **DESIGN SPEED** (MPH) | MINIMUM RADIUS | | (12) STOPPING SIGHT DISTANCE | | (11) MIN. WIDTH OF LANE | (3) STANDARD CURB & GUTTER | BUFFER STRIP WIDTH | (4) MINIMUM SIDEWALK WIDTH | (5) SLOPE | (6) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | ULS | Desir-able | Min. | | | | | | |
| STREETS WITH CURB & GUTTER | 60 | 1204’ | - | 650’ | 570’ | 12’ | CG-7 | (10) | 5’ | 2:1 | SAME AS CURB TO CURB OF APPROACHES |
| | 50 | 929’ | - | 475’ | 425’ | | | | | | |
| | 45 | 732’ | 739’ | 400’ | 360’ | | CG-6 | | | | |
| | 40 | 563’ | 539’ | 325’ | 305’ | (1)(2) 11’ | | | | | |
| | 30 | 300’ | 249’ | 200’ | 200’ | | | | | | |

| | DESIGN SPEED (MPH) | MINIMUM RADIUS | | STOPPING SIGHT DISTANCE | | MIN. WIDTH OF LANE | (7) MIN. WIDTH OF GRADED SHOULDERS | | (8) PAVED SHOULDER WIDTH | | (9) WIDTH OF DITCH (FRONT) SLOPE | (5) SLOPE | (6) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | ULS | DES. | MIN. | | FILL W/GR | CUT & FILL | RT | LT | | | |
| STREETS WITH SHOULDER DESIGN | 60 | 1204’ | - | 650’ | 570’ | 12’ | 13’ | 10’ | 8’ | 4’ | 10’ | 2:1 | 10’ + PAVEMENT WIDTH + 10’ |
| | 50 | 929’ | - | 475’ | 425’ | | | | | | 6’ | | |
| | 40 | 563’ | 539’ | 325’ | 305’ | (1)(2) 11’ | 11’ | 8’ | 6’ | 4’ | | | 8’ + PAVEMENT WIDTH + 8’ |
| | 30 | 300’ | 249’ | 200’ | 200’ | | | | | | | | |

## GENERAL NOTES

Design Speeds for Urban Arterials generally range from 40 to 60 mph and occasionally may be as low as 30 mph. The lower (40 mph and below) speeds apply in the central business district and intermediate areas. The higher speeds are more applicable to the outlying business and developing areas.

Standard TC-5.01R superelevation based on 8% maximum is to be used for 60 mph design speed.

Standard TC-5.01U (Urban) superelevation based on 4% maximum is to be used for design speeds less than 60 mph.

Standard TC-5.01ULS (Urban Low Speed) superelevation based on 2% maximum may be used for design speeds less than or equal to 45 mph (45 mph = 7° maximum).

Clear Zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

If medians are included, see Section 2E-3 of Chapter 2E of the Road Design Manual.

A minimum 30' width of surfacing or a minimum 30' face to face of curb is to be used within incorporated cities or towns to qualify for maintenance payments.

**RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS**

| TYPE OF TERRAIN | DESIGN SPEED (MPH) | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 45 | 50 | 60 |
| | GRADES (PERCENT) | | | | |
| LEVEL | 8 | 7 | 6 | 6 | 5 |
| ROLLING | 9 | 8 | 7 | 7 | 6 |
| MOUNTAINOUS | 11 | 10 | 9 | 9 | 8 |

## FOOTNOTES

(1) Lane width to be 12' at all interchanges or if design year ADT exceeds 2000.

(2) If heavy truck traffic is anticipated, an additional 1' width is desirable.

(3) Or equivalent City or Town design.

(4) A width of 8' or more may be needed in commercial areas.

(5) Slopes 3:1 and flatter may be used when the right of way is behind the sidewalk (or sidewalk space) in residential or other areas where slopes will be maintained by the property owner.

(6) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" (1' additional clearance required for non-vehicular overpasses).

(7) If graded median is used, the width of median shoulder is to be 8'.

(8) The Paved widths shown are the widths to be used if the Materials Division recommends the shoulders be paved. When the mainline is 4 lanes (both directions) a minimum 8' wide paved shoulder will be provided on the right of traffic and a minimum 4' wide paved shoulder on the median side. Where the mainline is 6 or more lanes, both right and median paved shoulders will be 8' in width. If paved shoulders are not recommended by the Materials Division the mainline pavement structure will be extended 1' at the same slope into the shoulder to eliminate raveling of the pavement edge.

(9) Ditch slope to be 6:1 - 10' width and 4:1 - 6' width.

(10) If a buffer strip is used between the back of curb and sidewalk, it should be 2' minimum.

(11) Situations having restrictions on trucks may allow the use of lanes 1' less in width.

(12) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 – 6**

## GEOMETRIC DESIGN STANDARDS FOR URBAN COLLECTOR STREET SYSTEM (GS-7)

| | **DESIGN SPEED (MPH)** | MINIMUM RADIUS U | MINIMUM RADIUS ULS | (11) STOPPING SIGHT DISTANCE Desir-able | (11) STOPPING SIGHT DISTANCE Min. | (1) (2) MIN. WIDTH OF LANE | (3) STANDARD CURB & GUTTER | BUFFER STRIP WIDTH | (4) MINIMUM SIDEWALK WIDTH | (5) SLOPE | (8)(9) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STREETS WITH CURB & GUTTER | 50 | 929' | - | 475' | 425' | 12' | CG-7 | (10) | 5' | 2:1 | SAME AS CURB TO CURB OF APPROACHES |
| | 45 | 730' | 738' | 400' | 360' | | CG-6 | | | | |
| | 40 | 563' | 539' | 325' | 305' | (1)(2) 11' | | | | | |
| | 30 | 300' | 249' | 200' | 200' | | | | | | |

| | **DESIGN SPEED (MPH)** | MINIMUM RADIUS U | MINIMUM RADIUS ULS | STOPPING SIGHT DISTANCE DES. | STOPPING SIGHT DISTANCE MIN. | (1)(2) MIN. WIDTH OF LANE | (7) MINIMUM WIDTH GRADED SHOULDERS FILL W/GR. | (7) MINIMUM WIDTH GRADED SHOULDERS CUT & FILL | (10) WIDTH OF DITCH (FRONT) SLOPE | (5) SLOPE | (8)(9) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STREETS WITH SHOULDER DESIGN | 50 | 929' | - | 475' | 425' | 12' | 11' | 8' | 6' | 2:1 | 8' + PAVEMENT WIDTH + 8' |
| | 40 | 563' | 539' | 325' | 305' | (1)(2) 11' | | | | | |
| | 30 | 300' | 249' | 200' | 200' | | 7' | 4' | 4' | | 4' + PAVEMENT WIDTH + 4 |

## GENERAL NOTES

A minimum design speed of 30 mph or higher should be used for collector streets, depending on available right of way, terrain, adjacent development and other area controls.

In the typical street grid, the closely spaced intersections usually limit vehicular speeds and thus make the effect of design speed of less significance. Nevertheless, the longer sight distances and curve radii commensurate with design speeds higher than the value indicated result in safer highways and should be used to the extent practicable.

Standard TC-5.01U (Urban) superelevation based on 4% maximum.

Standard TC-5.01ULS (Urban-Low Speed) superelevation based on 2% maximum may be used with a design speed of 45 mph or less (45 MPH = 7° maximum).

A minimum 30' width of surfacing or a minimum 30' curb to curb is to be used within incorporated cities or towns to qualify for maintenance payments.

Clear zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

| **RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS** | | | | |
|---|---|---|---|---|
| TYPE OF TERRAIN | DESIGN SPEED (MPH) | | | |
| | 30 | 40 | 45 | 50 |
| | GRADES (PERCENT) | | | |
| LEVEL | 9 | 9 | 8 | 7 |
| ROLLING | 11 | 10 | 9 | 8 |
| MOUNTAINOUS | 12 | 12 | 11 | 10 |

Maximum grades of short lengths (less than 500 ft.) and one-way down grades may be 2% steeper.

## FOOTNOTES

(1) 12' when ADT exceeds 2000'. Where feasible, lanes should be 12' wide in industrial areas; however, where available or attainable right of way imposes severe limitations, 10' lanes can be used in residential areas and 11' lanes can be used in industrial areas.

(2) Lane width to be 12' at all interchange locations.

(3) Or equivalent City or Town Design.

(4) A width of 8' or more may be needed in commercial areas.

(5) 3:1 and flatter slopes may be used when right of way is behind the sidewalk (or sidewalk space) in residential or other areas where the slopes will be maintained by the property owner.

(6) Ditch slopes to be 4:1 - 6' width and 3:1 - 4' width.

(7) When Design year ADT exceeds 2000 VPD, with greater than 5% total truck and bus usage:
Provide 4' wide paved shoulders when the graded shoulder is 5' wide or greater or provide 3' wide paved shoulders when the graded shoulder is 4' wide. All shoulders not being paved will have the mainline pavement structure extended 1', on the same slope, into the shoulder to eliminate raveling at the pavement edge.

(8) Where the approach roadway width (traveled way plus shoulder) is surfaced, that surfaced width shall be carried across all structures if that width exceeds the width shown in this table.

(9) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(10) If a buffer strip is used between the back of curb and sidewalk, it should be 2' minimum.

(11) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 – 7**

# GEOMETRIC DESIGN STANDARDS FOR URBAN LOCAL STREET SYSTEM (GS-8)

| | **DESIGN SPEED (MPH)** | MINIMUM RADIUS | | (1) MAXIMUM PERCENT OF GRADE | (11) STOPPING SIGHT DISTANCE | (2) MIN. WIDTH OF LANE | (3) STANDARD CURB & GUTTER | (4) BUFFER STRIP WIDTH | (5) MINIMUM SIDEWALK WIDTH | (6) SLOPES | (9) (10) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | ULS | | | | | | | | |
| STREETS WITH CURB & GUTTER | 30 | 300' | 249' | 15 | 200' | 10' | CG-6 | (10) | 5' | 2:1 | SAME AS CURB TO CURB OF APPROACHES |
| | 20 | 127' | 84' | | 125' | | | | | | |

| | **DESIGN SPEED (MPH)** | MINIMUM RADIUS | | (1) MAXIMUM PERCENT OF GRADE | STOPPING SIGHT DISTANCE | (2) MIN. WIDTH OF LANE | (7) MINIMUM WIDTH GRADED SHOULDERS | | (8) WIDTH OF DITCH (FRONT) SLOPE | (6) SLOPES | (9) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | ULS | | | | FILL W/GR. | CUT & FILL | | | |
| STREETS WITH SHOULDER DESIGN | 30 | 300' | 249' | 15 | 200' | 10' | 7' | 4' | 4' | 3:1 | 4' + PAVEMENT WIDTH + 4' |
| | 20 | 127' | 84' | | 125' | | | | | | |

## GENERAL NOTES

Design Speed is not a major factor for local streets. For consistency in design elements, design speeds ranging from 20 to 30 mph may be used, depending on available right of way, terrain, adjacent development and other area controls.

In the typical street grid, the closely spaced intersections usually limit vehicular speeds, making the effect of a design speed of less significance.

Design speeds exceeding 30 mph in residential areas may require longer sight distances and increased curve radii, which would be contrary to the basic function of a local street.

Standard TC-5.01U (Urban) superelevation based on 4% maximum.

Standard TC-5.01ULS (Urban Low Speed) superelevation based on 2% maximum may be used with a design speed of 45 mph or less (45 mph = 7° maximum).

A minimum 30' width of surfacing or a minimum 30' curb to curb is to be used within incorporated cities or towns to qualify for maintenance payments.

## FOOTNOTES

(1) Grades in commercial and industrial areas should be less than 8 percent; desirably, less than 5 percent.

(2) Where feasible, lanes should be 11' wide and in industrial areas should be 12' wide; however, where available or attainable right of way imposes severe limitations, 9' lanes can be used in residential areas and 11' lanes can be used in industrial areas.

(3) Or equivalent City or Town design.

(4) The minimum buffer strip width with no sidewalk or sidewalk space is to be 5'.

(5) A width of 8' or more may be needed in commercial areas.

(6) 3:1 and flatter slopes may be used when the right of way is behind the sidewalk (or sidewalk space) in residential or other areas where slopes will be maintained by the property owner.

(7) When Design year ADT exceeds 2000 VPD, with greater than 5% total truck and bus usage:
Provide 4' wide paved shoulders when the graded shoulder is 5' wide or greater or provide 3' wide paved shoulders when the graded shoulder is 4' wide. All shoulders not being paved will have the mainline pavement structure extended 1', on the same slope, into the shoulder to eliminate raveling at the pavement edge.

(8) Ditch slopes to be 3:1 - 4' width.

(9) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(10) If a buffer strip is used between the back of curb and sidewalk, it should be 2' minimum.

(11) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 - 8**

# GEOMETRIC DESIGN STANDARDS FOR SERVICE ROADS (GS-9)

<table>
<tr><th colspan="10">(1) DEAD END SERVICE ROADS UNDER 25 VPD</th></tr>
<tr><th rowspan="2">PROPERTIES SERVED</th><th rowspan="2">DESIGN SPEED (MPH)</th><th rowspan="2">MINIMUM RADIUS</th><th rowspan="2">STOPPING SIGHT DISTANCE</th><th rowspan="2">MINIMUM PASSING SIGHT DISTANCE</th><th rowspan="2">(2) MINIMUM TRAVELED WAY WIDTH</th><th colspan="2">MINIMUM WIDTH OF SHOULDER</th><th rowspan="2">(3) WIDTH OF DITCH (FRONT SLOPE)</th><th rowspan="2">SLOPES</th></tr>
<tr><th>FILL W/GR.</th><th>CUT & FILL</th></tr>
<tr><td>1</td><td>10</td><td>30’</td><td>50’</td><td>-</td><td>12’</td><td>4’</td><td rowspan="2">2’</td><td rowspan="2">3’</td><td rowspan="2">(4)</td></tr>
<tr><td>OVER 1</td><td>20</td><td>127’</td><td>125’</td><td>800’</td><td>14’</td><td>5’</td></tr>
</table>

## GENERAL NOTES

The minimum design speed for service roads should be 20 mph except for one lane service roads serving one property which may have a minimum design speed of 10 mph.

Standard TC-5.01R superelevation based on 8% maximum to be used.

<table>
<tr><th colspan="5">RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS</th></tr>
<tr><th rowspan="3">TYPE OF TERRAIN</th><th colspan="4">DESIGN SPEED (MPH)</th></tr>
<tr><th>10</th><th>20</th><th>30</th><th>40</th></tr>
<tr><th colspan="4">GRADES (PERCENT)</th></tr>
<tr><td>LEVEL</td><td>8</td><td>8</td><td>7</td><td>7</td></tr>
<tr><td>ROLLING</td><td>12</td><td>11</td><td>10</td><td>9</td></tr>
<tr><td>MOUNTAINOUS</td><td>18</td><td>16</td><td>14</td><td>12</td></tr>
</table>

## FOOTNOTES

(1) For through service roads and dead end service roads with over 25 VPD, use Standards shown for Local Roads and Streets.

(2) Under adverse conditions, intermittent shoulder sections or turnouts for passing may be required (see page 415, 2001 AASHTO A Policy on Geometric Design of Highways and Streets).

(3) Ditch slope to be 3:1.

(4) Slopes to be same as mainline when service road is parallel to or otherwise visible from the mainline. For other cases, slopes should be in accordance with standards for Local Roads and Streets.

**FIGURE A - 1 – 9**

# GEOMETRIC DESIGN STANDARDS FOR INTERCHANGE RAMPS (GS-RM)

<table>
<tr><th rowspan="4"></th><th rowspan="4">RAMP DESIGN SPEED<br>(MPH</th><th rowspan="4">MINIMUM RADIUS</th><th colspan="2" rowspan="3">(6) STOPPING SIGHT DISTANCE</th><th rowspan="4">(1) MINIMUM RAMP PAVEMENT WIDTHS</th><th colspan="5">MINIMUM WIDTH OF SHOULDER</th><th rowspan="4">(5) WIDTH OF DITCH (FRONT SLOPE)</th><th rowspan="4">(4) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS AND VERTICAL CLEARANCES</th></tr>
<tr><th colspan="2">RIGHT OF TRAFFIC</th><th colspan="3">LEFT OF TRAFFIC</th></tr>
<tr><th rowspan="2">GRADED WIDTH</th><th rowspan="2">(2) (3) PAVED WIDTH</th><th colspan="2">GRADED WIDTH</th><th rowspan="2">(2) (3) PAVED WIDTH</th></tr>
<tr><th>Desir-able</th><th>Min.</th><th>FILL W/GR.</th><th>CUT & FILL</th></tr>
<tr><td rowspan="6">INTERCHANGE RAMPS</td><td>60</td><td>1204’</td><td>650’</td><td>570’</td><td rowspan="4">16’</td><td rowspan="6">11’</td><td rowspan="6">8’</td><td rowspan="6">9’</td><td rowspan="6">6’</td><td rowspan="6">4’</td><td rowspan="6">10’</td><td rowspan="6">6’ PLUS PAVEMENT WIDTH PLUS 8’</td></tr>
<tr><td>50</td><td>760’</td><td>475’</td><td>425’</td></tr>
<tr><td>40</td><td>465’</td><td>325’</td><td>305’</td></tr>
<tr><td>30</td><td>251’</td><td>200’</td><td>200’</td></tr>
<tr><td>25</td><td>172’</td><td>155’</td><td>155’</td><td rowspan="2">18’</td></tr>
<tr><td>20</td><td>108’</td><td>125’</td><td>125’</td></tr>
<tr><td>AUXILIARY LANES</td><td colspan="11"></td><td>AUXILIARY LANE SHOULDER WIDTHS ARE TO BE THE SAME AS MAINLINE THROUGH LANES</td></tr>
</table>

## GENERAL NOTES

The determination of the proper design speed for any particular ramp should be made using guidelines shown in Exhibit 10-56 of the 2001 AASHTO A Policy On Geometric Design of Highways and Streets.

Maximum ramp superelevation to be 8%.

Clear Zone and Recoverable Area information can be found in Appendix A, Section A-2 of the Road Design Manual.

| RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEED | | | |
|---|---|---|---|
| DESIGN SPEED (MPH) | | | |
| 15 - 20 | 25 -30 | 35 - 40 | 45 - 50 |
| GRADES (PERCENT) | | | |
| 6 - 8 | 5 - 7 | 4 - 6 | 3 - 5 |

Where topographic conditions dictate, grades steeper than desirable may be used. One-way descending gradients on ramps should be held to the same general maximums, but in special cases they may be 2 percent greater.

## FOOTNOTES

(1) Interchange ramp widths shown are for one lane traffic. For two lane or other conditions see Exhibit 10-67 in the 2001 AASHTO A Policy on Geometric Design of Highways and Streets.

(2) Shoulder widths on ramps with a design speed of 40 mph or less may be reduced to 6’ right, or 3’ left, when justifiable. However, the sum of the right and left shoulder shall not be less than 10’. See 2001 AASHTO Green Book, page 842.

(3) On ramps with a radius of less than 500', consider (depending on degree of curvature, percent of trucks) the extension of the full pavement structure (on the same slope as the pavement) through the inside paved shoulder area to eliminate raveling of the pavement edge.

(4) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(5) Ditch slopes to be 6:1.

(6) For intersection sight distance requirements see Appendix C, Table C-1-5.

**FIGURE A - 1 - 10**

# SECTION A-2-CLEAR ZONE GUIDELINES

## INTRODUCTION

If practicable, a traversable recovery area for errant vehicles should be provided beyond the edge of the traveled way (edge of mainline pavement) in order to improve highway safety. Ideally this recovery area or "clear zone" should be free of obstacles such as unyielding sign and luminaire supports, non-traversable drainage structures, utility poles and steep slopes. It must be noted that clear zone roadside design involves a series of compromises between "absolute" safety and "engineering, environmental and economic constraints." The following clear zone guidelines were developed using the 2002 AASHTO Roadside Design Guide.

The recommended width of clear zone as discussed in the Roadside Design Guide is influenced by the traffic volume, speed, and embankment slope (see TABLE A-2-1). The Roadside Design Guide will be used as reference for determination of clear zones for Freeways; Rural and Urban Arterials (with shoulders); and Rural and Urban Collectors (with shoulders) with design speeds of 50 mph or greater and with design year ADT volumes greater than 2000. For Rural and Urban collectors with design speeds less than 50 mph and with a design year ADT less than 2000 and for Local Roads, no minimum required clear zone width will be specified; however, the designer should strive to provide as much clear zone as possible with a minimum ten foot width being desirable. Projects such as RRR, intersection improvements, etc., would not normally be provided with recoverable areas due to the intent of the project to provide minimal improvements and extend the service life of an existing highway for a fraction of the costs of reconstruction or to provide necessary interim improvements.

When adequate right of way is available, urban projects should be designed with shoulders in lieu of curbs (unless city ordinances require otherwise) and they should have clear zone widths consistent with their design speeds, traffic volumes, and embankment slopes as noted in TABLE A-2-1.

In urban and suburban areas where curb is utilized with a design speed of 45 mph or less, a 7.5 foot desirable and 6 foot minimum clear zone beyond the curb face is to be provided (see FIGURE A-2-1). It is policy to place utility poles or other fixed objects outside the clear zone (beyond the sidewalk space or behind the curb in the case of a raised median). However, in rare instances this may be impractical due to prevailing limitations or conditions (example - relocation of utility poles to another corridor may not be economically feasible). When this occurs, an absolute minimum horizontal clearance of 1.5 feet beyond the face of curb is to be provided (per Roadside Design Guide Section 3.4.1 page 3-14). The justification for not providing the 7.5 foot desirable or 6 foot minimum clear zone width beyond the curb face is to be documented in the project file (e.g. - F.I. Report, memorandum from Right of Way and Utilities Division, etc.).

When mountable curb is used in urban areas it is desirable to provide the same clear zone as would be provided for with a rural condition. However, if those values cannot be obtained, the clear zone widths for 45 mph or less should be utilized.

**TABLE A-2-1 CLEAR ZONE DISTANCES (IN FEET FROM EDGE OF DRIVING LANE)**

| DESIGN SPEED | DESIGN ADT | 6:1 OR FLATTER | 5:1 TO 4:1 | 3:1 |
|---|---|---|---|---|
| 40 MPH | UNDER - 750 | 7 - 10 | 7 - 10 | ** |
| OR | 750 - 1500 | 10 - 12 | 12 - 14 | ** |
| LESS | 1500 - 6000 | 12 - 14 | 14 - 16 | ** |
| | OVER 6000 | 14 - 16 | 16 - 18 | ** |
| | UNDER 750 | 10 - 12 | 12 - 14 | ** |
| 45-50 | 750 - 1500 | 14 - 16 | 16 - 20 | ** |
| MPH | 1500 - 6000 | 16 - 18 | 20 - 26 | ** |
| | OVER 6000 | 20 - 22 | 24 - 28 | ** |
| | UNDER 750 | 12 - 14 | 14 - 18 | ** |
| 55 | 750 - 1500 | 16 - 18 | 20 - 24 | ** |
| | 1500 - 6000 | 20 - 22 | 24 - 30 | ** |
| | OVER 6000 | 22 - 24 | 26 – 32* | ** |
| | UNDER - 750 | 16 - 18 | 20 - 24 | ** |
| 60 | 750 - 1500 | 20 - 24 | 26 – 32* | ** |
| MPH | 1500 - 6000 | 26 - 30 | 32 - 40* | ** |
| | OVER 6000 | 30 - 32* | 36 - 44* | ** |
| | UNDER - 750 | 18 - 20 | 20 - 26 | ** |
| 65-70 | 750 - 1500 | 24 - 26 | 28 - 36* | ** |
| MPH | 1500 - 6000 | 28 - 32* | 34 - 42* | ** |
| | OVER 6000 | 30 - 34* | 38 - 46* | ** |

* Where a site specific investigation indicates a high probability of continuing accidents, or such occurrences are indicated by accident history, the designer may provide clear zone distances greater than 30 feet as indicated. Clear zones may be limited to 30 feet for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

** Since recovery is less likely on the unshielded, traversable 3:1 slopes, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high speed vehicles that encroach beyond the edge of shoulder may be expected to occur beyond the toe of slope. Determination of the width of the recovery area at the toe of slope should take into consideration right of way availability, environmental concerns, economic factors, safety needs, and accident histories. Also, the distance between the edge of the travel lane and the beginning of the 3:1 slope should influence the recovery area provided at the toe of slope. While the application may be limited by several factors, the fill slope parameters which may enter into determining a maximum desirable recovery area are illustrated in FIGURE A-2-4, on page A-40.

Source: The 2002 AASHTO Roadside Design Guide.

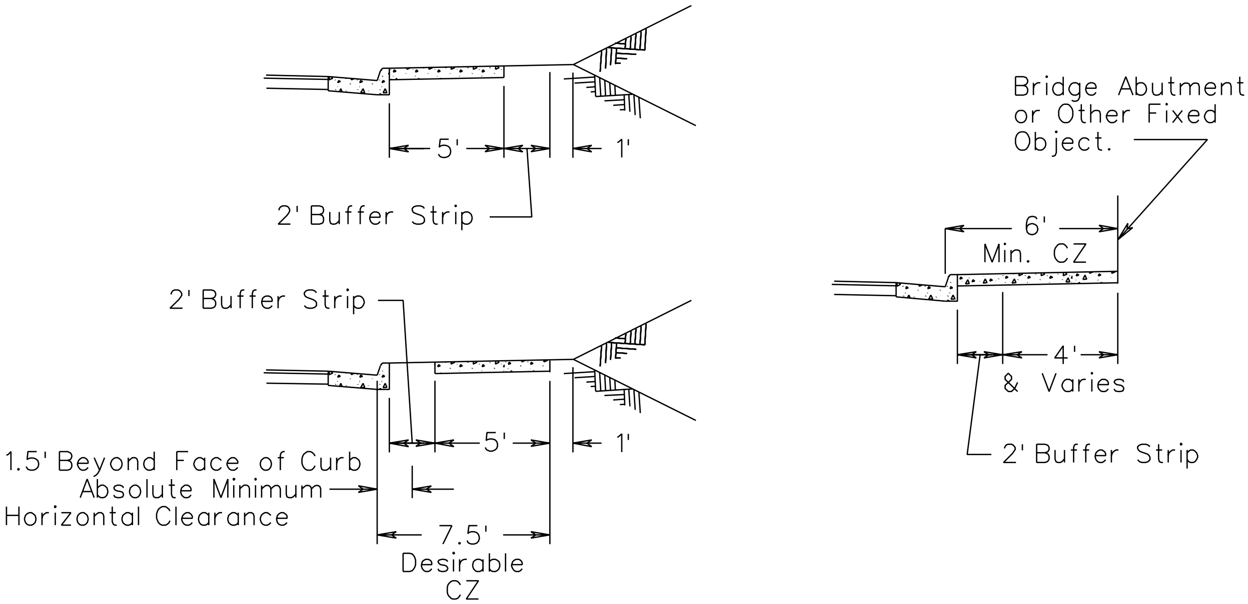



**FIGURE A-2-1**

**URBAN CLEAR ZONE WIDTH GUIDELINES**

## CLEAR ZONE COST-EFFECTIVENESS ANALYSIS

For projects where the clear zone widths from the AASHTO Roadside Design Guide are under consideration, Freeways; Rural and Urban Arterials (with shoulders); and Rural and Urban Collectors (with shoulders) with design speeds of 50 mph or greater and with a design year ADT greater than 2000, an early cost-effectiveness analysis is required to determine the feasibility of providing the recoverable areas to meet the clear zone requirements shown in TABLE A-2-1. This analysis should be done during the preliminary plan development process and should involve determining the additional construction and R/W costs to provide the desired clear zone.

Prior to establishing the additional construction and R/W cost estimate, the developed areas that would involve heavy R/W damages and/or relocations or environmental restrictions such as park properties, historic areas or wetlands should be noted and where practicable horizontal and vertical alignment adjustments are to be made to provide the desired recoverable areas and clear zones. In these situations alternate designs may include elimination of ditches and/or median width reductions with possible incorporation of raised medians or median barrier to reduce required R/W.

A suggested procedure is shown in FIGURE A-2-2 to develop the difference in cost between the typical section based on the project's functional classification and proper Geometric Design Standards and the typical section with the desired recoverable areas.

Any other procedure which will provide this cost is acceptable as long as it is documented in the project files. After the additional cost to provide the recoverable area is determined, it should be compared to the estimated accident cost without the recoverable area as determined from FIGURE A-2-3. This cost comparison along with good engineering judgment should be used to determine the feasibility of providing the recoverable areas through the project and should be documented on the Project Scoping Form LD-430 or SR-1 as applicable.

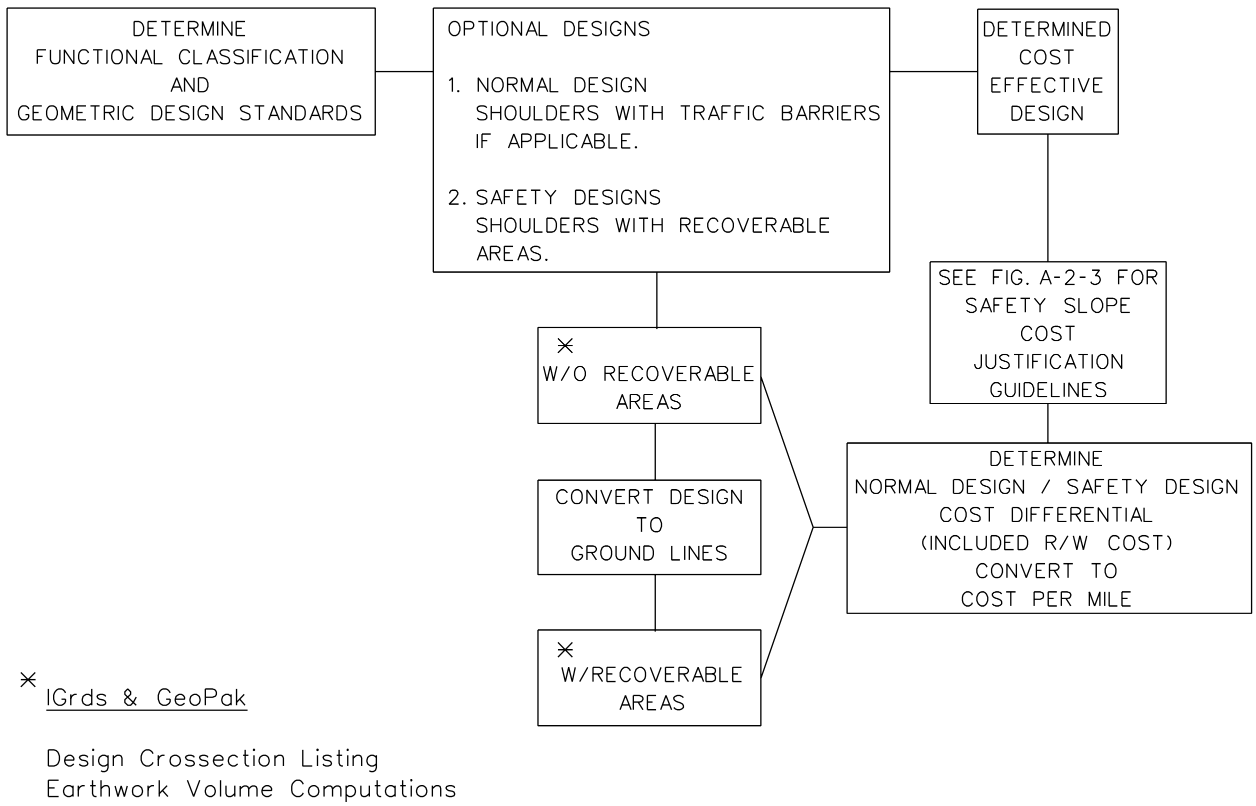
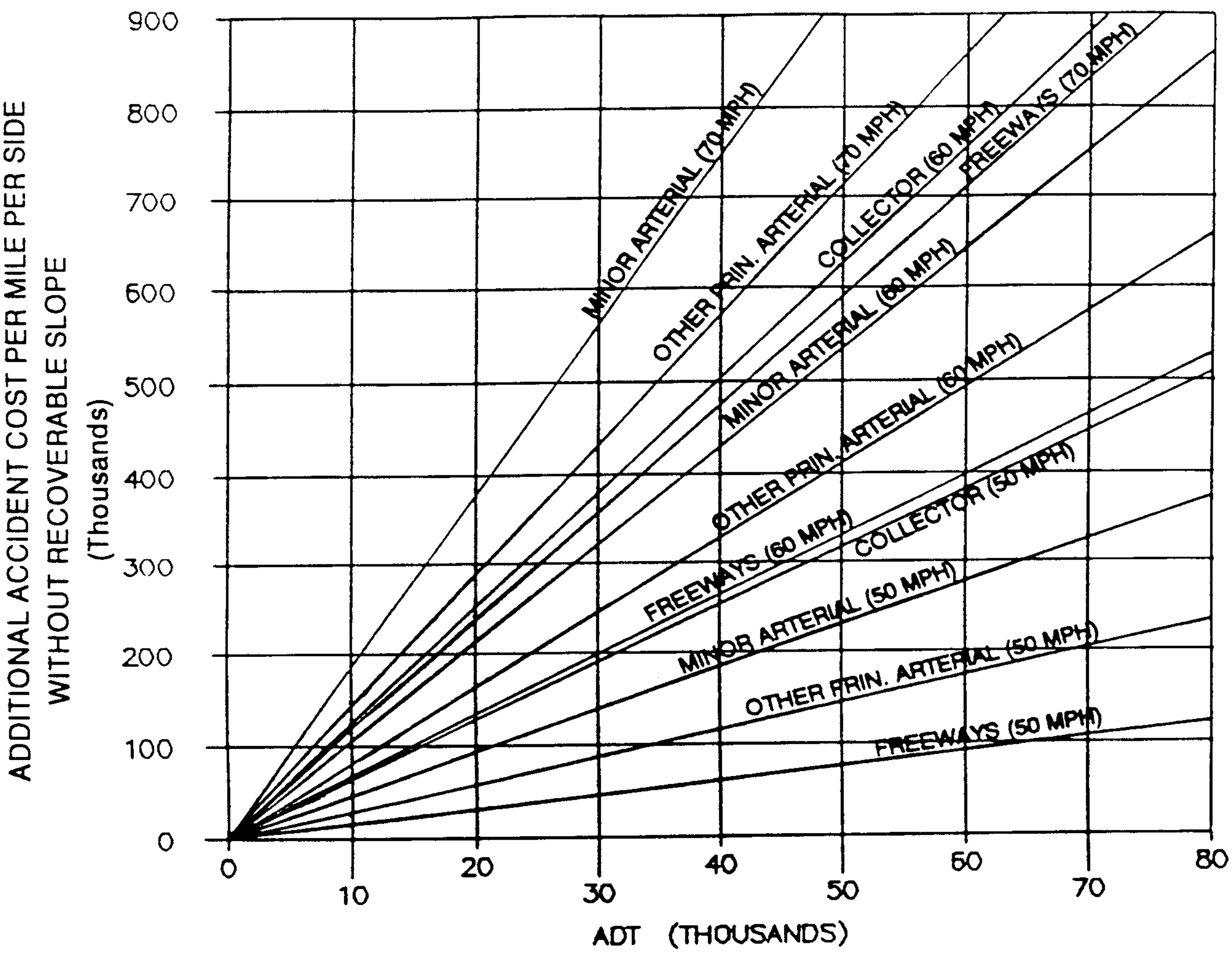



**FIGURE A-2-2**

**COST EFFECTIVE SELECTION PROCEDURE**

Note: Upon receipt of Normal Design and Safety Design earthwork quantities, a cursory review may indicate that the cost per mile per side for the earthwork alone far exceeds the Guideline for Maximum Cost per Mile Expenditure for Safety Slopes in Figure A-2-3, thereby eliminating the need to determine the other additional cost such as drainage extensions, right of way, etc.



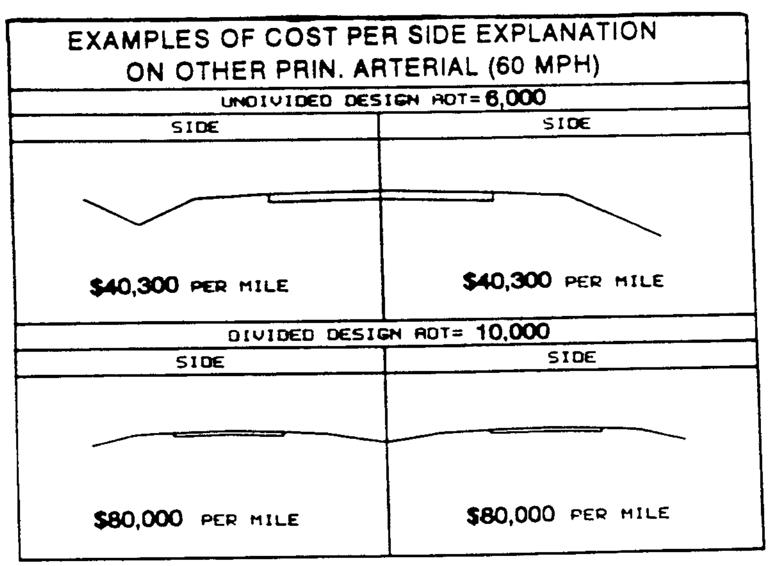
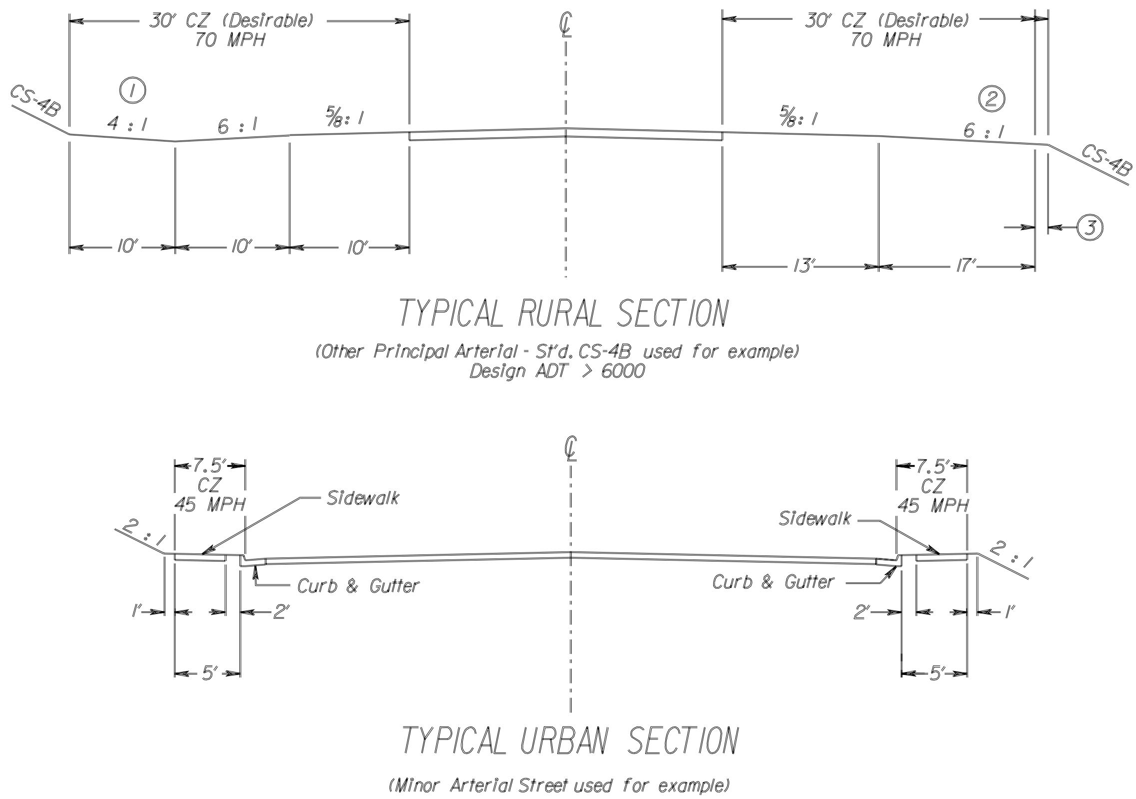




**FIGURE NO. A-2-3**

**SAFETY SLOPE COST JUSTIFICATION GUIDELINES**

## SHOWING CLEAR ZONES ON TYPICAL SECTIONS

The clear zone width(s) is to be clearly shown on the project typical sections if traversable slopes are being provided so that other divisions will be aware of the desirable clear zones for a project. When varying clear zone widths occur, furnish station to station breakdown. Following are typical methods of showing clear zone data on typical sections.




TYPICAL METHOD
OF SHOWING CLEAR ZONE DATA
ON TYPICAL SECTIONS

**NOTES**:

1. If the front slope of ditch is 6:1, the back slope should be 4:1, and if the front slope is 3:1, the back slope should be flat.

2. The preferred slope for recoverable areas with fills is 6:1 or flatter.

3. Recoverable area width to be increased 3' if GR-3 or 8 guardrail is required.

## DETERMINING CLEAR ZONE WIDTH

The following is a guide and should be supplemented with sound engineering judgment:

Clear zone (CZ) is defined as the roadside border area, starting at the edge of the traveled way (edge of mainline pavement), available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope 4:1 or flatter, a non-recoverable slope between 4:1 and 3:1, and/or a clear run-out area. Previously, 30 ft. was considered to be the standard clear zone, but current guidelines, as shown in TABLE A-2-1, give values greater or less than 30 feet, depending on the roadside slopes, design speeds, and traffic volumes. These values should suggest only the approximate center of a range to be considered and not a precise distance to be held as absolute.

TABLE A-2-1 is to be used by the designer and may be modified by the values shown in TABLE A-2-2. See the 2002 AASHTO Roadside Design Guide for further details.

Embankment slopes must have a relatively smooth and firm surface to be truly recoverable or traversable.

Fill slopes between 3:1 and 4:1 are non-recoverable slopes, defined as one which is traversable, but from which most motorists will be unable to stop or to return to the roadway easily. Vehicles on such slopes typically can be expected to reach the bottom. Since a high percentage of encroaching vehicles will reach the toe of these slopes, the recovery area cannot logically end on the slope. Fixed obstacles should not be constructed along such slopes and a clear runout area (10' min.) at the base is desirable. FIGURE A-2-4 on page A-40 provides an example of a clear zone computation for non-recoverable slopes.

Any non-traversable hazards or fixed objects, including but not limited to those listed in TABLE A-3-1, which are located within the clear zone as determined from TABLE A-2-1, should preferably be removed, relocated, made yielding, or as a last resort, shielded with a barrier.

## HORIZONTAL CURVE ADJUSTMENTS

These modifications are normally only considered where accident histories indicate a need, or a specific site investigation shows a definitive accident potential which could be significantly lessened by increasing the clear zone width and such increases are cost effective.

| **RADIUS** (ft) | **DESIGN SPEED** (mph) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **40** | **45** | **50** | **55** | **60** | **65** | **70** |
| **2860** | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.3 |
| **2290** | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 |
| **1910** | 1.1 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 |
| **1640** | 1.1 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.5 |
| **1430** | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | - |
| **1270** | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.5 | - |
| **1150** | 1.2 | 1.2 | 1.3 | 1.4 | 1.5 | - | - |
| **950** | 1.2 | 1.3 | 1.4 | 1.5 | 1.5 | - | - |
| **820** | 1.3 | 1.3 | 1.4 | 1.5 | - | - | - |
| **720** | 1.3 | 1.4 | 1.5 | - | - | - | - |
| **640** | 1.3 | 1.4 | 1.5 | - | - | - | - |
| **570** | 1.4 | 1.5 | - | - | - | - | - |
| **380** | 1.5 | - | - | - | - | - | - |

**TABLE A-2-2**

$$CZ_c = (L_c)\ (K_{cz})$$

Where

$CZ_c$ = clear zone on outside of curvature, ft.
$L_c$ = clear zone distance ft., Table A-2-1
$K_{cz}$ = curve correction factor

Note: Clear zone correction factor is applied to outside of curves only. Curves flatter than 2860 ft don't require an adjusted clear zone.

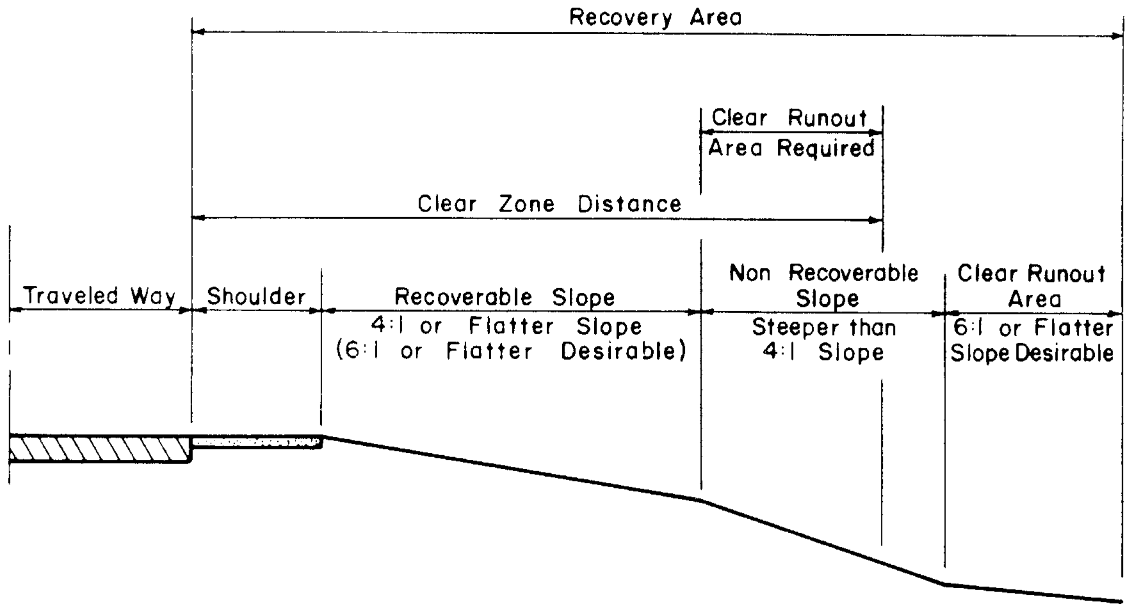



**FIGURE A-2-4 EXAMPLE OF A PARALLEL EMBANKMENT SLOPE DESIGN**

Source: The 2002 AASHTO Roadside Design Guide.

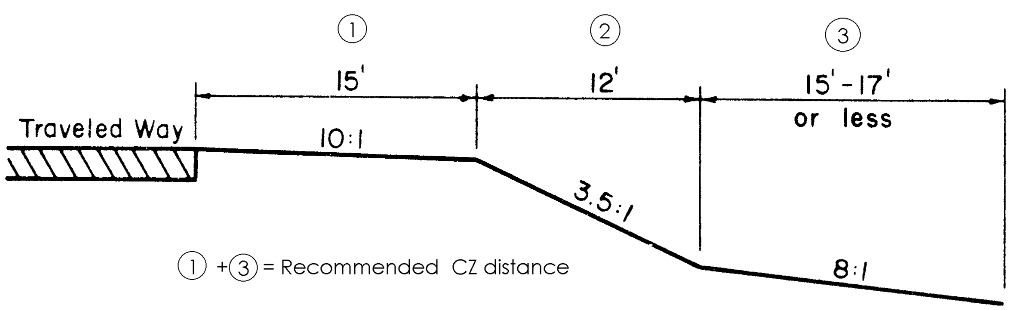
This figure illustrates a recoverable slope followed by a non-recoverable slope. Since the clear zone distance extends onto a non-recoverable slope, the portion of the clear zone distance on such a slope may be provided beyond the non-recoverable slope if practical. This clear runout area would then be included in the total recovery area. The clear runout area may be reduced in width based on existing conditions or site investigations. Such a variable slope typical section is often used as a compromise between roadside safety and economics. By providing a relatively flat recovery area immediately adjacent to the roadway, most errant motorists can recover before reaching the steeper slope beyond. The slope break may be liberally rounded so an encroaching vehicle does not become airborne. It is suggested that the steeper slope be made as smooth as practical and rounded at the bottom.

## NON-RECOVERABLE PARALLEL SLOPES

Embankment slopes from 3:1 up to 4:1 are considered traversable if they are smooth and free of fixed object hazards. However, since many vehicles on slopes this steep will continue on to the bottom, a clear run-out area beyond the toe of the slope is desirable. The extent of this recovery area could be determined by first finding the available distance between the edge of the traveled way and the breakpoint of the recoverable slope to the non-recoverable slope. This distance is then subtracted from the total recommended clear zone distance based on the slope that is beyond the toe of the non-recoverable slope. The result is the desirable clear run-out area. The following example illustrates this procedure:

EXAMPLE

Design ADT: 7000
Design Speed: 60 mph
Recommended clear zone distance for the 8:1 slope: 30-32 feet (from TABLE A-2-1)
Recovery distance before breakpoint of slope: 15 feet
Clear runout area at toe of slope: 30-32 feet minus 15 feet or 15-17 feet

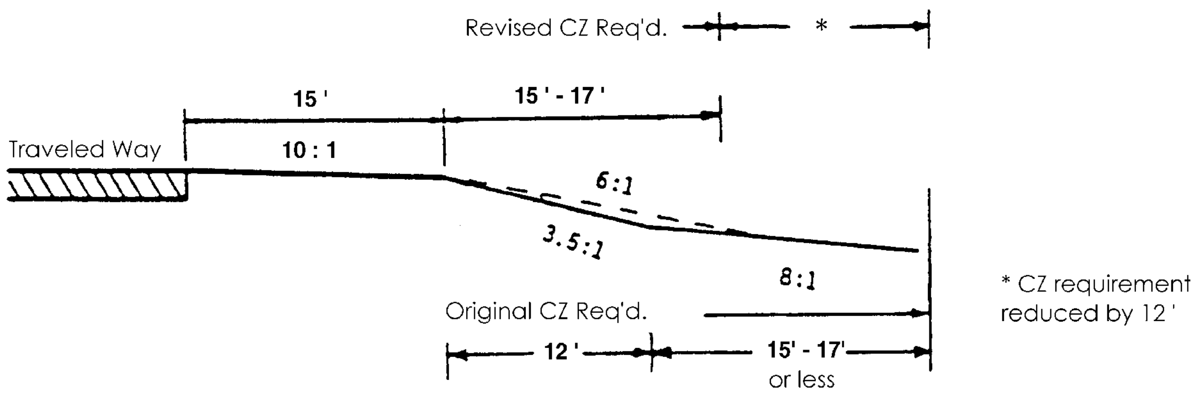



(For Example of Alternate Design to reduce CZ requirement, see below)

Discussion: Using the steepest recoverable slope before or after the non-recoverable slope, a recovery distance is selected from Table A-2-1. In this example, the 8:1 slope beyond the base of the fill dictates a 30-32 foot recovery area. Since 15 feet are available at the top, an additional 15-17 feet could be provided at the bottom. All slope breaks may be rounded and no fixed objects would normally be built within the upper or lower portions of the clear zone or on the intervening slope.

The designer may find it safe and practical to provide less than the entire 15-17 feet at the toe of the slope. A smaller recovery area could be applicable based on the rounded slope breaks, the flatter slope at the top, or past accident histories. A specific site investigation may be appropriate in determining an appropriate recovery area at the toe of the slope.

Example of Alternate Design (incorporating minor slope adjustment) to reduce total clearance requirement.




When traffic barriers must be provided because hazardous conditions can not be eliminated, see Section A-3-Barrier Installation Criteria.

# SECTION A-3-TRAFFIC BARRIER INSTALLATION CRITERIA

## INTRODUCTION

Traffic Barriers should only be used where the result of striking a fixed object hazard or leaving the roadway would be more severe than the consequence of striking the barrier. Where guardrail needs are indicated by warrants see the current AASHTO Roadside Design Guide. The roadway should be examined to determine the feasibility of adjusting site features so that the barrier will not be required (e.g. flattening a fill slope, removing a hazardous object such as a drainage headwall, etc.). The initial cost to eliminate the guardrail may appear excessive; however, the fact that a barrier installation will require maintenance costs for many years should not be overlooked.

## GUARDRAIL WARRANTS

The determining warrants for Traffic Barriers on VDOT projects are (1) Embankment Heights (see below) and (2) Fixed and Hazardous Objects Within the Clear Zone (see TABLE A-3-1).

| SYSTEM CLASSIFICATION | | TRAFFIC VOLUMES | FILLS OVER 7.5' | FILLS OVER 15' | AT OBVIOUS NEEDS SUCH AS BRIDGES, LARGE END WALLS, PARALLEL WATER HAZARDS, ETC., AND FILLS WHERE RECOMMENDED DURING FIELD INSPECTION |
|---|---|---|---|---|---|
| INTERSTATE - PRIMARY AND ARTERIAL | FILLS WITHOUT RECOVERABLE AREAS | ALL | √ | | √ |
| | FILLS WITH RECOVERABLE AREAS | | | | √ |
| SECONDARY AND FRONTAGE ROADS | | ADT OVER 1000 | √ | | √ |
| | | ADT 1000 - 250 | | *√ | √ |
| | | ADT LESS THAN 250 | | | √ |
| URBAN | | ALL | | | √ |

* Exception - Bristol, Salem, and Staunton Districts. Traffic barriers are to be provided only at obvious needs such as bridges, large endwalls, parallel water hazards, etc., and fills where recommended at field inspection.

When fill slopes are 3:1 or flatter, a barrier is not required unless there are hazardous obstacles within the clear zone limits. This may include the clear runout area if the fill slope is between 3:1 and 4:1 (see Fig. A-2-4).

## DETERMINING WARRANTS FOR ROADSIDE BARRIERS

| Fixed and Hazardous Objects Within The Clear Zone | Guardrail Required | |
|---|---|---|
| | YES | NO |
| 1. Sign Support (ground mounted): (A) Post of breakaway design (a) | | X |
| (B) Post not meeting breakaway criteria (b)(c)(d) | X | |
| 2. Lighting/Signal Poles and Towers (A) Breakaway design | | X |
| (B) Not meeting breakaway design (b)(c)(g)(h) | X | |
| 3. Bridge parapet ends, piers and abutments at underpasses | X | |
| 4. Retaining walls and culvert headwalls | X | |
| 5. Trees with a diameter of 4 inches or greater (e) | X | |
| 6. Utility Poles (f) | | X |
| 7. Above ground utilities (telephone pedestals, etc.) (i) | X | |
| 8. Rough rock cuts and large boulders | X | |
| 9. Streams or permanent bodies of water more than 2 feet deep (h) | X | |

NOTES

(a) Multiple post installations where the spacing between posts is less than the minimum spacing required for breakaway shall be replaced or shielded by guardrail.
(b) Every effort should be made to convert non-breakaway to breakaway.
(c) Where these devices exist and cannot be converted to breakaway, relocated or removed, the choice of guardrail should be in accordance with the deflection shown in Table A-3-2.
(d) Wood posts larger than 6" x 8" nominal size do not meet the breakaway requirements even if drilled.
(e) Every effort should be made to remove the tree rather than shield it with guardrail.
(f) Guardrail will not normally be used to shield a line of utility poles. However, where guardrails are used in front of utility poles for other reasons, the choice of guardrail should be in accordance with the deflection shown in Table A-3-2.
(g) Pedestal poles, except for those used for power supply, should be converted to breakaway standards where possible.
(h) A field review and evaluation should be made to determine if guardrail is suitable for protecting motorists from these roadside hazards.
(i) Consideration should be given to placing utilities underground.

**TABLE A-3-1**

## BARRIER TYPE SELECTION

When it has been determined that a barrier is required, a determination must be made as to the type of barrier that is to be used. Although the process is complicated by the number of variables and the lack of objective criteria, there are guidelines that can be used in making a barrier system selection. In general, the most desirable system is one that offers the lowest accident severity at the least cost and is consistent with the given constraints. The Standard GR-8 Weak Post System is to be used only when speeds are $\leq$ 45 m.p.h.

The AASHTO Roadside Design Guide presents eight items which must be considered before a system selection is made. In taking all eight items into account, the deflection, strength, and safety requirements should never be compromised. Table A-3-2 groups the Standard types of guardrail by three systems: flexible, semi-rigid and rigid. The table includes barrier height, maximum dynamic deflection, minimum offset from hazardous object, post spacing, and typical terminal treatment for each Standard. The Road and Bridge Standards provide transition designs for use in various situations.

| SYSTEM | STANDARD | MINIMUM BARRIER HEIGHT | MAXIMUM DYNAMIC DEFLECTION (A) | MINIMUM OFFSET FROM HAZARD (C) | POST SPACING | DIVIDED ROADWAY OR ONE-WAY TRAFFIC | | UNDIVIDED ROADWAY OR TWO-WAY TRAFFIC | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | RUN-ON TERMINAL TREATMENT | RUN-OFF TERMINAL TREATMENT (D) | RUN-ON TERMINAL TREATMENT | RUN-OFF TERMINAL TREATMENT |
| **FLEXIBLE** (WEAK POST OR CABLE) | GR-3 | 27" | 11' | 11' | 16'-0" | GR-3 | GR-3 | GR-3 | GR-3 |
| | GR-8 (L) | 30" | 7' | 7' | 12'-6" | GR-6,7,9 (H) | GR-8, TY. II | GR-6,7,9 (E) (H) | GR-6,7,9 (E) (H) |
| | GR-8A | 30" | 5' | 5' | 6'-3" | GR-6,7,9 (H) | GR-8, TY. II | GR-6,7,9 (E) (H) | GR-6,7,9 (E) (H) |
| | GR-8B | 30" | 4' | 4' | 3'-1 ½" | GR-6,7,9 (H) | GR-8, TY. II | GR-6,7,9 (E) (H) | GR-6,7,9 (E) (H) |
| | GR-8C | 30" | 4'-6" | 4'-6" | 4'-2" | GR-6,7,9 (H) | GR-8, TY. II | GR-6,7,9 (E) (H) | GR-6,7,9 (E) (H) |
| | MB-5 (F) | 30" | 7' | 7' | 12'-6" | IMPACT ATT. | IMPACT ATT. | N/A | N/A |
| | MB-5 (F) | 30" | 5' | 5' | 6'-3" | IMPACT ATT. | IMPACT ATT. | N/A | N/A |
| | MB-5 (F) | 30" | 4' | 4' | 3'-1 ½" | IMPACT ATT. | IMPACT ATT. | N/A | N/A |
| **SEMI-RIGID** (STRONG POST) | GR-2 | 27" | 3' | 3' | 6'-3" | GR-6,7,9 (H) | W BEAM | GR-6,7,9 (H) | GR-6,7,9 (H) |
| | GR-2A | 27" | 2' (B) | 2' | 3'-1 ½" | GR-6,7,9 (H) | END SECTION | GR-6,7,9 (H) | GR-6,7,9 (H) |
| | MB-3 (G) | 27" | 3' | 3' | 6'-3" | IMPACT ATT. | IMPACT ATT. | N/A | N/A |
| **RIGID** (CONCRETE BARRIER) | MB-7D, 7E 7F,12A, 12B, & 12C (k) | 32" | 0' | 0' | N/A | IMPACT ATTENUATOR (I) | N/A | IMPACT ATTENUATOR (I) | IMPACT ATTENUATOR (I) |

## TABLE A-3-2 – TYPICAL BARRIER/GUARDRAIL SELECTION AND PLACEMENT

**NOTES:**

(a) The deflection zone of all rail systems must be totally clear of any obstacles in order to assure that the rail will perform as tested.
(b) No test data available.
(c) Minimum offset from back of post to hazardous object.
(d) The noted terminal treatments apply when the terminal is installed outside the clear zone for opposing traffic. If a run-off terminal is installed within the clear zone of opposing traffic, see note "e".
(e) Transition from weak post system to terminal must be provided in accordance with St'd. GR-INS drawings to protect opposing traffic from impacting the opposite end of the terminal when it falls within clear zone.
(f) For use in wide flat medians (>30 feet).
(g) For use in narrow medians (approximately 10-30 feet).
(h) If more than a 200' extension of standard guardrail is necessary to tie into the slope with a St'd. GR- 6, terminal, use a St'd. GR-7 or GR-9 terminal. For St'd. GR-6 installations, St'd. GR-2 must be installed from the terminal to the beginning of the flare before introducing St'd. GR-8.
(i) Concrete turned down terminals may be used for locations outside clear zone.
(k) For use in medians 0-30 feet wide.
(j) GR-8 is not acceptable on projects with design speeds greater than 45 m.p.h.

## GUARDRAIL INSTALLATION IN URBAN SETTINGS

In Urban settings with speeds of 45 MPH or less that include curb or curb and gutter, the use of guardrail is not recommended. Standard CG-2 or CG-6 (6" high curb) is usually used for speeds of 45 MPH or less in urban and suburban areas and is referred to as "barrier curb" because it has a 6" vertical face and is intended to discourage motorists from deliberately leaving the roadway. Even when CG-3 or CG-7 (4" high mountable curb) is used in Urban settings, it is impractical to install guardrail in an attempt to protect pedestrians walking along sidewalks due to the lack of accessibility caused when placing guardrail and terminals adjacent to accessible routes.

When curbed sections do not include sidewalk or sidewalk space and hazards exist that warrant guardrail, St'd. GR-2 (Strong Post) guardrail (which includes a blockout) should be installed with the face of the rail aligned with the face of the curb. This decreases the possibility of an errant vehicle striking the curb before impacting the guardrail or from snagging the guardrail posts. If possible, to provide maximum offset, the guardrail should be placed 11’ or more behind the curb for high speed (50 mph or more) roadways and 6' or more behind the curb for low speed (40 mph or less) roadways. The guardrail height when placed at the curb is measured from the roadway surface. When offset from the curb, it is measured from the ground beneath the rail. St'd. GR-8 (Weak Post) guardrail should not be used adjacent to asphalt or concrete curb.

Sometimes hazards that need to be shielded exist on urban projects with sidewalk/sidewalk space. In situations like this, guardrail can be placed behind the sidewalk and in front of the hazard. Examples of such hazards are ponds, steep embankments, etc.. When these situations arise, sound engineering judgment should be used in deciding whether/where to place the guardrail. If the hazard is within the clear zone, a barrier would be warranted. The hazards that are outside the clear zone are the items that require an engineering decision based on evaluation of all the elements within the design site.

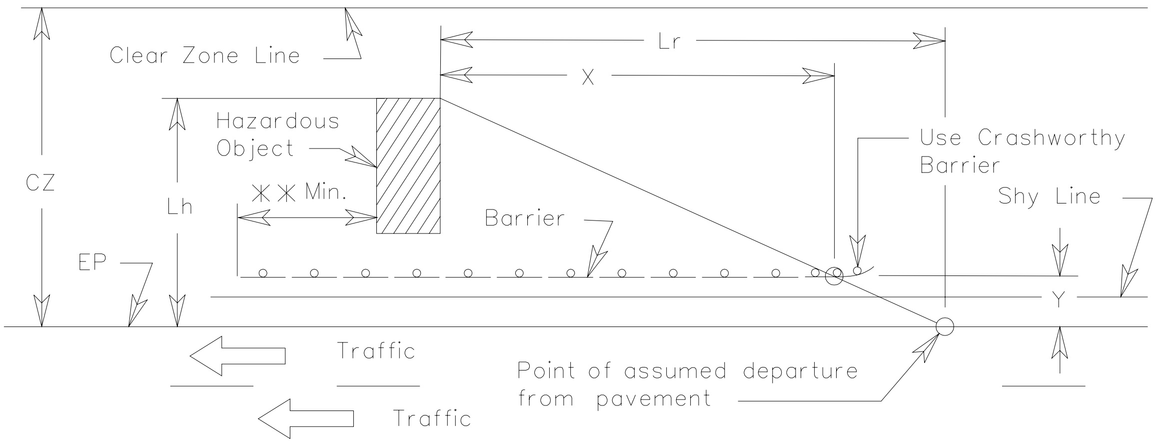
## GUARDRAIL LOCATIONS ON FIELD INSPECTION PLANS

The approximate locations of barriers should be shown on Preliminary Field Inspection plans and discussed at the Preliminary Field Inspection. If the locations are not shown, the type, terminals, and placement should be generally discussed. Maintenance of areas protected by barriers should also be discussed at this time.

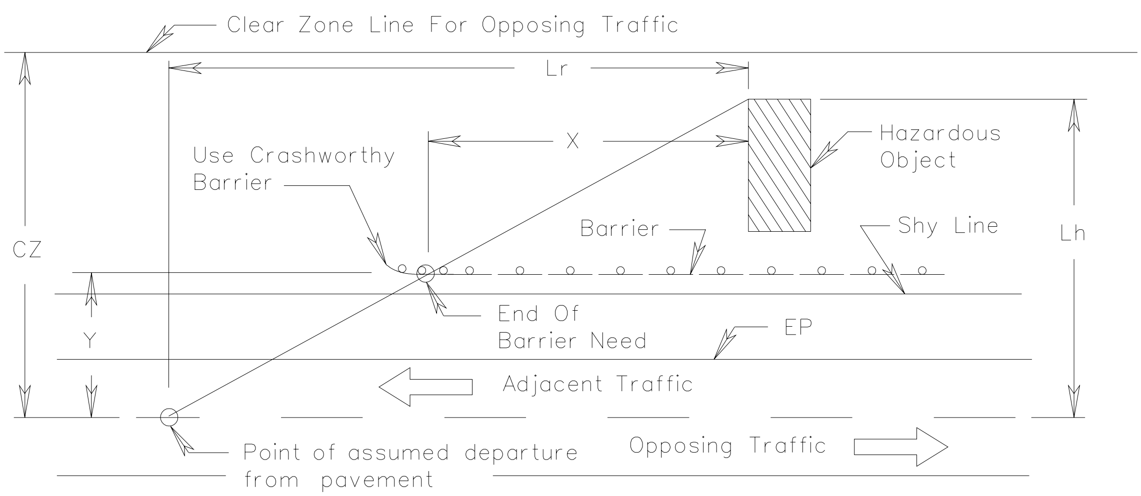
## DETERMINING LOCATION OF THE ENDS OF GUARDRAIL

Figure A-3-1 and Table A-3-3 give a method to determine the location of the end of guardrail systems. Appropriate terminals shall be placed at this point.

Condition showing hazard for adjacent traffic




Condition showing hazard for opposing traffic




### FIGURE A-3-1 - BARRIER LENGTH OF NEED DETERMINATION

$$X = (1 - {}^{Y}/_{Lh})\ Lr$$

X = Length of Need
CZ = Clear Zone Width
Lh Max. = CZ
Lr = Runout length (See table A-3-3)
LS = Shyline

** = 25' for GR-2
= 12.5' for GR-2A
= 25' plus a Type II for GR-8
= 1' for MB-7C

| DESIGN SPEED (MPH) | DESIGN TRAFFIC VOLUME (ADT) OVER 6000 RUNOUT LENGTH Lr(FT) | 2000-6000 RUNOUT LENGTH Lr(FT) | 800-2000 RUNOUT LENGTH Lr(FT) | UNDER 800 RUNOUT LENGTH Lr(FT) | * SHY LINE (FT) | FLARE RATE BEYOND SHY LINE GR-2, 3 & 8 MB-3 | BEYOND SHY LINE MB-7D, 7E,7F,12A, 12B,&12C | INSIDE SHY LINE ALL |
|---|---|---|---|---|---|---|---|---|
| 70 | 480 | 440 | 400 | 360 | 10 | 15:1 | 20:1 | 30:1 |
| 60 | 400 | 360 | 330 | 300 | 8 | 13:1 | 17:1 | 26:1 |
| 50 | 320 | 290 | 260 | 240 | 6.5 | 11:1 | 14:1 | 21:1 |
| 40 | 240 | 220 | 200 | 180 | 5 | 9:1 | 11:1 | 17:1 |
| 30 | 170 | 160 | 140 | 130 | 3.5 | 7:1 | 8:1 | 13:1 |

* Shy line is measured from the adjacent edge of pavement and is a distance beyond which a roadside object will not be perceived as a threat by a driver. In other words, a driver will not react to an object beyond the shy line offset. If possible, the roadside barrier should be placed beyond the shy line offset.

**TABLE A-3-3**

**DESIGN PARAMETERS FOR ROADSIDE BARRIER LAYOUT**

## SLOPES FOR APPROACH BARRIERS

As a general rule, a roadside barrier should not be placed on an embankment if the slope of the embankment is steeper than 10:1; however, in special cases, such as "barn roof" ("recoverable area") slopes, it is acceptable to place semi-rigid barrier on slopes as steep as 6:1. When semi-rigid barrier is used on 6:1 slopes, a 10-foot rounding should be included between the shoulder and slope. Where it is not feasible for the entire graded median in the area of the hazard to be on a 10:1 slope, an acceptable alternative is to provide the 10:1 slope between the edge of pavement and the approach barrier (See Fig. A-3-2). A clear run-out path should also be provided behind the terminal.

When recoverable areas are less than 14 feet in width and guardrail is required, the guardrail is to be placed using at least the minimum fill shoulder width specified in the Geometric Design Standard and the recoverable area is not to be provided. Although not encouraged, guardrail is permitted on 6:1 slopes if located beyond 12 feet of the shoulder hinge point.

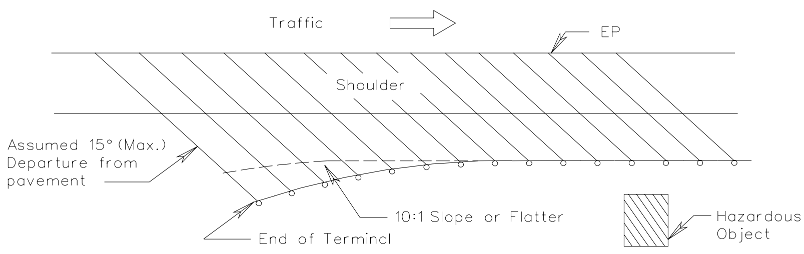



**FIGURE A-3-2 - SUGGESTED SLOPES FOR APPROACH BARRIERS**

## FIXED OBJECTS WITHIN DEFLECTION AREA

No fixed objects, regardless of their distances from the edge-of-pavement, will be allowed within the deflection zone of the guardrail system to assure that the barrier system will perform as designed. This will include overhead sign supports, walls, drainage structures, bridge piers, signal supports, utility poles, trees, etc.. Additionally, the deflection zone must be free of breakaway signs, signals, and luminaire supports since their performance when struck by deflecting guardrail is unknown and untested. If a sign or luminaire support must remain within the deflection zone, it must be a breakaway design.

When it is impractical to locate these obstacles outside of the deflection zone of a particular type of guardrail (e.g., GR-8 = 7', GR-8B = 4'), it will be necessary to strengthen the guardrail to decrease deflection or to use a different type of guardrail or barrier which has less deflection so the object is shielded within the clear zone.

Methods of stiffening the rail include decreasing post spacing and double nesting of rail elements. Each stiffening method typically halves the deflection. The stiffening method should begin 18' in advance of the hazard and continue at least to the end of the hazard. Plans fitting these criteria are to be submitted to the Engineering Services Section for review, approval and details.

Table A-3-2 (Typical Barrier/Guardrail Selection and Placement) specifies the minimum offset distance required from "hazardous objects" to meet deflection requirements of the different types of barrier systems.

## FIXED OBJECT ATTACHMENT/TRANSITIONS POLICY

A transition section is needed where flexible (weak post) roadside guardrail must join a rigid bridge railing, concrete barrier, retaining wall, etc. The transition design produces a gradual stiffening of the overall approach protection system so vehicular pocketing, snagging, or penetration can be reduced or avoided at any position along the transition. A transition is also needed when a GR-6, GR-7, or GR-9 terminal is used on the run-off end of a flexible (weak-post) guardrail system on undivided roadways with two-way traffic to protect opposing traffic from impacting the opposite end of the terminal. The Road and Bridge Standards include details on guardrail transitions.

A rub rail is provided in Standards GR-FOA-1, -2, and -4 to help prevent potential vehicular snagging at the immediate upstream end of the rigid bridge railing. The rub rail is not necessary on the Special Design GR-FOA-3 as it is attached to a flared terminal wall that has a transitioned face to prevent snagging. Special Design GR-FOA-3 will be retained for use only on bridges that have been designed with the flared terminal wall.

## ENTRANCES OR CONNECTIONS ADJACENT TO A BRIDGE

When entrances or connections cannot be relocated or eliminated and are located adjacent to a bridge on low-volume rural roads or in areas with dense entrance locations, it is necessary to install radial guardrail around the entrances or connections. Plans fitting this criteria are to be submitted to the Engineering Services Section for review, approval and details.

## GUARDRAIL OVER CULVERT IN FILLS

Standard GR-10, Type I, II, or III is the preferred method of installing guardrail over culverts where fills are less than 3'-7" above culvert the top slab.

Type I is adaptable to culverts with a perpendicular width of 10'-6" or less. A 25' section is used with the rail doubled and one post omitted. Type II is adaptable to culverts with a perpendicular width of 16'-9". A length of 37'-6" is used with the rail doubled and two posts omitted. Type III is for use with a perpendicular width of 23'. A length of 100" is used with the rail doubled and three posts omitted.

In situations where the use of Standard GR-10 is not feasible, an allowable alternative may be the TEXAS T-6 (BGR-01) for speeds $\leq$ 45 m.p.h.

## SHORT GAPS

Short gaps between barrier installations should be avoided. When the areas of concern are less than 200 feet apart, the barrier protection shall be made continuous.

## PONDS OR OTHER BODIES OF WATER

Barrier is to be constructed on all functional classifications at ponds or other bodies of water over 2 feet in depth.

## TERMINAL REQUIREMENTS

Guardrail/barrier terminals are to be provided for all installations regardless of "Functional Classification". Terminals develop the necessary tension at the end of the system in order to redirect a vehicle and, if hit, minimize the damage to a vehicle and its occupants. The termini of guardrail/barrier must be designed and located so there are no exposed rail element ends within the clear zone which a vehicle could impact.

(1) Flexible (Weak Post or Cable) Guardrail Installations -

> Cable guardrail should normally be used only on Limited Access projects which provide "Recoverable Areas" exceeding 14 feet in width. Cable guardrail should be introduced when the height of fill slopes exceed 20 feet. This height is based on the hinge point between 6:1 slopes and 2:1 slopes. If the introduction of cable guardrail is in close proximity to an adequate cut section, it should be

extended and terminated in the back slope of the cut ditch. (Use 15:1 transition for Design Speeds of 70 MPH or 13:1 transition for Design Speeds of 60 MPH or less). Standard GR-3 (Cable Guardrail) is terminated on both the run-on and run-off ends with an anchor assembly as detailed in St'd. GR-3.

When using GR-8 (Weak Post Guardrail), the preferable run-on terminal is St'd. GR-6, terminal which buries the end of the guardrail into a cut slope and anchors the terminal with a post or concrete block. This terminal treatment requires enough right of way to extend the guardrail a minimum of 12'-6" beyond the ditch line. The guardrail should terminate a minimum of 1' below the ground elevation of the backslope. The rail preceding the GR-6 terminal is to maintain a consistent height (30") from the ground elevation to the top of the rail to prevent errant vehicles from impacting at an improper height. A total length of St'd. GR-8 (Weak Post Guardrail) based on the appropriate flare for the design speed shown on the standard drawing should be used adjacent to the St'd. GR-6 terminal. If more than a 200 foot extension of St'd. GR-8 guardrail is necessary to tie into the slope with a Std. GR-6 terminal, it would not be cost effective. If the GR-8, Type II terminal installation is not feasible, a St'd. GR-7 (Breakaway Cable Terminal) or GR-9 (Strong Post Alternate Breakaway Cable Terminal) including appropriate transitions should be used.

For run-off terminal treatment with St'd. GR-8 (weak post guardrail), the St'd. GR-8, Type II terminal is acceptable only for divided roadways or one-way traffic situations. When two-way traffic on an undivided facility would introduce the possibility of opposing traffic impacting an intended run-off terminal for another lane, a GR-6, GR-7 or GR-9 terminal must be used. Because the possibility would then exist for opposing traffic to impact the opposite end of the terminal, a transition (in accordance with the Road and Bridge Standards) must be used to join the St'd. GR-6, GR-7 or GR-9 terminal and the weak post guardrail system (GR-8) to minimize any possible impacts.

(2) Semi-Rigid (Strong Post) Guardrail Installations -

With Standard GR-2 (Strong Post Guardrail), the preferred run-on terminal treatment on divided and undivided roadways is to bury the end of the guardrail into a cut slope, using St'd. GR-6 terminal, even if the guardrail must be extended 200 feet to accomplish this. If more than a 200 foot extension of St'd. GR-2 (Strong Post Guardrail) is necessary to tie a St'd. GR-6 terminal into the back slope, cost-effectiveness would justify use of a St'd. GR-7 (Breakaway Cable Terminal) or GR-9 (Alternate Breakaway Cable Terminal). Run-off terminals for use with undivided roadways with two-way traffic are handled in the same manner. However, for the run-off terminal on a divided roadway or with one-way traffic, a W-Beam End Section treatment in accordance with St'd. GR-HDW details is sufficient to terminate the St'd. GR-2.

### (3) Rigid (Concrete Barrier) Installations -

St'd. MB-7D, 7E, 7F, 12A, 12B and 12C Concrete Median Barriers are considered rigid installations, thus requiring special attention to the terminal treatment to minimize the hazard if impacted. For run-on treatment outside the clear zone and all run-off treatment, a concrete turned down terminal can be used to terminate concrete barrier.

A Standard Insertable Sheet is available in the CADD Insertable Sheet directory for a 12 foot section of the turned down terminal. A special design Impact Attenuator must be requested for all sites within the clear zone where concrete median barrier must be terminated.

## TERMINAL INSTALLATION

(1) GR-8, Type II, Terminal Treatment Installation:

The St'd. GR-8, Type II, terminal is used only as a means of anchoring the run-off end of GR-8 (Weak Post) guardrail on divided or one-way roadways when installed outside the clear zone for opposing traffic. The guardrail is to be flush with the concrete anchor throughout the length of the anchor assembly in order for the installation to function properly without shearing the bolts.

(2) GR-6 Terminal Treatment Installation:

The St'd. GR-6 terminal is used as a means of terminating run-on or run-off ends of St'd. GR-2 or GR-8 guardrail on divided or undivided roadways by burying the end of the guardrail into the cut slope.

(3) GR-7 Breakaway Cable Terminal Installation:

When using the St'd. GR-7 terminals on standard shoulders, the 4-foot flare as specified in the standard drawing or manufacturer’s specifications must be provided for the installation to function as tested. This is considered essential to proper performance for end-on impacts to eliminate the potential of spearing. In consideration of the 4-foot flare requirement to construct the terminal treatment for St'd. GR-7, the shoulder in the terminal area must be widened sufficiently to accommodate site preparation for the terminal. The terminal should be located, or the barrier may need to be extended as needed, to provide a clear run-out path behind the terminal.

On bridge replacement projects and other projects (involving guardrail updates) on which existing shoulders are of insufficient width and for which there are no provisions for widening such shoulders, additional fill material is required to be placed to ensure that the flare can be correctly installed. Typical installation details are shown in Standard GR-SP with a tabulation of the applicable widths. (Projects with paved shoulders - Details are shown on Special Design Drawing No. 2154-A, Asphalt Paving Under Guardrail).

When this situation occurs for the GR-7 terminals on projects without normal grading operations, a pay item [Guardrail Terminal site preparation (GR- ) - Item Code 13349 with pay unit of Each] is to be used to cover the required embankment, benching and reseeding.

(A Special Provision Copied Note is available for use in contracts involving this pay item.)

New construction projects provide the necessary shoulder widening for the required guardrail terminals; therefore, the separate pay item for site preparation is not applicable.

(4) GR-9 Alternate Breakaway Cable Terminal Installation:

If the 4 foot offset cannot be achieved to properly install the Standard GR-7 terminal, evaluate using a St'd. GR-9 or request a special design terminal treatment from the Engineering Services Section. The GR-9 terminal treatment should only be used after an analysis including additional right of way costs indicates it is more cost effective than providing the proper site preparation to install a St'd. GR-7 or to extend the guardrail (200' maximum) to provide a St'd. GR-6 terminal. The estimated cost of the GR-9 terminal is $2000.

The GR-9 terminal is intended solely for use on the end of a w-beam installation with no flare. The guardrail is anchored in a manner similar to the standard breakaway cable terminal and redirects side-impacting vehicles. For an "end-on" hit, the terminal essentially flattens and slides backward, absorbing crash energy.

The total length of the terminal is 50 feet. The length of need begins 12.5 feet from the first post. The maximum deflection for the terminal along the length of need is 4 feet. For GR-9 installations used to terminate GR-8 (weak post guardrail), an additional 50-foot transition of St'd. GR-2 (wood posts only) is required.

(5) W-Beam End Section Installation:

For run-off treatment on a divided or one-way roadway, St'd. GR-2 (Strong Post) guardrail can be terminated with a W-Beam End Section in accordance with the Standard GR-HDW details as long as the installation is outside the clear zone for opposing traffic. The "flared" or "rounded" treatment may be used if installed outside the clear zone for opposing traffic. Payment is length of St'd. GR-2 guardrail

## IMPACT ATTENUATORS (CRASH CUSHIONS)

During the preliminary design stages for new construction and for rehabilitation or reconstruction of existing highways, the need for and space requirements of crash cushions to shield non-removable fixed objects should be considered. This will ensure compatibility with the final design and the crash cushion that is to be installed. Since these devices are expensive to install and maintain, the hazard must be studied to determine if elimination is possible or its inherent hazard potential can be economically reduced to tolerable limits by less drastic safety treatments, such as guardrail, breakaway supports, set-back, safety shape, etc. Present procedure requires that the proposed site be selected by the roadway designer and reviewed by the Special Design section for the type of crash cushion to be used. When requesting the review and installation details from the Special Design section, submit a print of the plans with a transmittal slip giving the project number, PPMS numbers, activity number, roadway design speed and advertisement date. In no case will attenuation devices be designed for placement behind curbed locations. For additional data, refer to the AASHTO's Roadside Design Guide.

In 1993 the National Cooperative Highway Research Program (NCHRP) published NCHRP Report 350. As a result of that report the FHWA issued a requirement that all permanent safety hardware systems included in Federal Aid projects after August 1998 meet NCHRP 350. VDOT extended that requirement to include state funded projects as well.

Devices subjected to traffic speeds greater than 45 mph must meet NCHRP 350 Test Level 3.

Devices subjected to traffic speeds of 45 mph and less must meet NCHRP 350 Test Level 2.

For a list of approved devices see Instructional and Informational Memorandum LD-222.

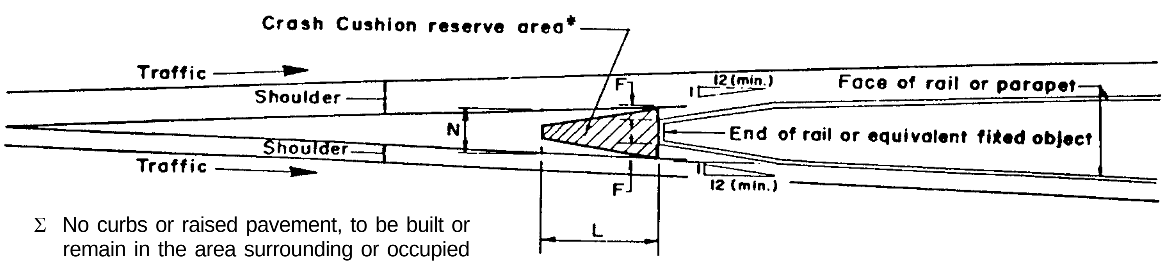
Fixed roadside hazards vary in size and shape, and in the degree of danger they present. The traffic passing by varies as well in volume, speed and density. For these reasons a selection from various types of crash cushions can be designed to meet the special requirements of a particular hazard site.

Figure A-3-3 suggests the area that should be made available for crash cushion installation. Although it depicts a gore location, the same recommendations will generally apply to other types of fixed object hazards that require shielding. The unrestricted conditions represent the minimum dimensions for all locations except for those sites where it can be demonstrated that the increased costs for obtaining these dimensions (as opposed to those for restricted conditions) will be unreasonable. The preferred condition dimensions should be considered optimum. The space provided by these dimensions will seldom be fully used by a crash cushion.

These dimensions are recommended so there will be additional space available should experience dictate the need for a device capable of slowing larger vehicles than originally considered or for producing lower deceleration forces. In the meantime, the unoccupied space provides valuable motorist recovery area. Site conditions may dictate the type of attenuator needed. For example, fixed objects such as barrier ends which are less than 3 feet wide should be shielded by a narrow crash cushion. Similarly, wide hazards, e.g., those greater than 3 feet, can be effectively shielded best by a wide impact attenuator or approved sand barrier arrays.

| DESIGN SPEED ON MAINLINE | TEST LEVEL | DIMENSIONS FOR CRASH CUSHION RESERVE AREA (Feet) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MINIMUM | | | | | | PREFERRED | | |
| | | RESTRICTED CONDITIONS | | | UNRESTRICTED CONDITIONS | | | | | |
| (m.p.h) | NCHRP 350 | N | L ** | F | N | L ** | F | N | L | F |
| 30<br>40<br>45 | TL-2 | 6<br>6<br>6 | 8<br>12<br>15 | 2<br>2<br>2 | 8<br>8<br>8 | 11<br>18<br>22 | 3<br>3<br>3 | 12<br>12<br>12 | 17<br>25<br>29 | 4<br>4<br>4 |
| 50<br>60<br>70<br>80 | TL-3 | 6<br>6<br>6<br>6 | 17<br>22<br>28<br>35 | 2<br>2<br>2<br>2 | 8<br>8<br>8<br>8 | 25<br>35<br>45<br>55 | 3<br>3<br>3<br>3 | 12<br>12<br>12<br>12 | 33<br>44<br>55<br>70 | 4<br>4<br>4<br>4 |

** Note: For Low Maintenance Impact Attenuators, a minimum length (L) of 31'-0" may be required. Check manufacturers' design details.




Σ No curbs or raised pavement, to be built or remain in the area surrounding or occupied by the crash cushion.

**FIGURE A-3-3**

## BRIDGES

When the proposed design calls for the utilization of an existing bridge having the older type parapet walls or rails, an appropriate detail showing the "Recommended Method for Attaching Guardrail to Bridge Rails" is to be obtained from the Engineering Services Section for inclusion in plans. Prints of the existing bridge rail should accompany the request. The method of measurement and basis of payment is for "Special Design Guardrail Bridge Attachment, (B or Str. No.), Lump Sum" which price bid shall include all materials, labor, tools, equipment, and incidentals necessary to complete the work connecting all segments of rail to one bridge.

When the use of guardrail on depressed medians is being planned to shield bridge piers, the designer should also consider the use of a Special Design Impact Attenuator Bull Nose Barrier. This design has been used for several years with excellent performance. The design utilizes a 5 foot radius W-beam guardrail and wooden breakaway posts; therefore, a 10 foot wide median would be the minimum. A similar design of the "Bull Nose Barrier" is shown in the AASHTO Roadside Design Guide. (Pay Item - Bull Nose Barrier-Each - Computer Est. No. 13601.) Installation layout details will be furnished by the Engineering Services Section for each Bull Nose Barrier location for inclusion in the plans. Bull nose barriers must not be used behind or on top of curbs or raised medians.

## SECONDARY PROJECTS

See Section A-1-Geometric Standards, GS-3, GS-4, GS-7 and GS-8 for additional widths to be added to the normal shoulders on secondary roads when guardrail is required.

## SAFETY/MAINTENANCE PROJECTS

When developing details for a Safety or Maintenance project, care must be taken to ensure proper barrier installation/maintenance/replacement to upgrade any outdated locations. There may be locations on a project where the guardrail has not been hit, but the installation may not be the safest that can currently be provided if an errant vehicle impacted the guardrail. Attention should be given to the following factors in evaluating these locations:

(1) Location of barrier:
- relative to hazard
- relative to pavement
- relative to shoulder break point
- relative to fixed objects (such as bridges); face of guardrail should be aligned with bridge rail, not closer to the roadway

(2) Type of guardrail used (Strong Post or Weak Post):
- no longer use Weak Post guardrail adjacent to curb
- cable guardrail normally used only on Limited Access facility with recoverable area exceeding 14 feet
- sufficient space for maximum deflection for type used
-

(3) Terminals (need, type, proper installation, etc.):
- end treatment needed on both ends of a run of barrier
- terminals used with strong post guardrail
- terminals used for run-on treatment with weak post guardrail
- terminal treatment used as anchor for run-off end of weak post guardrail when not subject to two-way traffic
- proper flare, anchor, post placement for terminal to effectively decrease damage caused to impacting vehicle
- substandard terminals such as GR-5 (old turndown terminal), old standard GR-7 (those with 2' diameter concrete footings for first two posts), etc., should be replaced with approved terminals.
- at bridges/walls, guardrail terminals should not be located closer to the roadway than the bridge rail or wall (fixed object attachment should be installed instead of separate units)

(4) Shoulder width and site preparation:
- provide sufficient width for site preparation
- provide additional fill if necessary for proper flare installation
- provide clear run-out area behind terminal installation

(5) Fixed object attachments:
- proper attachments to fixed objects (such as bridges/walls) to reduce possibility of snagging vehicles that impact the attachment
- align guardrail with face of bridge rail so that the end of the bridge with the fixed object attachment will not become an additional hazard
- include proper transition to gradually stiffen the overall approach

# SECTION A-4-GUIDELINES FOR RRR PROJECTS

## OBJECTIVE

The objective of the Virginia RRR Guidelines is to provide guidelines in the selection of projects where, with minimal improvements, the service life of the existing highway can be extended for a fraction of the cost of complete reconstruction.

Non-freeway resurfacing, restoration, and rehabilitation (RRR) projects primarily involve work on an existing roadway surface and/or subsurface. In addition to extending the service life of the roadway, the purpose of RRR projects includes providing additional pavement strength, restoring or improving the existing cross section, decreasing noise characteristics, improving the ride of the roadway, improving bridges, and enhancing safety through the implementation of appropriate safety improvements.

The scope of a RRR project is influenced by many factors. Factors include roadside conditions, environmental concerns, changing traffic and land use patterns, surface deterioration rate, accident rates, funding constraints and scenic/historic areas.

Although RRR type improvements are normally accomplished within the existing right of way, the acquisition of additional right of way may be necessary. Horizontal and vertical alignment modifications, when required, are generally minor.

## AUTHORITY

The Transportation Research Board's Special Report 214, Designing Safer Roads, Practices for Resurfacing, Restoration, and Rehabilitation, 1987, was the result of a study on safety cost-effectiveness of highway geometric design standards for RRR projects. Virginia has developed and adopted this guideline for non-NHS RRR projects.

In the planning and design of any Secondary System improvements in rural areas, Virginia's RRR Guidelines shall be utilized to the extent possible. On secondary projects that have a 15 year traffic projection of 750 vehicles per day or less, the RRR guidelines shall be the design concept of choice. Reconstruction under AASHTO design guidelines should be proposed on these projects only when the preliminary study report documents either:

1. The needed improvement is ineligible for development under the RRR concept.

or 2. Extenuating circumstances preclude the use of the RRR Design concept.

## DEFINITIONS

These definitions apply to RRR projects and are not an attempt to be all-inclusive of other related activities.

Maintenance - This work is directed toward preservation of the existing roadway and related appurtenances as necessary for safe and efficient operation. Design improvementsare not normally the intent of maintenance operations. Seal coats, overlays less than 0.06 foot thick, crack sealing, etc., are considered maintenance items, and are not RRR activities.

Resurfacing - The addition of a layer, or layers, of paving material to provide additional structural integrity or improved serviceability and rideability.

Restoration - Work performed on pavement, or bridge decks, to render them suitable for an additional stage of construction. This may include supplementing the existing roadway by increasing surfacing and paving courses to provide structural capability, and widening up to a total of ten feet. Restoration will generally be performed within the existing right of way.

Rehabilitation - Similar to "Restoration", except the work may include restoring structural integrity or correcting major safety defects of bridges, reworking or strengthening the base or subbase, recycling or reworking existing materials to improve their structural integrity, adding underdrains, improving or widening shoulders, and shifts in both vertical and horizontal alignment involving less than 50 percent of the project length. Rehabilitation may require acquisition of additional right of way.

Reconstruction - This type of project is not considered RRR activity. A reconstruction project is designed in accordance with AASHTO design guidelines for new and major reconstruction projects and may include significant changes in cross section and shifts in both vertical and horizontal alignment. If 50 percent or more of the alignment changes, the project will be considered reconstruction. Reconstruction may require acquisition of additional right of way and may include all items of work usually associated with new construction.

## PROJECT SELECTION

Projects are identified and selected based on a variety of factors with the pavement condition being of utmost importance. The pavement condition itself will not have a significant effect on the extent of geometric improvements included in the project. Geometric improvements will be initiated to fulfill traffic service/safety needs.

Logical project termini are to be set; and, at no time, are project exceptions for segments of roadway or bridge, etc., to be established within the project termini due to excessive cost to provide the required improvements.

## ELIGIBILITY

Improvements to Existing Highway:

Eligible Items of Work *

- Minor alterations to vertical and/or horizontal alignment.
- Minor lane and/or shoulder widening.
- Pavement structure and joint repair.
- Resurfacing (non-maintenance activities).
- Removal or protection of roadside obstacles.
- Repairs to restore bridge structural integrity, installation of deck protective systems and upgrading substandard bridge rail.
- Culvert Extensions.

* Some RRR-type projects may be funded with either regular Federal-aid or separate categorical aid.

Examples:

Bridge rehabilitation project - RRR funding or the bridge replacement and rehabilitation program.

Roadside hazard removal and guardrail installation - RRR funding or hazard elimination program funds.

Ineligible Items of Work

Projects in the National Highway System (NHS).

New or additional through lanes.

-
- Curbs and gutters, raised medians, storm sewers, and other urban type improvements

## ACCIDENT RECORDS

Evaluation of accident records often reveals problems requiring special attention. In addition, relative accident rates can be an important factor in establishing both the priority and the scope of RRR projects.

The Resident Engineer (or project designer) must request from the Mobility Management Division that the accident history for the project area be compiled and compared to the statewide average accident rate for the same type of road. This data review can be an integral part of the RRR project development process so that feasible safety modifications can be incorporated into the project as necessary.

The accident analysis shall be completed prior to the project field inspection/review and available for field review by the Federal Highway Administration.

## BRIDGE REHABILITATION OR REPLACEMENT SELECTION POLICY

Existing bridges shall be evaluated and the necessary work shall be determined in accordance with the following provisions:

Bridges with overall deck area exceeding 20,000 square feet shall be evaluated and any necessary work shall be determined by the Structure and Bridge Engineer on a case-by-case basis.

All other bridges shall be replaced, rehabilitated, or allowed to remain in existing condition in accordance with the following:

(1) Bridges shall be replaced under any one or more of the following conditions unless otherwise approved by the Structure and Bridge Engineer. The new replacement structure shall meet the current requirements of the Virginia Department of Transportation's Road and Bridge Standards.

a. If the estimated cost for rehabilitating the existing structure exceeds 65% of the estimated cost of a new structure.

b. If the existing or rehabilitated structure is overstressed under the loading specified in the AASHTO Manual for Maintenance Inspection of Bridges (i.e., if the bridge is to be posted for less than the legal load).

c. If the usable width of the existing or the rehabilitated bridge will be less than the minimum acceptable values for usable width of bridges on RRR projects shown in the table below, and it is not economically feasible to provide that width.

(2) Bridges shall be rehabilitated as required or remain in the existing condition, if conditions in A, B, or C above do not prevail. The usable width of the existing or the rehabilitated bridge shall meet or exceed the minimum acceptable values for usable width of bridges on RRR projects shown in the Table hereinafter.

| DESIGN YEAR VOLUME ADT | ✸ USABLE BRIDGE WIDTH (FACE-TO-FACE OF CURB) FT. |
|---|---|
| 0 - 750 | WIDTH OF APPROACH LANES |
| 751 - 2000 | WIDTH OF APPROACH LANES + 2 FT |
| 2001 - 4000 | WIDTH OF APPROACH LANES + 4 FT |
| OVER 4000 | WIDTH OF APPROACH LANES + 6 FT |

**MINIMUM BRIDGE WIDTHS ON RRR PROJECTS**

**SHALL BE AS FOLLOWS:**

NOTE:See DRAINAGE DESIGN ELEMENTS Bridge Restoration and Bridge Rehabilitation for hydraulic conditions that are to be evaluated.

✸ If lane widening is planned as part of the RRR project, the usable bridge width should be compared with the planned width of the approaches after they are widened.

## ENVIRONMENTAL CONSIDERATIONS

An environmental evaluation and documentation thereof, is required on all RRR Federal participation projects in accordance with current guidelines.

Prints are transmitted to the Environmental Engineer via Form LD-252.

**ACCESS CONTROL**

Generally, a RRR project will not be designated as a limited access highway due to the project being along an existing corridor with access provided to adjoining properties.

The elimination of existing access to properties is beyond the scope of work for RRR projects.

Existing limited access roadways may qualify as a RRR project.

**PROJECT DEVELOPMENT**

It is desirable that these projects be designed to meet the standards for new construction. If meeting these standards is not practical, due to limited funding, right of way and/or environmental restrictions, etc., improvements in roadway widths should still be considered.

The minimum roadway and travelway widths are shown under GEOMETRIC DESIGN CRITERIA, TABLE A-4-1. Lane and shoulder width requirements are provided for roadways with 10% or more trucks and for roadways with less than 10% trucks.

The design should not decrease the existing geometrics. Widths selected should be consistent throughout a given section. Minor lane and shoulder widening is acceptable. While additional new continuous traffic lanes are an ineligible type of work, the existing pavement may be widened up to a total of ten feet.

**ROADWAY AND TRAVELWAY WIDTHS**

Wide lanes and shoulders provide motorists with increased separation between overtaking and meeting vehicles and an opportunity for safe recovery of vehicles leaving the road.

Additional safety benefits include reduced interruption of the traffic flow as the result of emergency stopping and road maintenance activities, less pavement and shoulder damage at the lane edge, and improved sight distance for horizontal curves.

**FUNCTIONAL CLASSIFICATION**

The highway system in Virginia has been functionally classified as Principal Arterial, Minor Arterial, Collector and Local Service. The American Association of State Highway and Transportation Officials (AASHTO) utilizes, as presented in the publication: A Policy on Geometric Design of Highways and Streets, referred to as The AASHTO Book, a similar functional classification system. The designations used are: Freeway, Arterial, Collector, and Local Roads and Streets. Relationships between these two classification systems have been generally developed.

Principal and Minor Arterial Highways provide direct service between cities and larger towns and are high speed, high volume facilities. Collector highways serve small towns directly, connecting them and local roads to the arterial system.

**DESIGN TRAFFIC VOLUMES**

Traffic projections should be checked to assure that:

The anticipated traffic being used is correct and that the roadway and travelway needs will be properly accommodated for the service life of the improvement.

The project service life for RRR projects should be from 8 to 12 years.

Turning movements are obtained at signalized and problem intersections and at major traffic generators.

Future traffic generators that are anticipated to be established during the service life should be considered.

**DESIGN SPEED**

The design speed designated for a RRR project should be logical with respect to the character of terrain and type of highway and should be as high as practicable.

It is also important to consider the geometric conditions of adjacent sections of roadway when considering a RRR project. A uniform design speed should be maintained for a significant section of highway.

The design speed is a determining factor for required land and shoulder widths.
The following two methods may be used to determine the project design speed:

(1) Select an overall project design speed that equals or exceeds the posted or regulatory speed on the section of highway being improved.

(2) The average running speed throughout the project based on the "low volume" off peak hour traffic.

Average running speed is the speed of a vehicle over a specified section of highway, being the distance traveled divided by the running time (the time the vehicle is in motion).

An equivalent average running speed can be obtained on an existing facility where flow is reasonably continuous by measuring the spot speed.

The average spot speed is the arithmetic mean of the speeds of all traffic at a specified point.

For short sections of highway on which speed characteristics do not vary materially, the average spot speed may be considered as being representative of the average running speed.

On longer stretches of rural highway, spot speeds measured at several points, where each represents the speed characteristics pertinent to a selected segment of highway, may be averaged (taking relative lengths into account) to represent the average running speed.

**TERRAIN**

Terrain is a significant factor which must be given strong consideration when establishing design criteria for a highway project. High design speeds (50 MPH and greater) can generally be achieved on flat terrain, and lower design speeds (40 MPH and lower) are generally dictated by rolling and mountainous terrain, (depending upon road classification). Intermediate design speeds are determined by a combination of these factors.

While terrain is an important factor to be considered when designing a new project, RRR projects must be designed considering all existing constraints, and held within RRR parameters. That is to say that eligible RRR elements, due to terrain and other constraints upon the original design, may not allow the desired speed and safety enhancements.

**SAFETY**

All safety elements of the project are to be given specific consideration. Accidents, accident types, and accident rates for the project length shall be examined and documented.

The documentation may indicate deficiencies in one or more of the following areas, however, each should be examined:

Horizontal and vertical alignment
Cross-sectional geometrics
Traffic control
Access
Railroad crossings
Pedestrian facilities
Bridges that remain in place
Illumination
Signing
Channelization

Intersections
Pavement edge drop offs
Pavement surface condition
Maintenance of traffic
Bicycle facilities

Improvements to the roadway surface may result in increased operating speeds. Geometrics should be examined and modified, if necessary, to maintain an acceptable level of operational safety.

Horizontal and vertical curvature and stopping sight distance are directly related to the speed of vehicles and major deviations from the desirable design may cause serious problems. These geometric characteristics can be the most difficult and costly to improve. Although every sight distance restriction can create a potential hazard, improvement on that basis alone may not be practical on every RRR project.

If curvature is shown to be the cause of numerous accidents, some corrective action should be taken. This corrective action can range from some form of positive guidance, which may include placement of additional warning signs and markings, to reconstruction.

Alignment improvements should be undertaken when accident experience is high, and if previously installed warning signs, markings, or other devices have not proven effective. In many cases, under both rural and urban conditions, existing horizontal and vertical alignments may be retained if a careful analysis indicates they can be adequately signed and marked.

If the calculated design speed for a particular horizontal or vertical curve is within 15 MPH of the design speed of the adjacent sections and the location is not an identified high accident location, (facilities with ADT< 750 vehicles per day), proper signs and markings informing drivers of the condition may be used in lieu of reconstruction to meet standards for the assumed design speed. When the difference is over 15 MPH or the design speed of the horizontal or vertical curve is less than 20 MPH, (facilities with ADT> 750 vehicles per day), corrective action must be considered and should be undertaken unless cost or other factors make the improvement impractical. If improvement is not possible, appropriate signs, markings and other provisions should be used to provide for proper speed transition.

Sight distance on horizontal curves, and at intersections, can often be improved by minor cut slope flattening, selective clearing or both. If such work is done, the actual sight distance must be measured, the maximum safe speed determined, and the location signed and marked accordingly.

Grades generally do not need to be flattened on RRR projects. Steep grades and restricted horizontal or vertical curvature in combination, however, may warrant corrective action.

A completed roadside hazard review is required. This will provide information regarding areas of potential concern relating to safety.

For safety, it is desirable to provide a roadside recovery area that is as wide as practical, but because of existing topographic features and right of way limitations associated with RRR work, considerable judgment must be used. The clear zone must be given particular attention at identified high roadside accident locations (fixed object and run-off-the-road accidents). An evaluation should be made to determine the consistency of the clear zone throughout the project limits.

Widening to provide more clear distance through short sections of rock cuts should be considered. In longer rock cuts, protrusions should be cut back or shielded if warranted. A review of accident data will help to define dangerous obstructions. Good engineering judgment, cost effectiveness, and consideration of community impact may also influence decisions.

Under urban conditions the <u>minimum setback for any obstructions</u> should be as close to the right of way line as possible or 1.5 feet behind the curb. Where sidewalks are to be included, it is desirable to locate all obstructions behind the sidewalk.

Safety items for reducing the severity of run-off-the-road accidents include traffic barriers (including bridge rails), flattening slopes to eliminate the need for either existing barrier or contemplated barrier placement, crash cushions, breakaway or yielding sign supports, and breakaway luminaire supports.

The priority for action relative to roadside hazards is to:

- Remove or redesign
- Relocate
- Make breakaway
- Redirect by using appropriate barrier
- Delineate

To enhance safety, all RRR projects should provide the following:

Evaluation of existing traffic barrier and end treatments to determine whether they are necessary and meet applicable guidelines and standards. The extent to which the barrier must be upgraded should be consistent.

Appropriate transition and connection of approach rail to bridge rail.

Mitered end sections for both parallel and cross-drain structures located in the clear zone.

Relocating, shielding, or providing breakaway features for sign supports and luminaires.

Protection for exposed bridge piers and abutments.

Drop inlets with traversable grates that are not a hazard to be used within the clear zone.

## GEOMETRIC DESIGN CRITERIA

The design criteria in Table A-4-1 for Minor Arterial, Collector and Local Road projects are based on the general approach in the "AASHTO Book" regarding functional classification and corresponding appropriate design volumes and also recommendations presented in TRB special Report 214, Practices for Resurfacing, Restoration, and Rehabilitation.

| MINIMUM LANE AND SHOULDER WIDTH VALUES<br>MINOR ARTERIAL/RURAL COLLECTOR/RURAL LOCAL ROAD SYSTEMS | | | | | | |
|---|---|---|---|---|---|---|
| DESIGN TRAFFIC VOLUME ADT | DESIGN SPEED MPH | 10% OR MORE TRUCKS (d) | | LESS THAN 10% TRUCKS (d) | | DITCH WIDTH 3:1 SLOPE |
| (a) | (b) | LANE WIDTH (FT.) | SHOULDER WIDTH (c) (FT.) | LANE WIDTH (FT.) | SHOULDER WIDTH (c) (FT.) | (FT.) |
| 1 - 750 | < 50<br>≥ 50 | 10 (e)<br>10 | 2 (i)<br>2 (i) | 9<br>10 | 2 (i)<br>2 (i) | 3 (h)<br>3 (h) |
| 751 - 2000 | < 50<br>≥ 50 | 11 (f)<br>12 (g) | 2 (l)<br>3 (i) | 10<br>11 | 2 (l)<br>3 (i) | 3<br>3 |
| 2001 - 4000 | ALL | 12 | 6 | 12 | 6 | 4 |
| 4001 - OVER | ALL | 12 | 6 | | 6 | 4 |

**GEOMETRIC DESIGN CRITERIA**

**TABLE A-4-1**

(a) Design traffic volume is between 8 and 12 years from completion.

(b) Highway segments should be classified as "Under 50" only if most vehicles have an average running speed of less than 50 MPH over the length of the segment.

(c) Cut shoulder width may be reduced by one foot in mountainous terrain.

(d) Trucks are defined as heavy vehicles with six or more tires.

(e) Use 9' lane width for Local Road System with ADT of 1 - 250. (9' lane width is equal to new construction standards.)

(f) Use 10' lane width for Collector Road and Local Road System in mountainous terrain. (10' lane width is equal to new construction standards.)

(g) Use 11' lane width for Collector Road and Local Road System in level terrain. (11' lane width is equal to new construction standards.)

(h) Use 2' ditch width with pavement depths (excluding cement stabilized courses) of 8" and less.

(i) Minimum width of 4' if roadside barrier is utilized (minimum 2' from edge of pavement to face of G.R.).

NOTE: PAVEMENT AND SHOULDER WIDTHS NOTED ARE MINIMUMS FROM A DESIGN CRITERIA STANDPOINT. UNDER NO CIRCUMSTANCES SHALL THE EXISTING PAVEMENT OR SHOULDER WIDTHS BE REDUCED TO CONFORM TO THESE MINIMUM STANDARDS.

NOTE: FOR VALUES NOT SHOWN, SEE APPROPRIATE GEOMETRIC DESIGN STANDARD FOR THE FUNCTIONAL CLASSIFICATION OF ROADWAY (GS-2, GS-3 OR GS-4) CONTAINED IN THE VDOT ROAD DESIGN MANUAL, APPENDIX A, SECTION A-1 .

NOTE: ROADSIDE HAZARDS AND PRIORITY FOR RELATIVE ACTION ARE COVERED ON PAGES A-48 AND A-49.

## CLEAR ZONES AND SLOPES

Wherever possible, existing side slopes should not be steepened when widening lanes and shoulders. When the initial slopes are relatively flat, however, the slope can be steepened to 6:1 with little effect, and steepening to 4:1 may be reasonable.

Consideration should be given to flattening side slopes of 3:1 or steeper at locations where run-off-the-road type accidents are likely to occur (e.g. on the outsides of horizontal curves). Accident data should be used (when available) to substantiate run-off-the-road accident locations.

Removing, relocating or shielding of isolated roadside obstacles should be evaluated in accordance with the Clear Zone and Traffic Barrier Guidelines contained in the Road Design Manual, Appendix A, Sections A-2 and A-3.

## GRADES

Grades generally do not need to be flattened on RRR projects. Steep grades and restricted horizontal or vertical curvature in combination, however, may warrant corrective action.

## CREST VERTICAL CURVES

An existing vertical curve may be retained as is, without further evaluation, if the existing design speed provides the stopping sight distance within 15 MPH of the overall project design speed and the average daily traffic volume is less than 750 vehicles per day.

Reconstruction of crest vertical curves is to be evaluated when the above speed and traffic volumes are exceeded and the vertical curve hides major hazards from view. Major hazards include, but are not limited to intersections or entrances, sharp horizontal curves and narrow bridges.

## SAG VERTICAL CURVES

Substandard sag vertical curves should be investigated to ensure that potential hazards do not exist, especially ones that become apparent when weather conditions, or darkness, reduces visibility.

## STOPPING SIGHT DISTANCES

Guidelines for determining the existing sight distances of vertical and horizontal curves are as follows:

- Existing road data to be determined from survey plan and profile sheets and/or old plans obtained from the plan library.

- Road and Bridge Standards SD-3 and SD-4 may be used to determine the sight distances using the following methods:

  Vertical curves - Determine algebraic differences of grades in percent and length of vertical curve in feet from the survey plans, or old project plans, and the sight distance may be obtained from Standard SD-4.

  Horizontal curves - Determine the existing degree of curve and the middle ordinate or radial distance from centerline of inside lane to obstruction to view and the sight distance may be obtained from Standard SD-3.

- Vertical and horizontal curve sight distances may be scaled from the plans using the following heights of driver's eye and object:

| Sight Distance | Height of Eye | Height of Object |
|---|---|---|
| Stopping | 3.5' | 2’ |
| Passing | 3.5' | 3.5' |

## HORIZONTAL CURVES

An existing horizontal curve may be retained as is, without further evaluation, if the existing curve design speed, with correct superelevation provided, corresponds to a speed that is within 15 MPH of the running speeds of approaching vehicles and the average daily traffic volume is less than 750 vehicles per day.

Reconstruction of horizontal curves should be considered and evaluated when the above speed and/or volume criteria are exceeded.

When a roadway segment consists of a series of reverse curves or curves connected by short tangents, the succession of curves shall be analyzed as a unit rather than as individual curves.

The first substandard curve in a series should receive special attention because this change in alignment prepares the driver for the remaining curves in the series.

Any intermediate curve in a series of substandard curves that is significantly worse than the others in the series should be analyzed individually.

These controlling curves can be used to determine the safety and/or other mitigation measures to apply throughout the series.

## PAVEMENT CROSS SLOPE

Pavement resurfacing or rehabilitation will be accomplished such that the finished pavement on tangent sections will be crowned in accordance with new construction standards.

## SUPERELEVATION REQUIREMENTS

Standard superelevation will be provided on all curves to comply with the project design speed unless the following conditions exist:

> Excessive cost to provide superelevation.
> Excessive property damage.

Superelevations may be provided for design speeds up to a maximum of 15 MPH less than the project design speed for current traffic volumes of 750 vehicles per day or less, if the above conditions exist, with appropriate signing:

> Advisory curve signs and speed limit signs will be erected.

## PAVEMENT EDGE DROP

Pavement edge drops usually are caused by resurfacing of pavement without regrading the existing shoulder or erosion of gravel, turf, or earth shoulder materials.

This hazard shall be eliminated or mitigated by utilizing one or more of the following practices:

Paving the full top width between shoulder breaks.

Selectively paving shoulders at points where vehicle encroachments are likely to create pavement edge drops, such as on the inside of horizontal curves.

Constructing a beveled or tapered pavement edge so that any edge drop that develops has a reduced impact on the recovery maneuver.

Reconstruction of shoulders.

## INTERSECTIONS

Many intersection improvements can be made at a relatively low cost and are safety cost-effective, particularly at higher traffic volumes.

The intersection improvements must be tailored to site-specific conditions and rely heavily on professional judgment and experience along with current Department guidelines.

## DESIGN EXCEPTIONS

All efforts should be made to adhere to the standards stated herein. However, under unusual conditions, it may be necessary to use values that are less than the minimum values shown. If lesser values are proposed for use, a justification report will be needed and approval by the State Location and Design Engineer and the Federal Highway Administration on Federal aid funded projects must be granted before developing the project further.

Methods of showing design exceptions on the plans are noted in Section 2D-8 of the Road Design Manual.

## PLANNING DRAINAGE DESIGN ELEMENTS

The hydraulic consequences of a highway improvement need to be addressed during the planning phase of the project.

Failure to assess the hydraulic aspects of the improvement could result in an increase in damages to adjacent property as well as the highway facility. Although detailed site information may not be required, it is important that a hydraulic assessment be made by a drainage engineer in the planning phase to determine that engineering and regulatory constraints can be met.

Items to be considered include:

- Hydraulic impacts
- Interaction with other agencies
- Utilities
- R/W and property owners' concerns
- Environmental concerns and permits.

## REPLACEMENT OR REHABILITATION OF DRAINAGE ELEMENTS

The decision to rehabilitate or replace a structure should not be made without checking hydraulic adequacy. Normally, the highway designs that improve upstream flooding conditions should generally result from meeting highway flooding criteria. Scour protection, spur dikes, or other protective measures should be included with the bridge rehabilitation.

The decision regarding the rehabilitation or replacement of existing bridges or culverts is often a structural or functional decision. Hydraulic input is important when the cost of the rehabilitation is high enough to consider replacement or where the contemplated rehabilitation involves a change in the roadway profile which, by lessening roadway overflow, could increase hydraulic stresses on the structure and change flow distribution.

Rehabilitation or replacement of culverts often becomes necessary when the culvert is no longer structurally sound. Consideration of the remaining service life of the existing culvert is, therefore, a very important factor in deciding to rehabilitate or to replace it.

In some instances, structures may require replacement due to inadequate waterway area and subsequent frequent interruption of traffic due to flooding. Prolonged ponding behind an embankment caused by an inadequate culvert may also lead to embankment saturation or piping along the culvert.

## HYDRAULIC CHARACTERISTICS

The hydraulic considerations for RRR improvement projects are, in many respects, the same as those for a highway on new alignment. The primary difference is that the hydraulic characteristics of the existing facility are already established. These hydraulic characteristics include:

- Culvert performance (inlet or outlet control or headwater at culvert sites).
- Culvert outlet velocities and scour tendencies.
- Flow lines and culvert alignment.
- Backwater at bridge sites.
- Flow distribution.
- Scour patterns at bridge piers, bridge abutments and adjacent banks.
- Skew and channel alignment.
- Storm drain systems and their performance.

The engineer must consider the need for changing and the consequences of changes to these hydraulic characteristics.

Most improvement projects will require some modification of the existing drainage structures. If the hydraulic performance of a drainage structure is changed, the change should be investigated for both upstream and downstream effects of the change.

Because the hydraulic effects of existing structures are usually well established, there is sometimes opposition to change from the landowner(s) affected. This is particularly true in developed areas.

Debris conditions may be changed and should be considered in design. Roadside ditch drainage patterns may be altered. These conditions should be thoroughly studied before any change is allowed.

## SAFETY IMPROVEMENTS RELATIVE TO DRAINAGE DESIGN

Where the hazard is a culvert headwall, the options usually are to extend the culvert, protect traffic with guardrail, or construct a protective grate over the headwall. The alternative selected should be based on particular site conditions. Grates on cross culverts with the potential to collect significant debris are undesirable because of the potential hazard created for local flooding. A good way to evaluate the risk is to assume the grate will be plugged and then determine what flood hazard will be created. In all cases, it is very important that grates on culvert end be inspected frequently and always cleared of debris. Spaces between grate bars should be as large as practicable in order to lessen the probability of plugging.

The wide openings tend to minimize the flood hazard by reducing the potential of debris plugging the culvert.

## BRIDGE RESTORATION

Hydraulically Equivalent Replacement Structure (HERS) definition:

The waterway opening of the proposed structure provides the same height, width obstructions (piers) and geometric configuration as the existing structure.

The proposed roadway grades on the approaches and the structure provide the same overtopping characteristics as the existing facility.

Any of the above characteristics of the proposed facility are less restrictive to the passage of flood flows than are the characteristics of the existing facility.

Every waterway crossing whose 1% exceedance probability discharge is anticipated, estimated or expected to be 500 cfs or greater **MUST** be reviewed by an appropriate river mechanics specialist. When the proposed facility is determined to be the hydraulic equivalent of the existing facility, no formal design analysis will be required.

If a rehabilitation of the structure and/or its approach roadway does not conform to the HERS requirements, it must be treated as a bridge replacement, and an engineering analysis is required.

## BRIDGE REHABILITATION

Bridge repairs are often required because of structural deterioration, damage from floods, and damage from vehicles. Bridge rehabilitation consists of physical changes to a bridge which are necessary because of inadequate width, structural capacity, hydraulic capacity, or because of scour or degradation.

Where bridge repair or rehabilitation is being considered, the cost of the repair should be compared with the cost of complete replacement. (see BRIDGE REHABILITATION OR REPLACEMENT SELECTION POLICY on page A-42). The hydraulic requirements of the bridge should also be reviewed when extensive repair or rehabilitation is being contemplated. This hydraulic review is particularly important if a change in the roadway profile is to be included in the rehabilitation.

In some cases, the grade may be raised so that roadway overflow is eliminated without changing the bridge size. This can be a deliberate change of the grade or a slow change, such as maintenance forces placing asphalt overlays on the grade over a period of years. These changes should always be reviewed by the hydraulics design section for effect on flow distribution, on backwater, and on velocity through the bridges.

A replacement bridge may have a deeper superstructure and solid rails. These differences will affect a stream crossing unless compensating adjustments are made in the profile gradeline.

Where the profile grade is raised, the effect may be to eliminate or lessen roadway overflow which could force more water to flow through the bridge opening. Solid rails can have the same effect. If the grade is lowered, the flow pattern and the amount of flow directed over the road and into downstream property could be increased.

When replacement bridges have shorter spans than the existing bridge, the resulting increase in the number of piers could add a debris and scour problems or increase backwater.

## CULVERT REPLACEMENT

When an existing culvert is to be replaced, an analysis should be made to see if the size of the existing culvert is either smaller or larger than necessary.

## CULVERT REHABILITATION

A properly installed culvert generally loses its structural integrity through corrosion and/or abrasion of its invert, although overall loss of material in the pipe wall can occur some installations due to the corrosive action of the backfill material or the water flowing through the culvert. Common restoration techniques include:

> Provision for replacement of the culvert invert.
>
> Threading of a smaller size culvert or liner plate through the original culvert and grouting of the voids between the two culverts.
>
> Use of commercial products for relining pipe with epoxy-coated fabric materials.

Any proposed culvert rehabilitation scheme should be analyzed for hydraulic adequacy and outlet protection. Normally, the smaller cross sectional area resulting from culvert rehabilitation will lead to higher headwater elevation; however, this effect may be insignificant if there is storage upstream or if the potential for damage is minimal. Another consequence of a reduction in pipe size may be higher outlet velocities. This factor should also be assessed during the design of a culvert rehabilitation project.

Use of smooth linings, improved inlets, etc. may also improve the hydraulic performance of the relined culvert and essentially offset the loss of cross sectional area.

Many older culverts were built during a period when less attention was given to the need for accommodating fish passage. Such accommodations can often be incorporated by the addition of baffles in the culvert barrel; however, such designs should be checked to ensure that the revised design is hydraulically adequate.

## CULVERT EXTENSIONS

The extension of an existing culvert can result in significant changes to the hydraulic performance. Extending the inlet of a culvert operating in inlet control establishes a higher inlet flow line, which will raise the inlet headwater elevation an equal amount. Extending a culvert which operates under outlet control may also increase the headwater because of head losses associated with the longer barrel.

Culvert extensions can cause the approach or the exit flow alignment to be unacceptable. This can usually be corrected by either extending the culvert on a skew angle that will fit the channel alignment or modifying the channel.

Long culvert extensions could cause the culvert to switch from inlet control to barrel (outlet) control, which will result in an increase in headwater.

In addition to the above noted changes, a long culvert extension may also create problems with fish passage through the culvert that should be addressed during the design.

## SIGNING, SIGNALS AND PAVEMENT MARKINGS

Traffic control devices such as signing, signals, and pavement markings must be updated in accordance with the Manual on Uniform Traffic Control Devices and the VDOT's Road and Bridge Standards.

While traffic control devices cannot fully mitigate all problems associated with substandard geometric features, they are a relatively low cost measure that can compensate for certain operational deficiencies.

Where roadway geometry or other roadway or roadside features are less than standard, do not meet the driver's expectancy, and reconstruction is not feasible, additional signs, markings, delineation and other devices beyond normal requirements of the MUTCD should be considered.

Judicious use of special traffic regulations, positive guidance techniques, and traffic operational improvements can often forestall expensive reconstruction by minimizing or eliminating adverse safety and operational features on or along existing highways .

Signals are to be provided at warranted locations.

## PLAN REVIEWS

Preliminary Plan Reviews and Field Inspections are to be held in accordance with the standard procedures. The Federal Highway Administration (FHWA) is to be notified of each and invited to attend.

## PUBLIC INVOLVEMENT

RRR projects are to be developed utilizing the Department's Public Involvement Policy to keep the public sufficiently informed and involved as the project progresses so that a formal public hearing can be eliminated in most, if not all, cases.

## RIGHT OF WAY

Although RRR type improvements are normally made within the existing right of way, additional right of way may be required to provide the necessary improvements.

Any required right of way and/or easements will normally be secured by donation. However, right of way may be acquired.

All right of way negotiations are to be conducted in accordance with the applicable statutes, regulations, policies, and procedures stipulated in the Right of Way and Utilities Division's Manual of Instructions and related memoranda.

## UTILITIES (UNDERGROUND AND OVERHEAD)

Where utilities are involved on RRR projects, the Department's General Guidelines for Accommodating Utilities Within Highway Right of way are to be followed.

Relocation or adjustment may be required if the minimum clear zone requirements are not met or if the utility system conflicts with proposed RRR improvements and sufficient right of way is available. For Federally funded RRR projects, an exception request must be made if the project does not meet the minimum clear zone requirements.

In some cases, the utility system on RRR projects may be retained without adjustment or relocation if the accident history does not indicate the existence of a hazard or if the system has demonstrated adequate performance and does not conflict with proposed improvements.

## TORT LIABILITY AND GEOMETRIC DESIGN

In recent years highway agency administrations have become increasingly concerned about the growth of tort claims. Such claims allege that highway agencies have committed a legal wrong by improper or negligent highway design, operation, or maintenance that became a cause or partial cause of a highway accident. Claims against highway agencies are part of a nationwide problem of rising liability insurance premiums and increasing costs of tort actions.

Studies indicate that the geometric design features covered in RRR standards are usually not the central focus of tort claims. Pavement features, traffic control devices, and roadside barriers account for the large majority of tort claims.

## BACKGROUND ON TORT LIABILITY

Tort is defined as a civil wrong or injury, and a tort action seeks repayment for damages to property and injuries to an individual. If a defendant is found negligent in his actions, or lack of action, he is liable for a tort claim and must compensate the plaintiff. State laws and rulings differ regarding tort claims against a governmental entity. In Virginia, as in most states, the courts or state legislatures have eliminated sovereign immunity (whereby an individual cannot sue the state or its agents for negligence).

Highway agencies are spending substantial sums as a result of tort claims. The costs of handling tort claims include not only the direct costs of judgment awards, settlements, and insurance, but also attorneys' fees and the cost of engineers' and other staff time.

Negligence can be alleged on two grounds particularly relevant to highway agencies:

- Agency (or person) improperly performs its duties (misfeasance).

- Agency (or person) fails to perform its duties (nonfeasance).

## RRR IMPROVEMENTS AND TORT CLAIMS

Little is known about how frequently the geometric features addressed by RRR design standards are cited in tort claims against highway agencies. Few states maintain data on tort claims by alleged defect. Further, classifying tort lawsuits is difficult because most involve several defects that differ in importance.

Geometric features (such as cross-sections, alignment, and intersections) usually covered by RRR standards account for a small percentage of total claims filed against highway agencies. Of the cases in which a geometric feature is at issue, horizontal and vertical curves are the most often cited.

Pavement features including edge drops, potholes, surface deterioration and slippery pavements, account for large amounts of the settlement costs.

## SUSCEPTIBILITY OF RRR PROJECTS AND STANDARDS TO TORT CLAIMS

The standards selected for RRR projects, the design process followed, and the scope of the improvements may influence the litigation of future tort claims. The issues that might arise in a tort action are:

- Did the project meet the appropriate design standards?
- Are the standards reasonable?
- Was the design process reasonable?
- Did the improvements correct existing dangers?

- Should unimproved roads be judged by standards used for roads that are unimproved?

The resolution of tort claims alleging an inadequate geometric design is contingent on determining the appropriate set of design standards used to assess negligence.

Determining whether a highway improvement project is sufficiently extensive to qualify as reconstruction can be a key issue in a tort claim because reconstruction projects usually must meet current new construction standards.

Deficient roadside signs or pavement markings and pavement edge-drop problems, which are often the basis of tort claims, can be routinely corrected on RRR projects.

## DEFENSE OF A RRR PROJECT DESIGN

Although planning and design activities are exempt from liability in most states, this immunity has been held not to apply to decisions made without prior study or conscious deliberation.

Documentation of the planning process should be part of the state highway agency's defense.

For RRR projects, documentation should demonstrate that safety aspects of the roadway design were properly considered. Reports that identify deficiencies in existing roadways are potentially threatening to the public agency preparing the report if the deficiencies are not addressed. Thus, if any exception to an applicable design standard was granted, documentation should explain the reasons for the exception and show that logic and orderly procedures were followed in obtaining it.

When a highway agency contemplates a design exception for a geometric or roadside feature, it should be prepared to prove why the feature need not meet the same standards as other facets of the roadway design. Often, the best defense in this situation is to demonstrate that the safety cost-effectiveness of further upgrading the feature does not meet any reasonable criteria.

Courts seldom rule that the unavailability of funds is justification for not correcting an alleged defect, but he issue of availability of funds can be part of the defense in relation to the agency's programming procedures.

The following points are important to such a defense:

- The agency is aware of the condition of its facilities
- Deficiencies have been ranked on a logical basis
- Given the existing funding, items are being corrected in the order of priority

> Appropriate warnings or other temporary measures should be used to alert the public that deficiencies have not been corrected. The highway agency can then affirm that it has performed its duties in the best way possible with the available resources.

In order to receive immunity for planning and design activities, a state must thoroughly document the design process in order to defend challenges.

A rational and orderly process must be followed if a plan or design is to be considered immune from claims of negligence. If a feature built during construction was not called for in the plans or was altered from the specifications, it is open to a claim of negligence in a tort action.

**RRR NOTES ON PROJECT TITLE SHEET**

For applicable projects, the following note shall be placed on the plan title sheet under the Functional Classification and Traffic Data Block:

NOTE: THESE PLANS WERE DESIGNED IN ACCORDANCE WITH VIRGINIA RRR GUIDELINES.

# SECTION A-5-BICYCLE FACILITY GUIDELINES

## INTRODUCTION

These guidelines consist of six sections:

A. INTRODUCTION
B. DOT POLICY ON PARTICIPATION IN THE DEVELOPMENT OF BICYCLE FACILITIES
C. SELECTING ROADWAY DESIGN TREATMENTS TO ACCOMMODATE BICYCLES; this report contains recommendations for bikeway design
D. VDOT/AASHTO DESIGN GUIDELINES; these include bicycle path design guidelines and minimum bikeway design guidelines
E. AASHTO APPROVED INTERSTATE BICYCLE ROUTES
F. RESOURCES (followed by conversions from Imperial units to metric units)

The Transportation Planning Division will recommend to the road designer the inclusion of a bikeway on a particular project. Discussion will take place at the scoping meeting concerning the expected type of bicyclist that will use the facility and the type of facility to be designed. The district, locality, Transportation Planning Division and other interested parties will provide input. Types of bicyclist include Group A, advanced; Group B, basic; and Group C, children. AASHTO designates bicycle facility types as Shared Roadway (No Bikeway Designation), Signed Shared Roadway, Bike Lane or Bicycle Lane and Shared Use Path. Individuals involved in the planning and design of bicycle facilities should be familiar with and refer to the latest Guide for the Development of Bicycle Facilities published by the American Association of State Highway and Transportation Officials. At the printing of these VDOT guidelines the date of the AASHTO Guide was 1999.

In rural and some urban sections of highway with scattered development, it is recommended that the facility be designed for Group A bicyclists. In developed areas near parks, schools, recreation areas, etc., it is recommended that the facility be designed for Group B, C bicyclists. Separate bike paths are recommended in areas where bicyclists are expected to be children, pre-teen or casual recreation riders.

Guidelines in SELECTING ROADWAY DESIGN TREATMENTS TO ACCOMMODATE BICYCLES are recommended as bikeway design criteria, but in no case will a bikeway be designed with criteria less than those contained in the VDOT/AASHTO DESIGN GUIDELINES. Bicycle facility design guidelines are available only in the VDOT/AASHTO DESIGN GUIDELINES section. One set of pertinent plans, profiles and typical sections on appropriate projects are to be provided to the Location and Design Bicycle Facilities Coordinator prior to Preliminary Engineering, Field Inspection and after related comments are received at public information meetings.

The procedure for planning and designing a bicycle facility is:

1. Select the type of bicyclist; A, B or C or a combination of these.
2. Select the roadway design treatment or type of facility.
3. Design the facility in accordance with the VDOT Guidelines: FHWA and AASHTO

**VDOT POLICY TO IMPROVE BICYCLE AND PEDESTRIAN ACCESS**

The Commonwealth Transportation Board (CTB) approved a new policy aimed at providing bicyclists and pedestrians greater access to safe transportation on roadways across the state. The policy became effect upon its adoption by the Board on March 18, 2004, and will apply to projects that reach the scoping phase after its adoption. This policy shall supersede all current department policies and procedures related to bicycle and pedestrian accommodations.

Highlights from the policy include:

- A framework through which VDOT will accommodate bicyclists and pedestrians, including pedestrians with disabilities, along with motorized transportation modes in the planning, funding, design, construction, operation, and maintenance of Virginia's transportation network to achieve a safe, effective, and balanced multimodal transportation system.

- Sidewalks, bike lanes, shared-use paths or other accommodations will be considered in the design of all new highway and major reconstruction projects, depending on safety issues and the need.

Project Managers should be familiar with the policy prior to starting the Project Development Process. The entire policy can be obtained at http://www.virginiadot.org/infoservice/resources/Policy%20on%20Integrating%20BP%20Accommodations.pdf

The following are a few excerpts from the policy:

The Virginia Department of Transportation (VDOT) will initiate all highway construction projects with the presumption that the projects shall accommodate bicycling and walking. VDOT will provide the leadership to implement this policy. During the decision process, the project manager and local representatives will, based on the factors listed in the policy, develop a recommendation on how and whether to accommodate bicyclists and pedestrians in a construction project prior to the public hearing. VDOT will promote the inclusion of bicycle and pedestrian accommodations in transportation planning activities at local, regional, and statewide levels. There are exceptions to the provision of accommodations.

Bicycle and pedestrian accommodations can be developed through projects that are independent of highway construction either within the highway right-of-way or on an independent right-of-way. Highway construction funds can be used to build bicycle and pedestrian accommodations either concurrently with highway construction projects or as independent transportation projects. Both types of bicycle and pedestrian accommodation projects will be funded in the same manner as other highway construction projects for each system (i.e., interstate, primary, secondary, or urban.

VDOT will work with localities to select and design accommodations, taking into consideration community needs, safety, and unique environmental and aesthetic characteristics as they relate to specific projects. The selection of the specific accommodations to be used for a project will be based on the application of appropriate planning design, and engineering principles. The accommodations will be designed and built, or installed, using guidance from VDOT and AASHTO publications, the MUTCD, and the Americans with Disabilities Act accessibility Guidelines (ADAAG). Methods for providing flexibility within safe design parameters, such as context sensitive solutions and design, will be considered.

During the preparations of an environmental impact statement (EIS), VDOT will consider the current and anticipated future use of the affected facilities by bicyclists and pedestrians, the potential impacts of the alternatives on bicycle and pedestrian travel, and proposed measures, if any, to avoid or reduce adverse impacts to the use of these facilities by bicyclists and pedestrians.

During project design VDOT will coordinate with the Virginia Department of Rail and Public Transportation (VDRPT) to address bicyclist and pedestrian access to existing and planned transit connections.

Requests for exceptions to design criteria must be submitted in accordance with VDOT's design exception review process. The approval of exceptions will be decided by the Federal Highway Administration or VDOT's Chief Engineer.

VDOT will ensure that accommodations for bicycling and walking are built in accordance with design plans and VDOT's construction standards and specifications.

## BICYCLE ACCESS FACILITIES

VDOT may participate in the development of bicycle access facilities to serve public recreational areas and historic sites based on the current Recreational Access Fund Policy.

## EXISTING ROADS

In some instances, for route continuity, bicycle facilities may be routed over existing facilities which are not planned for expansion. In these cases, the facilities are an operational feature and usually result in the identification of a bike lane, restriction of parking, or some other physical modification to accommodate bicycle travel. It is necessary for the Transportation Planning Engineer to coordinate with the District Administrator, the District Traffic Engineer, and appropriate Divisions in the Central Office to assure agreement on the method of treatment for a bikeway over an existing route. All the conditions of VDOT Bicycle Facility Participation Guidelines and VDOT Funding Guidelines need to be met except the bicycle facility is not required to be constructed concurrently with a highway construction project. VDOT's financial participation and funding will be the same as specified in VDOT Funding Guidelines.

## MAJOR DEVELOPMENTS AND SITE PLANS

When bicycle facilities are considered as part of the total development of a property where the road system will be maintained in the future by VDOT and the local government requires bikeways in new developments, the following conditions must be satisfied:

- The bicycle element of the entire plan for the development must be Reviewed and approved by the local government prior to final approval by the Transportation Planning Engineer. Appropriate Review must be made, and communication regarding the resolution of bicycle facility systems must be carried on between the Resident Engineer, District Traffic Engineer, and the Transportation Planning Engineer.

- Along any roadways identified in the site plan, which will be maintained in the future by VDOT, a bike path may be incorporated into the development parallel to but off of the right of way dedicated for street purposes. The maintenance and the responsibility for operating the bike path would fall on the owner, which would be the locality, the developer, or other entity with the responsibility of maintenance of the common land of the development and not the responsibility of VDOT. The bike path right of way will be exclusive of the road right of way; thus, future changes and/or modifications in the bike path would not be the responsibility of VDOT.

- Bikeways within the VDOT right of way shall be designed to meet AASHTO and VDOT guidelines.

For major developments and site plans where the road system will not be maintained in the future by VDOT, all bicycle facility connections to VDOT maintained facilities shall be subject to Review and approval by the District Administrator.

## SELECTING ROADWAY DESIGN TREATMENTS TO ACCOMMODATE BICYCLES

Choosing the appropriate facility type is important. No one type of bicycle facility or highway design suits every bicyclist. Within any given transportation corridor, bicyclists may be provided with more than one option to meet the travel and access needs of all potential users.

The choice of highway design will affect the level of use, the types of user that can be expected to use any given road, and the level of access and mobility that is afforded bicyclists. For example, a four-lane divided highway with 12-foot travel lanes, no shoulder and a 55 mph speed limit will attract only the most confident of riders. The same road with a 5-foot shoulder or bike lane might provide sufficient "comfortable operating space" for many more adult riders, but would still not be comfortable for children or less confident adults. This latter group might only be accommodated through an alternative route using neighborhood streets linked by short sections of shared use path. If such an alternative route is provided and the four-lane road has a continuous paved shoulder, most experienced and many casual adult riders will continue to use the shoulder for the sake of speed and convenience.

Facilities for bicyclists should also be planned to provide continuity and consistency for all users. Children using a path to get to school should not have to cross a major arterial without some intersection controls, and shoulders and bike lanes should not end abruptly and unannounced at a difficult intersection or busy stretch of highway.

The selection of a bicycle facility type is dependent on many factors, including the ability of the users, specific corridor conditions and facility cost. AASHTO designates bicycle facility types as Shared Roadway (No Bikeway Designation), Signed Shared Roadway, Bike Lane or Bicycle Lane and Shared Use Path. The following are explanations of when each of these facilities may be appropriate. Design parameters for these four types are discussed later in this publication.

- Shared Roadway (No Bikeway Designation) - Most bicycle travel in the United States now occurs on streets and highways without bikeway designations. In some instances, a community's existing street system may be fully adequate for efficient bicycle travel and signing and striping for bicycle use may be unnecessary. In other cases, some streets and highways may be unsuitable for bicycle travel at present, and it would be inappropriate to encourage bicycle travel by designating the routes as bikeways. Finally, some routes may not be considered high bicycle demand corridors, and it would be inappropriate to designate them as bikeways regardless of roadway conditions (e.g., minor residential streets).

- Some rural highways are used by touring bicyclists for inner city and recreational travel. In most cases, such routes should only be designated as bikeways where there is a need for enhanced continuity with other bicycle routes. However, the development and maintenance of 4-foot paved shoulders with a 4-inch edge stripe can significantly improve the safety and convenience of bicyclists and motorists along such routes.

- Signed Shared Roadway - Signed-shared roadways are designated by bike route signs, and serve either to provide continuity to other bicycle facilities (usually Bike Lanes) or designate preferred routes through high-demand corridors.

- Bike Lane or Bicycle lane - Bike lanes are established with appropriate pavement markings and signing along streets in corridors where there is significant bicycle demand and where there are distinct needs that can be served by them. The purpose should be to improve conditions for bicyclists on the streets. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. Bike lanes also help to increase the total capacities of highways carrying mixed bicycle and motor vehicle traffic.

- Shared Use Path - Generally, shared use paths should be used to serve corridors not served by streets and highways or where wide utility or former railroad right-of-way exists, permitting such facilities to be constructed away from the influence of parallel streets. Shared use paths should offer opportunities not provided by the road system. They can provide a recreational opportunity or, in some instances, can serve as direct commute routes if cross flow by motor vehicles and pedestrians is minimized.

The tables in this section contain roadway design treatments and widths to accommodate bicycles found in the Federal Highway Administration Report "Selecting Roadway Design Treatments to Accommodate Bicycles", Publication Number FHWA-RD-92-073 January 1994. The controlling feature in the design of every bicycle facility is its location, whether it is on the roadway or on an independent alignment. The FHWA Report describes five basic types of facilities to accommodate bicyclists. The Shared Lane or Wide Outside Lane types may be appropriate designs for AASHTO’s Shared Roadway (No Bikeway Designation) or Signed Shared Roadway types. The shoulder types may be appropriate designs for AASHTO’s Shared Roadway (No Bikeway Designation). The Separate Bike Path correlates to AASHTO’s Shared Use Path. The following are FHWA definitions of their five types of bicycle facilities:

- Shared Lane - Shared motor vehicle/bicycle use of a "standard" width travel lane.

- Wide Outside Lane (or wide curb lane) - An outside travel lane with a width of at least 14 feet.

- Bike Lane - A portion of the roadway designated by striping, signing, and/or pavement markings for preferential or exclusive use of bicycles. On urban projects the bike lane width is the distance from the face of the curb to the bike lane stripe. For VDOT projects, the bike lane stripe will lie 4 feet minimum from the edge of a gutter pan and 5 feet minimum from the face of curb.

- Shoulder - A paved portion of the roadway to the right of the edge stripe on which bicyclists may ride. These areas are not marked or signed as 'bike lanes'.

- Separate Bike Path - A facility physically separated from the roadway and intended for bicycle use.

The FHWA publication categorizes bicyclists into three groups. Group A are advanced bicyclists with experience who can operate under most traffic conditions. Group B are basic bicyclists who are casual or new adult and teenage riders with less confidence of their ability to operate in traffic without special provisions for bicycles. Group C, children, are pre-teen riders whose roadway use is initially monitored by parents.

Tables A-5-1 through A-5-6 indicate the appropriate design treatments given various sets of traffic operations and design factors. The design treatments are considered "desirable widths" by the FHWA. There are three basic types of roadway sections for bicycles; urban without parking, urban with parking, and rural. Controlled-access freeways are considered a special case and are not addressed by the tables.

Roadway improvements such as bicycle facilities depend on the roadway's design. Bicycle paths located on independent alignment depend on many factors, including the performance capabilities of the bicyclist and the bicycle. The following tables do not include any specific recommendations for separate bike paths and their design standards are addressed under VDOT/AASHTO Design Guidelines for Shared Use Paths.

| average motor vehicle operating speed | average annual daily traffic (AADT) volume | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | less than 2,000 | | | | 2,000-10,000 | | | | over 10,000 | | | |
| | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | |
| | | truck,bus,rv | truck,bus,rv | | | truck,bus,rv | truck,bus,rv | | | truck,bus,rv | truck,bus,rv | |
| less than 30 mph | sl 12 | sl 12 | wc 14 | wc 14 | sl 12 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 |
| 30-40 mph | wc 14 | wc 14 | wc 15 | wc 15 | wc 14 | wc 15 | wc 15 | wc 15 | wc 14 | wc 15 | wc 15 | wc 15 |
| 41-50 mph | wc 15 | wc 15 | wc 15 | wc 15 | wc 15 | wc 15 | sh 6 | sh 6 | wc 15 | wc 15 | sh 6 | sh 6 |
| over 50 mph | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 |

**TABLE A-5-1**

**GROUP A BICYCLISTS, URBAN SECTION, NO PARKING**

(widths are in feet)

For Table A-5-1: wc and sl widths represent “usable widths” of outer lanes, measured from lane stripe to edge of gutter pan, rather than to the face of curb. If no gutter pan is provided, add 1 ft. Minimum for shy distance from the face of curb.

Key: wc = wide curb lane; sh = shoulder; sl = shared lane; bl = bike lane; na = not applicable; truck, buses, and/or recreation vehicles (approximately 30 per hour or more)

| average motor vehicle operating speed | average annual daily traffic (AADT) volume | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | less than 2,000 | | | | 2,000-10,000 | | | | over 10,000 | | | |
| | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | |
| | | truck,bus,rv | | | | truck,bus,rv | | | | truck,bus,rv | | |
| less than 30 mph | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 15 | wc 15 | wc 14 |
| 30-40 mph | wc 14 | wc 14 | wc 15 | wc 15 | wc 14 | wc 15 | wc 15 | wc 15 | wc 14 | wc 15 | wc 15 | wc 15 |
| 41-50 mph | wc 15 | wc 15 | wc 15 | wc 15 | wc 15 | wc 16 | wc 16 | wc 16 | wc 15 | wc 15 | wc 16 | wc 16 |
| over 50 mph | na | na | na | na | na | na | na | na | na | na | na | na |

**TABLE A-5-2**

**GROUP A BICYCLISTS, URBAN SECTION, WITH PARKING**

(widths are in feet)

For Table A-5-2: wc widths represent “usable widths” of outer travel lanes, measured from the left edge of the parking space (8 to 10 ft. minimum from the curb face) to the left stripe of the travel lane.

Source: FHWA’s “Selecting Roadway Design Treatments to Accommodate Bicycles” dated 1994.

| average motor vehicle operating speed | average annual daily traffic (AADT) volume | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | less than 2,000 | | | | 2,000-10,000 | | | | over 10,000 | | | |
| | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | |
| | | truck,bus,rv | | | | truck,bus,rv | | | | truck,bus,rv | | |
| less than 30 mph | sl 12 | sl 12 | wc 14 | wc 14 | sl 12 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | sh 4 | sh 4 |
| 30-40 mph | wc 14 | wc 14 | sh 4 | sh 4 | wc 14 | wc 15 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 |
| 41-50 mph | sh 4 | sh 4 | sh 4 | sh 4 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 |
| over 50 mph | sh 4 | sh 6 | sh 6 | sh 4 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 |

**TABLE A-5-3**

**GROUP A BICYCLISTS, RURAL SECTION**

(widths are in feet)

For Table A-5-3: wc and sl widths represent “usable widths” of outer lanes, measured from lane stripe to edge of the pavement if a smooth, firm, level shoulder is adjacent. If rough or dropped pavement edges or a soft shoulder exists, add 1 ft. minimum for shy distance from the edge of the pavement.

Key: wc = wide curb lane; sh = shoulder; sl = shared lane; bl = bike lane; na = not applicable; truck, buses, and/or recreation vehicles (approximately 30 per hour or more)

| average motor vehicle operating speed | average annual daily traffic (AADT) volume | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | less than 2,000 | | | | 2,000-10,000 | | | | over 10,000 | | | |
| | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | |
| | | truck,bus,rv | | | | truck,bus,rv | | | | truck,bus,rv | | |
| less than 30 mph | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | bl 5 | bl 5 | bl 5 | bl 5 |
| 30-40 mph | bl 5 | bl 5 | bl 5 | bl 5 | bl 5 | bl 6 | bl 6 | bl 5 | bl 5 | bl 6 | bl 6 | bl 5 |
| 41-50 mph | bl 5 | bl 5 | bl 5 | bl 5 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 |
| over 50 mph | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 |

**TABLE A-5-4**

**GROUP B/C BICYCLISTS, URBAN SECTION, NO PARKING**

(widths are in feet)

For Table A-5-4: wc widths represent "usable widths" of outer lanes, measured from lane stripe to edge of gutter pan, rather than to the face of curb. If no gutter pan is provided, add 1 ft. minimum for shy distance from the face of curb. bl widths represent the minimum width from the curb face. For VDOT projects, the bike lane stripe will lie 4 feet minimum from the edge of the gutter pan. The bike lane stripe will lie 5 feet minimum from the face of curb.

Source: FHWA's "Selecting Roadway Design Treatments to Accommodate Bicycles" dated 1994.

| average motor vehicle operating speed | average annual daily traffic (AADT) volume | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | less than 2,000 | | | | 2,000-10,000 | | | | over 10,000 | | | |
| | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | |
| | | truck,bus,rv | | | | truck,bus,rv | | | | truck,bus,rv | | |
| less than 30 mph | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | wc 14 | bl 5 | bl 5 | bl 5 | bl 5 |
| 30-40 mph | bl 5 | bl 5 | bl 5 | bl 5 | bl 5 | bl 6 | bl 6 | bl 5 | bl 6 | bl 6 | bl 6 | bl 6 |
| 41-50 mph | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 | bl 6 |
| over 50 mph | na | na | na | na | na | na | na | na | na | na | na | na |

**TABLE A-5-5**

**GROUP B/C BICYCLISTS, URBAN SECTION,WITH PARKING**

(widths are in feet

For Table A-5-5: wc and sl widths represent "usable widths" of outer lanes, measured from the left edge of the parking space (8 to 10 ft. minimum from the curb face) to the left stripe of the travel lane.

Key: wc = wide curb lane; sh = shoulder;  sl = shared lane; bl = bike lane; na = not applicable; truck, buses. And/or recreation vehicles (approximately 30 per hour or more)

| average motor vehicle operating speed | average annual daily traffic (AADT) volume | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | less than 2,000 | | | | 2,000-10,000 | | | | over 10,000 | | | |
| | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | | adequate sight distance | | inadequate sight distance | |
| | | truck,bus,rv | | | | truck,bus,rv | | | | truck,bus,rv | | |
| less than 30 mph | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 |
| 30-40 mph | sh 4 | sh 4 | sh 4 | sh 4 | sh 4 | sh 6 | sh 6 | sh 4 | sh 6 | sh 6 | sh 6 | sh 6 |
| 41-50 mph | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 | sh 6 |
| over 50 mph | sh 6 | sh 6 | sh 6 | sh 6 | sh 8 | sh 8 | sh 8 | sh 8 | sh 8 | sh 8 | sh 8 | sh 8 |

**TABLE A-5-6**

**GROUP B/C BICYCLISTS, RURAL SECTION**

(widths are in feet)

Source: FHWA's "Selecting Roadway Design Treatments to Accommodate Bicycles" dated 1994

## VDOT/AASHTO DESIGN GUIDELINES

The following design guidelines are to assist in the design of bicycle facilities and have been obtained from AASHTO's 1999 "Guide for the Development of Bicycle Facilities" and in combination with VDOT Policy. Only key information from AASHTO's Guide are contained in this VDOT publication. Individuals involved in the planning and design of bicycle facilities should be familiar with and refer to the latest AASHTO Guide for additional information. AASHTO criteria will be considered as "minimum criteria" by designers. These design guidelines consider four types of bicycle facilities: Shared Roadway (No Bikeway Designation), Signed Shared Roadway, Bike Lane or Bicycle Lane and Shared Use Path.

When bicycle facilities are proposed, the roadway conditions will be examined for potential problems specific to bicyclists. Safe drainage grates and railroad crossings, smooth pavements, and signals responsive to bicycles will be provided where warranted. Drainage grate inlets and utility covers in particular are potential problems to bicyclists and should be located in a manner which will minimize severe and/or frequent maneuvering by the bicyclist. When a new roadway is designed, all such grates and covers should be out of the bicyclists' expected path.

## SHARED ROADWAYS

The most critical variable affecting the ability of a roadway to accommodate bicycle traffic is width. Adequate width may be achieved by providing paved shoulders or wide outside lanes.

Paved Shoulders

Paved shoulders should be at least 4 feet wide to accommodate bicycle travel. However, where 4 foot widths cannot be provided, any additional shoulder width is better than none at all. A shoulder width of 5 feet is recommended from the face of guardrail, curb or other roadside barriers. It is desirable to increase the width of shoulders where higher bicycle usage is expected. Additional shoulder width is also desirable if motor vehicle speeds exceed 50 mph, or the percentage of trucks, buses, and recreational vehicles is high, or if static obstructions exist at the right side of the roadway.

On rural and urban collector and local roads and streets, provide minimum 4 foot wide paved shoulders when:

a) Design Year ADT > 2000 VPD, with ≥ 5% total truck and bus usage

or

b) The route is an AASHTO Approved Interstate Bicycle Route or designated as a bicycle route on a Locality's Thoroughfare Plan and the graded shoulder width is 6 feet or greater.

For the above situations, the remainder of the shoulder will be topsoil and seeded.

AASHTO's recommendations for shoulder width (as described in *A Policy on Geometric Design of Highways and Streets)* are the best guide for bicycles as well, since wider shoulders are recommended on heavily traveled and high-speed roads and those carrying large numbers of trucks. In order to be usable by bicyclists, the shoulder must be paved.

Rumble strips or raised pavement markers, where installed to discourage or warn motorists they are driving on the shoulder, are not recommended where shoulders are used by bicyclists unless there is a minimum clear path of 1 foot from the rumble strip to the traveled way, 4 feet from the rumble strip to the outside edge of paved shoulder, or 5 feet to adjacent guardrail, curb or other obstacle. If existing conditions preclude achieving the minimum desirable clearance, the width of the rumble strip may be decreased or other appropriate alternative solutions should be considered. VDOT's policy is to not install pavement markers along the outside edge line of a travelway.

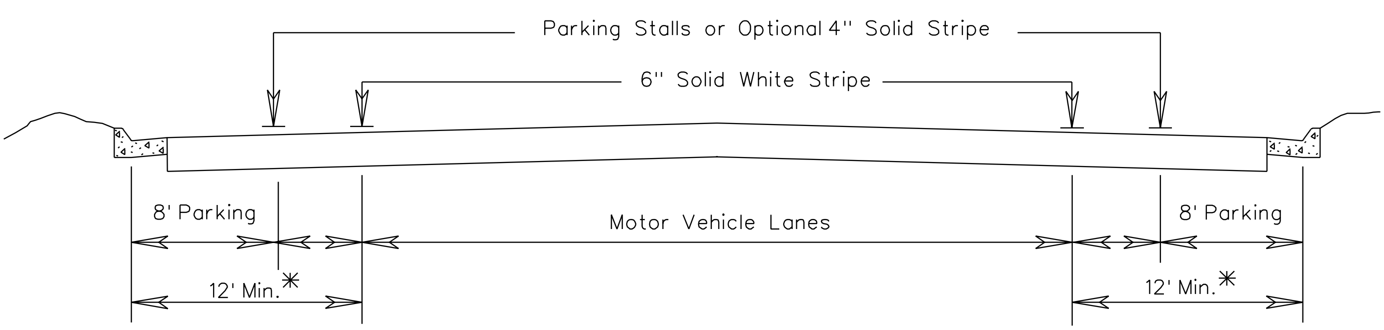
Wide Outside Lanes

Wide outside lanes for bicycle use are usually preferred where shoulders are not provided, such as in restrictive urban areas. On highway sections without designated bikeways, an outside or curb lane wider than 12 feet can better accommodate both bicycles and motor vehicles in the same lane and thus is beneficial to both bicyclists and motorists.

In general 14 feet of usable lane width is the recommended width for shared use in a wide outside lane. Usable width normally would be from edge stripe to lane stripe or from the longitudinal joint of the gutter pan to lane stripe (the gutter pan should not be included as usable width). On stretches of roadway with steep grades where bicyclists need more maneuvering space, the wide outside lane should be slightly wider where practicable (15 feet is preferred). The 15 foot width may also be necessary in areas where drainage grates, raised reflectors on the right-hand side of the road, or on-street parking effectively reduce the usable width. With these exceptions in mind, widths greater than 14 feet that extend continuously along a stretch of roadway may encourage the undesirable operation of two motor vehicles in one lane, especially in urban areas, and therefore are not recommended. In situations where more than 15 feet of pavement width exists, consideration should be given to striping bike lanes or shoulders.

- On-Street Parking

When there is on-street parking on urban roadways, the bicycle riding location is in the area between parked cars and moving motor vehicles. 12 feet of combined bicycle travel and parking width should be the minimum considered for this type of shared use. Striping should be provided to delineate the parking stalls. (See Figure A-5-1)




T13 feet is recommended where there is substantial parking or turn over of parked cars is high (e.g. commercial areas)

**PARKING PERMITTED WITH PARKING STRIPE**

(Bike lane not designated or marked)

**FIGURE A-5-1**

## SIGNED SHARED ROADWAYS

The distinction between shared roadways and signed shared roadways is that signed are those that have been identified by signing as preferred bike routes.

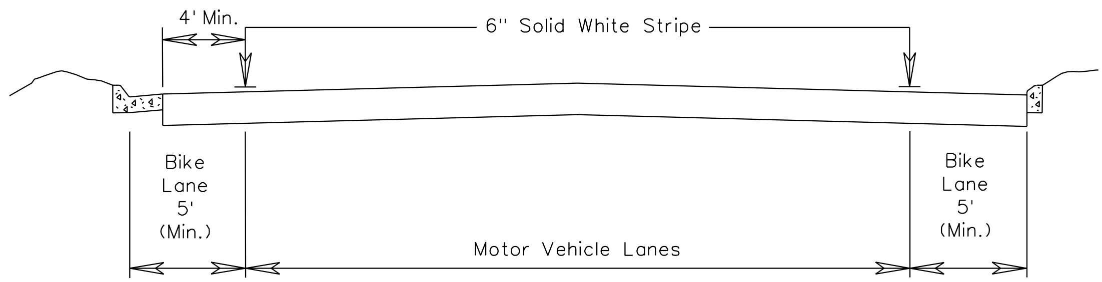
## BIKE LANES

Bike lanes are incorporated into a roadway design when it is desirable to delineate available road space for use by bicyclists and motorists. Delineating bike lanes is not recommended within a required paved shoulder area. Urban settings will typically use a bike lane to accommodate bicyclists. Rural areas will normally make use of a 4' minimum paved shoulder to accommodate bicyclists. Drainage grates, railroad crossings, traffic control devices, etc must be evaluated and modified if necessary for bicycle use.

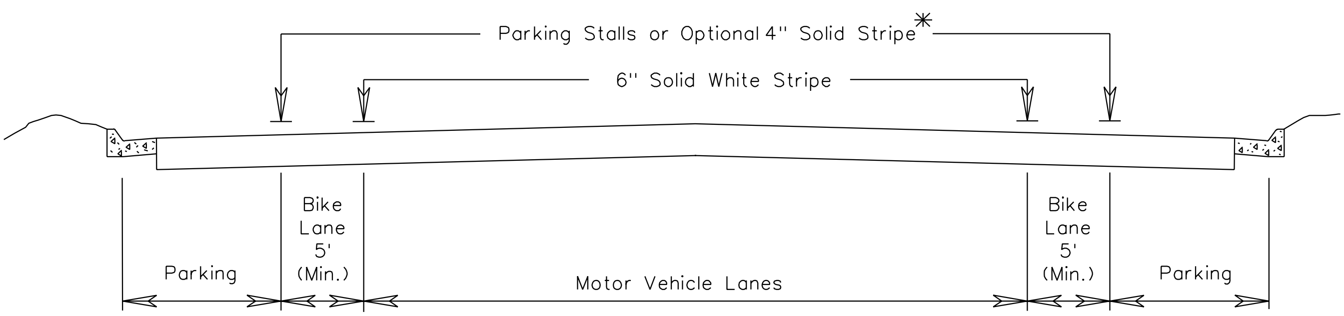
Bike lanes should be one-way facilities and carry bike traffic in the same direction as adjacent motor vehicle traffic. Two-way bike lanes on one side of the roadway are not recommended when they result in bicycle riding against the flow of motor vehicle traffic. In general, on one-way streets, a bike lane should be placed only on the right side of the street.

(1) BIKE LANES

(With Curb and Gutter) (Without Gutter)




(2) BIKE LANES WITH ON-STREET PARKING




[T]The optional solid white stripe may be advisable where stalls are unnecessary (because parking is light) but there is concern that motorists may misconstrue the bike lane to be a traffic lane.

**TYPICAL BIKE LANE CROSS SECTIONS**

**FIGURE A-5-2**

- Bike Lane Widths

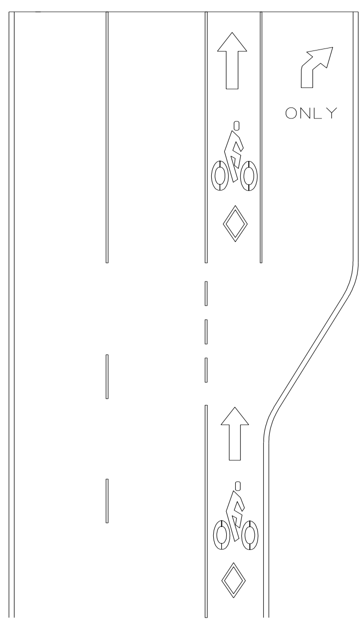
The recommended width of a bike lane is 5 feet from the face of a curb to the bike lane stripe on roadways without a gutter pan. The recommended width of a bike lane is 4 feet from the edge of pavement to the bike lane stripe on curb and gutter roadways. Greater bike lane widths are desirable where substantial truck traffic is present, or where motor vehicle speeds exceed 50 mph. Where vehicle traffic volume is high or substantial truck, bus or recreational vehicle traffic is present or speeds warrant, 6 feet minimum is appropriate to the bike lane stripe from the face of curb. Figure A-5-2, Section (2), depicts a bike lane along the outer portion of an urban curbed street where parking is prohibited.

Bicyclists tend to ride a distance of 32 to 40 inches from a curb face and it is important that the surface in this area be smooth and free of structures. Drain inlets and utility covers that extend into this area may cause bicyclists to swerve, and have the effect of reducing the usable width of the lane. Where these structures exist, the bike lane width may need to be adjusted accordingly.

If parking is permitted, as in Figure A-5-2, Section (2), the bike lane should be placed between the parking area and the travel lane and have a minimum width of 5 feet. Bike lanes should never be placed between the parking lane and curb line.

Bike Lanes and Turning Lanes

Bike lanes complicate bicycle and motor vehicle turning movements at intersections. It is preferable to continue the same width of bike lane through the intersection. Locations where a bike lane approaches an intersection (4 feet from the edge of pavement on a curb and gutter roadway), the 4 foot wide section should continue parallel to the left of a right turn lane.




**RIGHT TURN ONLY LANE**

**FIGURE A-5-3**

- Bicycle Lanes Approaching Right-Turn-Only Lanes

NOTES: For other intersection situations see the AASHTO Guide for the Development of Bicycle Facilities. For current typical bicycle lane pavement markings see <u>VDOT Road and Bridge Standards</u> or current insertable sheets.

Figure A-5-3 presents a treatment for pavement markings where a bike lane approaches a motorist right-turn-only lane. The design of bike lanes should include appropriate signing at intersections to warn of conflicts. The approach shoulder width should be provided through the intersection, where feasible, to accommodate right turning bicyclists or bicyclists who prefer to use crosswalks to negotiate the intersection.

## SHARED USE PATHS

Shared use paths are facilities on exclusive right-of-way and with minimal cross flow by motor vehicles. Users are non-motorized and may include bicyclists, inline skaters, roller skaters, wheelchair users (both non-motorized and motorized) and pedestrians including walkers, runners, and people with baby strollers and people waking dogs. Shared use paths are most commonly designed for two-way travel, and the following guidance assumes a two-way facility is planned unless otherwise stated. When paths are planned, it is desirable to provide paths on both sides of the roadway to decrease the likelihood of children crossing the road. Pavement design for shared use paths are recommended by the Materials Division.

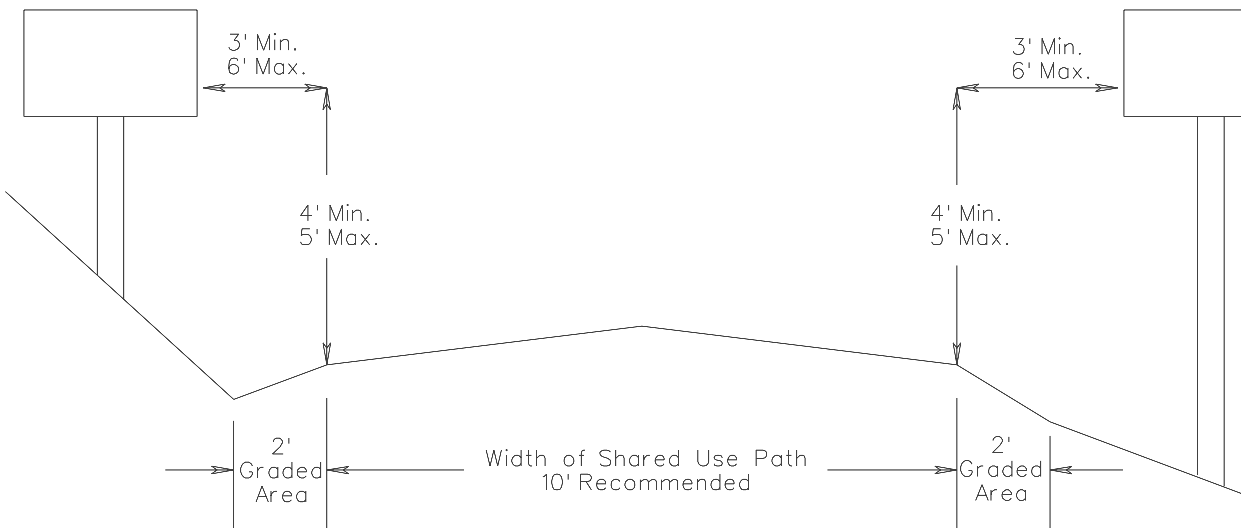
- Separation Between Shared Use Paths and Roadways

  When two-way shared use paths are located adjacent to a roadway, wide separation between a shared use path and the adjacent highway is desirable to demonstrate to both the bicyclist and the motorist that the path functions as an independent facility for bicyclists and others. When this is not possible and the distance between the edge of the shoulder and the shared use path is less than 5 feet, a suitable physical barrier is recommended. On curb or curb and gutter roadways, when the distance between the travel way (edge of pavement) and the shared use path is less than 5 feet (7 feet recommended for new construction), a suitable physical barrier is recommended. Consideration should be given to future signs or mailboxes, which may require additional clearance. Such barriers serve both to prevent path users from making unwanted movements between the path and the highway shoulder and to reinforce the concept that the path is an independent facility. Where used, the barrier should be a minimum of 42 inches high (54 inches on structures), to prevent bicyclists from toppling over it. A barrier between a shared use path and adjacent highway should not impair sight distance at intersections, and should be designed to not be a hazard to motorists or bicyclist.

- Width and Clearance

  The paved width and the operating width required for a shared use path are primary design considerations. Under most conditions, a recommended paved width for a two-directional shared use path is 10 feet. In rare instances, a reduced width of 8 feet can be adequate. This reduced width should be used only where the following conditions prevail:

(1) bicycle traffic is expected to be low, even on peak days or during peak hours
(2) pedestrian use of the facility is not expected to be more than occasional
(3) there will be good horizontal and vertical alignment providing safe and frequent passing opportunities
(4) during normal maintenance activities the path will not be subjected to maintenance vehicle loading conditions that would cause pavement edge damage. Under certain conditions it may be necessary or desirable to increase the width of a shared use path to 12 feet, or even 14 feet, due to substantial use by bicycles, joggers, skaters and pedestrians, use by large maintenance vehicles, and steep grades.




**CROSS SECTION OF TWO-WAY SHARED USE PATH ON SEPARATED RIGHT OF WAY**

**FIGURE A-5-4**

The minimum width of a one-directional shared use path is 6 feet. A one-way path would rarely be designed and only in a special situation. It should be recognized that one-way paths often would be used as two-way facilities unless effective measures are taken to assure one-way operation. Without such enforcement, it should be assumed that shared use paths would be used as two-way facilities by both pedestrians and bicyclists and designed accordingly.

A minimum 2 foot wide graded area should be maintained adjacent to both sides of the path. A minimum 3 foot clearance should be maintained from the edge of the path to signs, trees, poles, walls, fences, guardrail, or other lateral obstructions. Where the path is adjacent to canals, ditches or slopes steeper than 1:3, a wider separation should be considered. A minimum 5 foot separation from the edge of the path pavement to the top of slope is desirable.

Where a slope of 1:2 or greater exist within 5 feet of a path and the fill is greater than 10 feet, a physical barrier such as dense shrubbery, railing or chain link fence should be provided along the top of slope. Other situations may also dictate a physical barrier, such as the height of embankment and condition at the bottom.

The vertical clearance to obstructions should be a minimum of 8 feet. However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In undercrossings and tunnels, 10 feet is desirable for adequate vertical shy distance.

- Design Speed

Shared use paths should be designed for a selected speed that is at least as high as the preferred speed of the faster bicyclists. In general, a minimum design speed 20 mph should be used. When a downgrade exceeds 4 percent, or where strong prevailing tailwinds exist, a design speed of 30 mph or more is advisable.

- Horizontal Alignment

Most shared use paths built in the United States must also meet the requirements of the Americans with Disabilities Act, ADA guidelines require that cross slopes not exceed 2% to 3% to avoid the severe difficulties that greater cross slopes can create for people using wheelchairs. Thus, for most shared use paths, the maximum superelevation rate will be 3%. When transitioning a 3% superelevation, a minimum 25 foot transition distance should be provided between the end and beginning of consecutive and Reversing horizontal curves.

The coefficient of friction depends upon speed; surface type, roughness, and condition; tire type and condition; and whether the surface is wet or dry. Extrapolating from values used in highway design, design friction factors for paved shared use paths can be assumed to vary from 0.31 at 12 mph to 0.21 at 30 mph.

Based upon various design speeds of 12 to 30 mph and a desirable maximum lean angle of 15°, minimum radii of curvature for a paved path can be selected from Table A-5-7:

| Design Speed (V) (mph) | Minimum Radius ® (feet) |
|---|---|
| 12 | 36 |
| 20 | 100 |
| 25 | 156 |
| 30 | 225 |

**Desirable Minimum Radii for Paved Shared Use PATHS BASED ON 15° LEAN ANGLE**

**TABLE A-5-7**

- Grade

Grades on shared use paths should be kept to a minimum, especially on long inclines. Grades greater than 5 percent are undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent or comfortable. On some shared use paths, where terrain dictates, designers may need to exceed the 5% grade recommended for bicycles for some short sections. For a general guide maximum grade lengths where the grade must exceed 5% see Table A-5-8.

| | |
|---|---|
| 5 to 6% | **For up to 800 feet** |
| 7% | For up to 400 feet |
| 8% | For up to 300 feet |
| 9% | For up to 200 feet |
| 10% | For up to 100 feet |
| 11+% | For up to 50 feet |

**MAXIMUM GRADE LENGTHS**

**TABLE A-5-8**

- Sight Distance

The following charts indicate the minimum stopping sight distance for various design speeds and grades based on a total perception and brake reaction time of 2.5 seconds and a coefficient of friction of 0.25 to account for the poor wet weather braking characteristics of many bicycles. For two-way shared use paths, the sight distance in the descending direction, that is, where "G" is negative, will control the design.

Sight Distance Descending Grade (ft/ft)

| | 0% | 1% | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 10% | 11% | 12% | 13% | 14% | 15% | 16% | 17% | 18% | 19% | 20% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 mph | 27 | 27 | 27 | 27 | 28 | 28 | 28 | 29 | 29 | 30 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 37 | 39 | 42 | 46 |
| 12 mph | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 74 | 76 | 78 | 81 | 84 | 88 | 92 | 97 | 104 | 113 | 124 | 140 |
| 20 mph | 127 | 129 | 131 | 134 | 137 | 140 | 144 | 147 | 152 | 157 | 162 | 169 | 176 | 185 | 195 | 207 | 222 | 240 | 264 | 296 | 340 |
| 25 mph | 175 | 179 | 182 | 186 | 191 | 196 | 201 | 207 | 214 | 222 | 231 | 241 | 252 | 265 | 281 | 300 | 323 | 352 | 389 | 439 | 508 |
| 30 mph | 230 | 235 | 241 | 246 | 253 | 260 | 268 | 277 | 287 | 298 | 310 | 324 | 341 | 360 | 383 | 410 | 443 | 485 | 539 | 610 | 710 |

**MINIMUM STOPPING SIGHT DISTANCE (FT.) DESCENDING GRADE**

**TABLE A-5-9**

Sight Distance Ascending Grade (ft/ft)

| | 0% | 1% | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 10% | 11% | 12% | 13% | 14% | 15% | 16% | 17% | 18% | 19% | 20% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 mph | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| 12 mph | 63 | 63 | 62 | 61 | 61 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 57 | 57 | 56 | 56 | 56 | 55 | 55 | 55 | 55 |
| 20 mph | 127 | 125 | 123 | 121 | 119 | 118 | 116 | 115 | 114 | 113 | 111 | 110 | 109 | 108 | 108 | 107 | 106 | 105 | 104 | 104 | 103 |
| 25 mph | 175 | 172 | 169 | 166 | 164 | 161 | 159 | 157 | 155 | 153 | 151 | 150 | 148 | 147 | 145 | 144 | 143 | 141 | 140 | 139 | 138 |
| 30 mph | 230 | 225 | 221 | 217 | 214 | 210 | 207 | 204 | 201 | 198 | 196 | 193 | 191 | 189 | 187 | 185 | 183 | 182 | 180 | 178 | 177 |

**MINIMUM STOPPING SIGHT DISTANCE (FT.) ASCENDING GRADE**

**TABLE A-5-10**

$$S = \frac{V^2}{30\,(f \pm G)} + 3.67\,V$$

Where: S = stopping sight distance (feet)
V = velocity (mph)
F = coefficient of friction (use 0.25)
G = grade (ft/ft) (rise/run)

Table A-5-11 indicates the minimum length of vertical curve necessary to provide minimum stopping sight distance at various speeds on crest vertical curves. The eye height of the bicyclist is assumed to be 4.5 feet and the object height is assumed to be 0 inches to recognize that impediments to bicycle travel exist at pavement level.

| A | "S" = Stoppping Sight Distance (feet) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (%) | **20** | **40** | **60** | **80** | **100** | **120** | **140** | **160** | **180** | **200** | **220** | **240** | **260** | **280** | **300** |
| **2** | | | | | | | | | | | | 30 | 70 | 110 | 150 |
| **3** | | | | | | | | 20 | 60 | 100 | 140 | 180 | 220 | 260 | 300 |
| **4** | | | | | | 15 | 55 | 95 | 135 | 175 | 215 | 256 | 300 | 348 | 400 |
| **5** | | | | | 20 | 60 | 100 | 140 | 180 | 222 | 269 | 320 | 376 | 436 | 500 |
| | | | | | | | | | | | | | | | |
| **6** | | | | 10 | 50 | 90 | 130 | 171 | 216 | 267 | 323 | 384 | 451 | 523 | 600 |
| **7** | | | | 31 | 71 | 111 | 152 | 199 | 252 | 311 | 376 | 448 | 526 | 610 | 700 |
| **8** | | | 8 | 48 | 88 | 128 | 174 | 228 | 288 | 356 | 430 | 512 | 601 | 697 | 800 |
| **9** | | | 20 | 60 | 100 | 144 | 196 | 256 | 324 | 400 | 484 | 576 | 676 | 784 | 900 |
| **10** | | | 30 | 70 | 111 | 160 | 218 | 284 | 360 | 444 | 538 | 640 | 751 | 871 | 1000 |
| | | | | | | | | | | | | | | | |
| **11** | | | 38 | 78 | 122 | 176 | 240 | 313 | 396 | 489 | 592 | 704 | 826 | 958 | 1100 |
| **12** | | 5 | 45 | 85 | 133 | 192 | 261 | 341 | 432 | 533 | 645 | 768 | 901 | 1045 | 1200 |
| **13** | | 11 | 51 | 92 | 144 | 208 | 283 | 370 | 468 | 578 | 699 | 832 | 976 | 1132 | 1300 |
| **14** | | 16 | 56 | 100 | 156 | 224 | 305 | 398 | 504 | 622 | 753 | 896 | 1052 | 1220 | 1400 |
| **15** | | 20 | 60 | 107 | 167 | 240 | 327 | 427 | 540 | 667 | 807 | 960 | 1127 | 1307 | 1500 |
| | | | | | | | | | | | | | | | |
| **16** | | 24 | 64 | 114 | 178 | 256 | 348 | 455 | 576 | 711 | 860 | 1024 | 1202 | 1394 | 1600 |
| **17** | | 27 | 68 | 121 | 189 | 272 | 370 | 484 | 612 | 756 | 914 | 1088 | 1277 | 1481 | 1700 |
| **18** | | 30 | 72 | 128 | 200 | 288 | 392 | 512 | 648 | 800 | 968 | 1152 | 1352 | 1568 | 1800 |
| **19** | | 33 | 76 | 135 | 211 | 304 | 414 | 540 | 684 | 844 | 1022 | 1216 | 1427 | 1655 | 1900 |
| **20** | | 35 | 80 | 142 | 222 | 320 | 436 | 569 | 720 | 889 | 1076 | 1280 | 1502 | 1742 | 2000 |
| | | | | | | | | | | | | | | | |
| **21** | | 37 | 84 | 149 | 233 | 336 | 457 | 597 | 756 | 933 | 1129 | 1344 | 1577 | 1829 | 2100 |
| **22** | | 39 | 88 | 156 | 244 | 352 | 479 | 626 | 792 | 978 | 1183 | 1408 | 1652 | 1916 | 2200 |
| **23** | | 41 | 92 | 164 | 256 | 368 | 501 | 654 | 828 | 1022 | 1237 | 1472 | 1728 | 2004 | 2300 |
| **24** | 3 | 43 | 96 | 171 | 267 | 384 | 523 | 683 | 864 | 1067 | 1291 | 1536 | 1803 | 2091 | 2400 |
| **25** | 4 | 44 | 100 | 178 | 278 | 400 | 544 | 711 | 900 | 1111 | 1344 | 1600 | 1878 | 2178 | 2500 |

Heavy line represents S = L

when S > L $L = 2S - \frac{900}{A}$

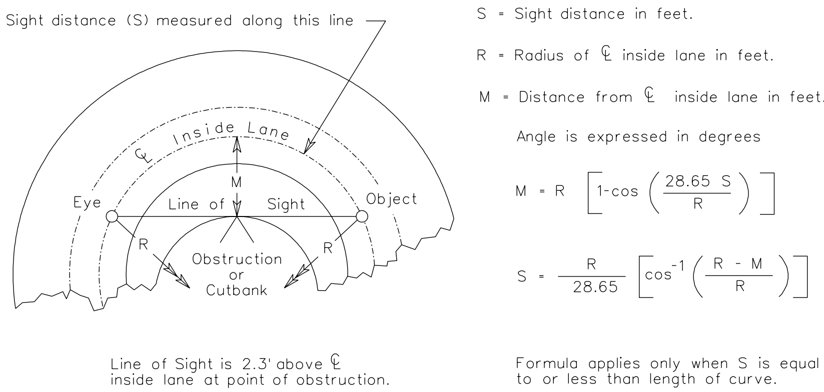
L = Minimum Length of Vertical Curve (feet)
A = Algebraic Grade Difference (%)
S = Stopping Sight Distance (feet)
Minimum Length of Vertical Curve = 3 feet

when S < L $L = AS^2/900$
Height of cyclist eye – 4.5 feet
Height of object – 0 feet

**MINIMUM LENGTH OF CREST VERTICAL CURVE (L) BASED ON STOPPING SIGHT DISTANCE**

**TABLE A-5-11**

Figure A-5-5 and Table A-5-12 indicate the minimum clearance that should be used to line of sight obstructions for horizontal curves. The lateral clearance is obtained from the stopping sight distance and the proposed horizontal radius of curvature. The stopping sight distance is obtained from Table A-5-9 and Table A-5-10.




Formula applies only when S is equal to or less than length of curve.
Line of sight is 2.3 feet above centerline of inside lane at point of obstruction.

**FIGURE A-5-5**

| **R** | **"S" = Stopping Sight Distance (feet)** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(feet)** | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 |
| **25** | 2.0 | 7.6 | 15.9 | | | | | | | | | | | | |
| **50** | 1.0 | 3.9 | 8.7 | 15.2 | 23.0 | 31.9 | 41.5 | | | | | | | | |
| **75** | 0.7 | 2.7 | 5.9 | 10.4 | 16.1 | 22.8 | 30.4 | 38.8 | 47.8 | 57.4 | 67.2 | | | | |
| **95** | 0.5 | 2.1 | 4.7 | 8.3 | 12.9 | 18.3 | 24.7 | 31.8 | 39.5 | 48.0 | 56.9 | 66.3 | 75.9 | 85.8 | |
| **125** | 0.4 | 1.6 | 3.6 | 6.3 | 9.9 | 14.1 | 19.1 | 24.7 | 31.0 | 37.9 | 45.4 | 53.5 | 61.7 | 70.6 | 79.7 |
| **155** | 0.3 | 1.3 | 2.9 | 5.1 | 8.0 | 11.5 | 15.5 | 20.2 | 25.4 | 31.2 | 37.4 | 44.2 | 51.4 | 59.1 | 67.1 |
| **175** | 0.3 | 1.1 | 2.6 | 4.6 | 7.1 | 10.2 | 13.8 | 18.0 | 22.6 | 27.8 | 33.5 | 39.6 | 46.1 | 53.1 | 60.5 |
| **200** | 0.3 | 1.0 | 2.2 | 4.0 | 6.2 | 8.9 | 12.1 | 15.8 | | 24.5 | 29.5 | 34.9 | 40.8 | 47.0 | 53.7 |
| **225** | 0.2 | 0.9 | 2.0 | 3.5 | 5.5 | 8.0 | 10.8 | 14.1 | 17.8 | 21.9 | 26.4 | 31.3 | 36.5 | 42.2 | 48.2 |
| **250** | 0.2 | 0.8 | 1.8 | 3.2 | 5.0 | 7.2 | 9.7 | 12.7 | 16.0 | 19.7 | 23.8 | 28.3 | 33.1 | 38.2 | 43.7 |
| **275** | 0.2 | 0.7 | 1.6 | 2.9 | 4.5 | 6.5 | 8.9 | 11.6 | 14.6 | 18.0 | 21.7 | 25.8 | 30.2 | 34.9 | 39.9 |
| **300** | 0.2 | 0.7 | 1.5 | 2.7 | 4.2 | 6.0 | 8.1 | 10.6 | 13.4 | 16.5 | 19.9 | 23.7 | 27.7 | 32.1 | 36.7 |
| **350** | 0.1 | 0.6 | 1.3 | 2.3 | 3.6 | 5.1 | 7.0 | 9.1 | 11.5 | 14.2 | 17.1 | 20.4 | 23.9 | 27.6 | 31.7 |
| **390** | 0.1 | 0.5 | 1.2 | 2.1 | 3.2 | 4.6 | 6.3 | 8.2 | 10.3 | 12.8 | 15.4 | 18.3 | 21.5 | 24.9 | 28.5 |
| **500** | 0.1 | 0.4 | 0.9 | 1.6 | 2.5 | 3.6 | 4.9 | 6.4 | 8.1 | 10.0 | 12.1 | 14.3 | 16.8 | 19.5 | 22.3 |
| **565** | | 0.4 | 0.8 | 1.4 | 2.2 | 3.2 | 4.3 | 5.7 | 7.2 | 8.8 | 10.7 | 12.7 | 14.9 | 17.3 | 19.8 |
| **600** | | 0.3 | 0.8 | 1.3 | 2.1 | 3.0 | 4.1 | 5.3 | 6.7 | 8.3 | 10.1 | 12.0 | 14.0 | 16.3 | 18.7 |
| **700** | | 0.3 | 0.6 | 1.1 | 1.8 | 2.6 | 3.5 | 4.6 | 5.8 | 7.1 | 8.6 | 10.3 | 12.0 | 14.0 | 16.0 |
| **800** | | 0.3 | 0.6 | 1.0 | 1.6 | 2.2 | 3.1 | 4.0 | 5.1 | 6.2 | 7.6 | 9.0 | 10.5 | 12.2 | 14.0 |
| **900** | | 0.2 | 0.5 | 0.9 | 1.4 | 2.0 | 2.7 | 3.6 | 4.5 | 5.6 | 6.7 | 8.0 | 9.4 | 10.9 | 12.5 |
| **1000** | | 0.2 | 0.5 | 0.8 | 1.3 | 1.8 | 2.4 | 3.2 | 4.0 | 5.0 | 6.0 | 7.2 | 8.4 | 9.8 | 11.2 |

**MINIMUM LATERAL CLEARANCE (M) FOR HORIZONTAL CURVES**

**TABLE A-5-12**

Bicyclists frequently ride side-by-side on shared use paths, and on narrow paths bicyclists have a tendency to ride near the middle of the path. For these reasons, and because of the higher potential for bicycle crashes, lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists traveling in opposite directions around the curve. Where this is not possible or feasible, consideration should be given to widening the path through the curve, installing a yellow center line stripe, installing a “Curve Ahead” warning sign in accordance with the MUTCD, or some combination of these alternatives.

- Path-Roadway Intersections

Intersections between paths and roadways are often the most critical issue in shared use path design. Due to the potential conflicts at these junctions, careful design is of paramount importance to the safety of path users and motorists. Solutions are provided in the AASHTO guide and should be considered as guidelines, and not as absolutes. Each intersection is unique, and will require sound engineering judgment on the part of the designer as to the appropriate solution. Shared use paths should cross roadways as close to an intersecting road as practical, however, in no case should the crossing be closer than 4 feet from the edge of the parallel travelway. As the Path approaches the crossing it should be aligned with the destination of the crossing on the other side of the road. Curb cuts should be appropriately aligned and be the same width as the path. The crossing should also be perpendicular (or nearly so) to the road being crossed. Normally, two curb cuts are recommended at each corner where a path crosses an intersection. Sight distance should be evaluated and sound engineering judgement must be used in locating crossings. There may be situations, such as low traffic volumes where the crossing should be located further from the intersection.

When a shared use trail intersects a road, with no sidewalk, the trail should slope to a relatively level (1%$\pm$ slope) area at the road elevation and the curb opening should be the same width as the trail. This layout would be similar to the Typical Alternate Plan seen in VDOT’s CG-12 Standard. The level area should be of exposed aggregate. If a sidewalk exist along the road, then the sidewalk must also slope to the same relatively level area at the road elevation.

When a paved shared use path or trail crosses a gravel road or drive, the road or drive should be paved a minimum of 3 feet, on each side of the path or trail.

- Signing and Marking

Adequate signing and marking are essential on shared use paths, especially to alert bicyclists to potential conflicts and to convey regulatory messages to both bicyclists and motorists at highway intersections. In addition, guide signing, such as to indicate directions, destinations, distances, route numbers and names of crossing streets, should be used in the same manner as they are used on highways. In general, uniform application of traffic control devices, as described in the MUTCD, provides minimum traffic control measures which should be applied.

- Pavement Structure

Hard, all weather pavement surfaces are preferred over those of crushed aggregate, sand, clay, or stabilized earth since these materials provide a much lower level of service and require higher maintenance.

- Structures

On new structures, the minimum clear width should be the same as the approach paved shared use path, plus the minimum 2 foot wide clear areas on both sides of the path. Carrying the clear areas across the structures provides a minimum horizontal shy distance from the railing or barrier and it provides needed maneuvering space to avoid conflicts with pedestrians and other bicyclists who are stopped on the bridge. The typical section, including the shared use path and the 2 foot wide clear areas, may be modified by the State Structure and Bridge Engineer because of expected low bicycle volume, budget considerations, or other reasons. Railings, fences, or barriers on both sides of a path on a structure shall be a minimum of 54 inches (4.5 feet) high. In situations where the structure crosses a high speed or high volume road and objects are subject to being thrown (dangerously) off the structure, it maybe desirable to totally enclose the path with fencing. Totally enclosing a path may also be desirable in other areas such as a waterway crossing.

- Drainage

The recommended minimum pavement cross slope of 2 percent adequately provides for drainage. Sloping in one direction instead of crowning is preferred and usually simplifies the drainage and surface construction. A smooth surface is essential to prevent water ponding and ice formation. On unpaved shared use paths, particular attention should be paid to drainage to avoid erosion.

- Lighting

Lighting for shared use paths is important and should be considered where night usage is expected, such as paths serving college students or commuters, and at highway intersections. Lighting should also be considered through underpasses or tunnels, and when nighttime security could be an issue.

- Restriction of Motor Vehicle Traffic

Shared use paths may need some form of physical barrier at highway intersections to prevent unauthorized motor vehicles from using the facilities. Provisions can be made for a lockable, removable (or reclining) barrier post to permit entrance by authorized vehicles.

- Railroad Crossings

Railroad-highway grade crossings should be at a right angle to the rails. The greater the crossing deviates from this ideal crossing angle, the greater is the potential for a bicyclist's front wheel to be trapped in the flangeway causing loss of steering control. Consideration should be given to the crossing surface materials and to the flangeway depth and width.

- Bicycle Facilities Through Interchange Areas

Turning roadways provided for interchange ramp ingress and egress often require bicyclists to perform merging, weaving or crossing maneuvers with other vehicles. These conflict points are made challenging when a wide disparity in speed exists between traffic on the ramp and bicycle traffic crossing the ramp, and when grade separations create significant profile gradients. If a bike lane or route must traverse an interchange area, these intersection or conflict points should be designed to limit the conflict areas or to eliminate unnecessary uncontrolled ramp connections to urban roadways.

## AASHTO APPROVED INTERSTATE BICYCLE ROUTES

VDOT provides signing along the designated AASHTO approved Interstate Bicycle Routes. Figure A-5-6 shows the corridors for Interstate Bicycle Routes 1 and 76 and the counties the routes pass through. The individual county maps provide detailed location information. County maps are to be checked by the plan designer to determine if their project is on a designated Interstate Bicycle Route. All proposed projects involving major construction or redevelopment along designated Interstate Bicycle Routes are to provide the necessary design features to facilitate bicycle travel in accordance with the parameters established in these guidelines.

## RESOURCES

It should be understood that this Guide is not all inclusive. The publications listed below will provide additional information to be used in the design of bicycle facilities.

"Guide for the Development of Bicycle Facilities." AASHTO

"Manual on Uniform Traffic Control Devices." Federal Highway Administration

"Selecting Roadway Design Treatments to Accommodate Bicycles." Federal Highway Administration

"A Virginia Guide for Bicycle Facility Planning." Virginia Department of Transportation

# Interstate Bicycle Routes 1 and 76

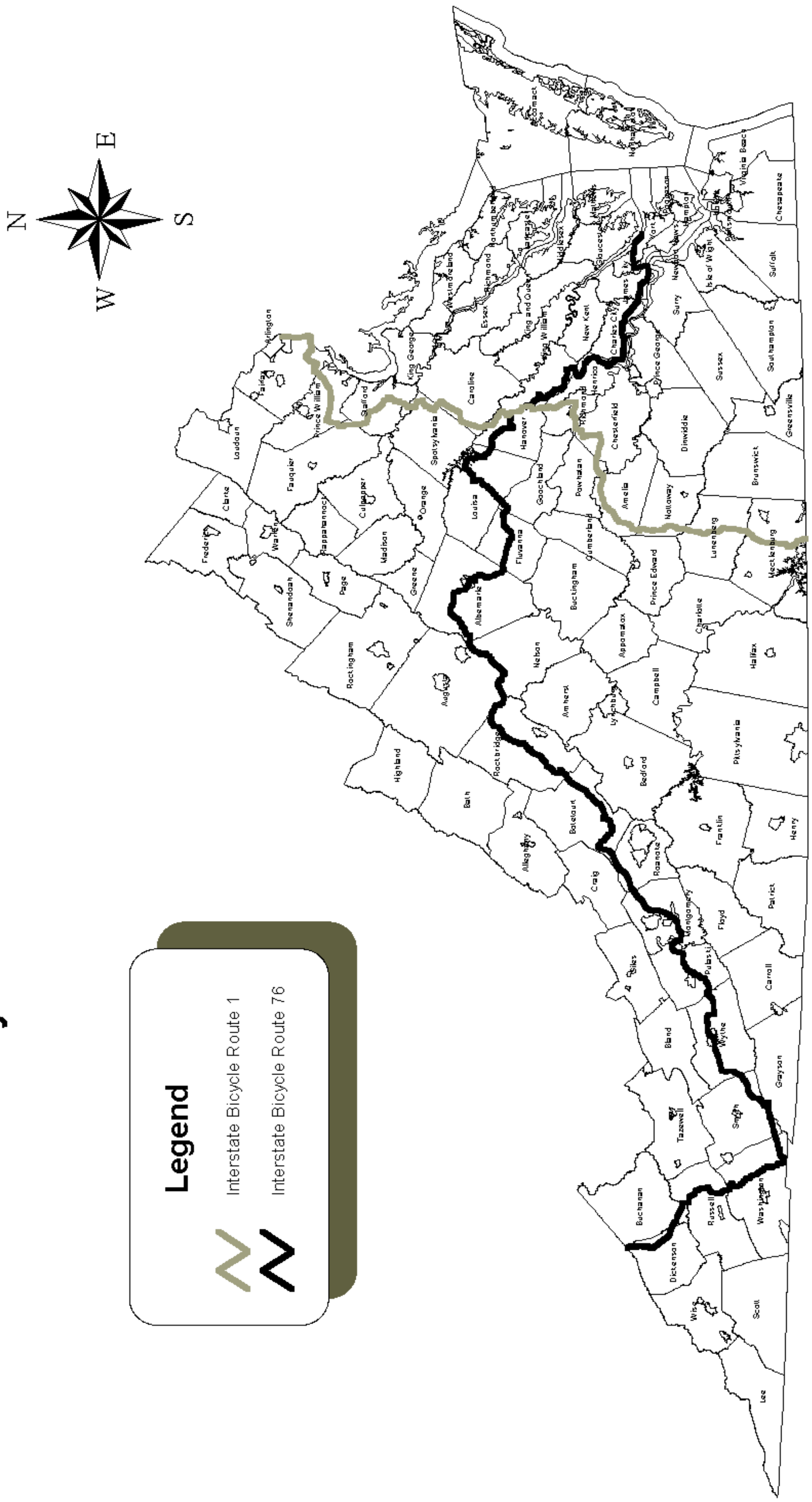



**FIGURE A-5-6**

| feet | meters | | mph | km/h | | inches | mm |
|---|---|---|---|---|---|---|---|
| 1 | 0.3 | | 12 | 20 | | 4 | 100 |
| 2 | 0.6 | | 20 | 30 | | 6 | 150 |
| 3 | 0.9 | | 25 | 40 | | | |
| 4 | 1.2 | | 30 | 50 | | | |
| 5 | 1.5 | | 50 | 80 | | | |
| 6 | 1.8 | | 55 | 85 | | | |
| 7 | 2.1 | | | | | inches | meters |
| 8 | 2.4 | | | | | 32 | 0.8 |
| 9 | 2.7 | | | | | 40 | 1.0 |
| 10 | 3.0 | | | | | 42 | 1.1 |
| 11 | 3.4 | | | | | | |
| 12 | 3.6 | | | | | | |
| 13 | 3.9 | | | | | | |
| 14 | 4.2 | | | | | | |
| 15 | 4.5 | | | | | | |
| 16 | 4.9 | | | | | | |

**CONVERSIONS FROM IMPERIAL UNITS TO METRIC UNITS**
(for bicycle guidelines)

| TO CONVERT | MULTIPLY BY | TO OBTAIN |
|---|---|---|
| feet | 0.3048 | meters |
| mph | 1.6093 | km/h |
| inches | 0.0254 | meters |
| inches | 25.4 | mm |

1 foot = 0.3048 meter
1 mph = 1.6093 km/h
1 inch = 0.0254 meter
1 inch = 25.4 mm

**CONVERSION FACTORS FOR DIMENSIONS OR SPEEDS NOT SHOWN ABOVE :**

**TABLE A-5-13**

## SECTION A-6 AIRPORT CLEARANCE REQUIREMENTS

During the Project Planning Stage, the Designer will determine if there is a potential for substandard airway - highway clearance, or other potential hazard, as determined by the project's location listed below:

1. Within 20,000 feet of public use or military airports with at least one runway greater than 3,200 feet in length.

2. Within 10,000 feet of public use or military airports with runways with a length of 3200 feet or less.

3. Within 5,000 feet of public use, military, or hospital heliports.

4. Any permanent or temporary construction or alteration including any equipment, materials or apparatus that would be more than 200 feet in height above ground level at its site.

5. Construction of wetlands or stormwater management ponds within 5 miles of a public use or military airport.

The Designer will request a review and coordinate notice requirements for any project determined to be within the applicable limits as listed above. A list of airports, as of the printing of these instructions, is provided at the end of this section for assistance in locating applicable airports. The request for review will be made to the Location & Design Airport Clearance Coordinator in the Photogrammetry and Survey Section by Form LD-252.

The Airport Clearance Coordinator will determine current Federal Aviation Administration (FAA) requirements pertaining to the subject project and notify the FAA as early as possible. Part 77 of the Federal Aviation Regulations and the U. S. Department of Transportation FAA Advisory Circular 70/7460-21 contain FAA requirements as of the printing of these instructions.

All evaluations will be determined by using U.S.G.S. or N.G.S. (U.S.C. & G.S.) datum or datum matching quadrangle sheets. In no case will assumed data or local city or town datum be used.

When a new corridor is being developed or an existing corridor is being redeveloped to add lanes, interchanges, etc., the entire corridor is to be reviewed for clearance requirements at a very early stage.

For Final Design, the corridor will probably be divided into multiple projects and be handled by different design sections and/or in a District Office. The establishment of the proposed grade elevations based on the airport clearance requirements at an early stage is important because grade adjustments on a Final Design Project by a section may create major design adjustments on an adjoining project that is being prepared by another section or District Office.

When lighting is required on a project or a possible addition in the future, the pole heights are to be considered in the initial review for clearance requirements. Although a highway may present no problems with vertical clearances, the use of certain types of materials (such as fencing, lighting, etc.) may affect navigational equipment. Also, the use of large construction equipment (such as cranes) may cause encroachment of navigable airspace. Encroachment problems may also result from signs and/or lighting added several years after the roadway completion.

When proposed construction or maintenance activities initiated by other Divisions (i.e. Environmental, Structure and Bridge, Maintenance, Mobility Management ) or a District Office are within the limits (specified earlier in this section) of airports or heliports, the Location and Design Highway Airport Clearance Coordinator is to be notified by Form LD-252.

When potential clearance conflicts are determined, the designer will contract the Highway Airport Clearance Coordinator via Form LD-252 and request a review. The Designer will submit Form LD-252; one (1) print of the title, typical section(s), and applicable plan and profile sheets for the Highway Airport Clearance Coordinator's review.

The Highway Airport Clearance Coordinator will evaluate the appropriate desirable clearance dimensions between highway surfaces and airway approach zones and, if necessary, request that the designer furnish prints of applicable project plan sheets. This is for early communication between the FHWA, FAA, and the Department and for alerting the FAA of potential hazards to aviation.

When a potential problem exists, FAA Form 7460-1 (notice of proposed construction or alternation), or current form, along with appropriate project review data will be filled by the Highway Airport Clearance Coordinator. A Notice of Construction or Alteration to the Federal Aviation Administrator is required for any proposed construction or alteration. This applies to, but is not limited to, the following:

1. Any object of natural growth or terrain.

2. Permanent or temporary construction or alteration, including equipment or materials used therein, and/or apparatus of a permanent or temporary character.

3. Structures with a change in height (including appurtenances) or lateral dimensions, including equipment or materials used therein.

4. Proposed changes in the land use practices that would attract or sustain hazardous wildlife populations at or near airports.

| **ASSOCIATED CITY** | **AIRPORT** |
|---|---|
| Abingdon | Virginia Highlands Airport |
| Ashland | Hanover County Municipal Airport |
| Blacksburg | Virginia Tech Airport |
| Blackstone | Blackstone AAF/A. C. Perkinson |
| Bridgewater | Bridgewater Airpark |
| Brookneal | Brookneal-Campbell County Airport |
| Bumpass | Lake Anna Airport |
| Charlottesville | Charlottesville-Albemarle Co. Airport |
| Chase City | Chase City Airport |
| Chesapeake | Chesapeake Municipal Airport |
| Chesterfield | Chesterfield County Airport |
| Clarksville | Marks Municipal Airport |
| Crewe | Crewe Municipal Airport |
| Culpeper | Culpeper County Airport |
| Danville | Danville Regional Airport |
| Dublin | New River Valley Airport |
| Emporia | Emporia Municipal Airport |
| Farmville | Farmville Municipal Airport |
| Forest | New London Airport |
| Franklin | Franklin Municipal Airport |
| Fredericksburg | Shannon Airport |
| Front Royal | Front Royal-Warren County Airport |
| Galax | Twin County Airport |
| Gordonsville | Gordonsville Municipal Airport |
| Grundy | Grundy Municipal Airport |
| Hot Springs | Ingall's Field |
| Kenbridge | Lunenburg County Airport |
| Lawrenceville | Lawrenceville-Brunswick Co. Airport |
| Leesburg | Leesburg Municipal Airport |
| Louisa | Louisa County Airport/Freeman Field |
| Luray | Luray Caverns Airports |
| Lynchburg | Falwell Airport<br>Lynchburg Regional Airport |
| Manassas | Manassas Municipal Airport<br>Whitman Strip |
| Marion/<br>Wytheville | Mountain Empire |

-continued-

(continued list of airports)

| ASSOCIATED CITY | AIRPORT |
|---|---|
| Martinsville | Blue Ridge Airport |
| Melfa | Accomack County Airport |
| Moneta | Smith Mountain Lake Airport |
| New Market | New Market Airport |
| Newport News | Newport News-Williamsburg International |
| Norfolk | Norfolk International Airport |
| Orange | Orange County Airport |
| Pennington Gap | Lee County Airport |
| Petersburg | Petersburg-Dinwiddie Airport |
| Portsmouth | Hampton Roads Airport |
| Quinton | New Kent Airport |
| Tazewell | Tazewell Airport |
| Richmond | Richmond International Airport |
| Chesterfield County Airport | |
| Hanover County Municipal Airport | |
| New Kent County Airport | |
| Roanoke | Roanoke Regional Airport |
| Saluda | Hummel Field |
| Somerville | Hartwood Airport |
| South Boston | William M. Tuck Airport |
| South Hill | Mecklenburg-Brunswick Airport |
| Staunton | Shenandoah Valley Regional Airport |
| Suffolk | Suffolk Municipal |
| Tangier | Tangier Island Airport |
| Tappahannock | Tappahannock Municipal Airport |
| Wakefield | Wakefield Municipal Airport |
| Warrenton | Warrenton-Fauquier Airport |
| Washington, D.C. | Washington Dulles International Airport |
| Washington National Airport | |
| Waynesboro | Eagle's Nest |
| Weirwood | Kellam Field |
| West Point | West Point Municipal |
| Williamsburg | Williamsburg - Jamestown Airport |
| Newport News-Williamsburg International | |
| Winchester | Winchester Regional Airport |
| Wise | Lonesome Pine Airport |

| Associated Area | Military Airfields |
|---|---|
| Fort Belvoir | Davidson AAF |
| Fort Eustis | Felker AAF |
| Norfolk | NAS Norfolk |
| Poquoson | Langley |
| Quantico | MCAF Quantico |
| Va. Beach | NAS Oceana |
| | NALF Fentress |

# SECTION A-7-"NO PLAN" AND "MINIMUM PLAN" PROJECTS

## GENERAL CONCEPTS

### Description

The "No Plan" and "Minimum Plan" concept provides for the accomplishment by contract of the type improvements that would not require complete and detailed surveys and plans, and where the use of modified Specifications would be appropriate. Generally, the improvements will consist of widening, grading, draining and stabilizing primary and secondary roads with relatively low traffic volumes by using engineering judgment. "No Plan" and "Minimum Plan" concepts are to be used only for projects where significant reductions in the cost of engineering and construction can be experienced by using these concepts to obtain the quality of improvement necessary for the particular situation. To optimize the usefulness of this concept, very careful initial study and project selection by the District and Residency staff is required. On secondary projects, this determination should be made in accordance with Mr. E. C. Cochran, Jr.'s memorandum dated December 1, 1994 concerning "Initial Field Review / Scoping Report - Revised Guidelines". The Federal Highway Administration has concurred with the use of the "No Plan" and "Minimum Plan" concept on selected projects with Federal Oversight.

"No Plan" projects are used when no survey, engineering, hydraulic analysis or river mechanics studies are needed or when there will be no major structures with "B" or "D" designation numbers. Right of way may be acquired on "No Plan" projects provided it is acquired thru donations and no condemnation is required. A "No Plan" project is an assembly of letter size sketches showing the location of the project with a typical cross section and estimated quantities.

A "Minimum Plan" project differs in that limited survey is needed to provide the information necessary to secure right of way by the Right of Way and Utilities Division and a profile sheet is provided. In the establishment of such projects, attention should be given to determine that the project location and selection is in an area where disruption due to construction can be tolerated by the users of that particular roadway for a reasonable period of time.

## PUBLIC HEARING AND RIGHT OF WAY

All right of way negotiations are to be conducted in accordance with the applicable statutes, regulations, policies, and procedures stipulated in the Right of Way and Utilities Division’s Manual of Instructions and related memoranda.

Any required right of way and/or easements will normally be secured by donation. However, right of way may be purchased by individual deeds or under the minimum plan concept (see - second paragraph under "Minimum Plan" Projects, Page A-97).

The Commonwealth Transportation Board's resolution of February 16, 1961 specifies a minimum 40-foot right of way is to be provided for any initial improvement to the secondary system, except in extenuating circumstances.

Section 33.1 - 70.1, Code of Virginia permits consideration for hard surfacing of a secondary road on less than a 40-foot right of way.

Right of Way - Donations

> Public hearing requirements will normally be waived on "No Plan" and "Minimum Plan" projects when all landowners are willing to donate the right of way provided there is no evidence of controversy, the landowners have been advised of their right to receive just compensation prior to requesting donations, and the project files have been so documented.

Right of Way - Acquisitions

> When right of way must be acquired, a "Willingness to Hold a Public Hearing" will be advertised and public hearings will be conducted upon request. A public hearing handout and appropriate environmental document, on projects with Federal Oversight, will be prepared following the usual guidelines. If there are questions concerning the public hearing requirements or procedures, check with the State Location and Design Engineer.

**SPECIAL DESIGN STRUCTURES, SOIL SURVEY AND PAVEMENT DESIGN**

"No Plan" projects may include drainage structures; however, major structures with "B" or "D" designation numbers and all standard box culverts that require a hydraulic study are to be constructed under the "Minimum Plan" concept. When pipes are to be extended and endwalls, end sections, pipe spillouts, etc., are to be provided, separate bid items are to be set up.

The District Materials section is to review the project site to determine if soil samples may be necessary and the District Materials Engineer is to furnish recommendations regarding any undercutting and pavement design.

**MOBILIZATION AND FIELD OFFICE**

Mobilization is to be set up as a contract item on "No Plan" and "Minimum Plan" projects in accordance with VDOT's Road and Bridge Specifications.

When it is necessary to set up a field office, it is set up as a contract item in accordance with VDOT's Road and Bridge Specifications at the discretion of the District; however, other arrangements should be considered such as the use of existing facilities where feasible to eliminate the need for the extra cost of a field office.

## EROSION AND SEDIMENT CONTROL

Temporary and permanent erosion and sediment control measures are required in accordance with the Department's standard practices and procedures. Seeding operations, erosion control, and sedimentation measures shall be included as specific contract items in accordance with standard specifications and procedures or shall be performed by State Forces, at the discretion of the District. When seeding operations and other items are to be performed by State Forces, a plan note must be included to denote such State Force work; and, in the event of Federal Oversight, finding of cost effectiveness must be furnished in accordance with existing policy and procedures.

## CONTRACT TIME LIMIT

Generally, a 90 to 180 calendar day time limit should be established; however, the contract time limit should be determined after thorough consideration of the need to realize the lowest cost possible to provide the improvement at the earliest practical date.

## PROCEDURES

### General

Form C-99 (No Plan and Minimum Plan Quantity Support Report) and a Field Narrative (i.e., detailed description of proposed work in narrative or sketch form - See Page A-96) are to be completed by the Resident Engineer or the District Administrator's staff. They are to be submitted with the project assembly for the purpose of providing information concerning the general description of construction work from which to develop and support the construction cost estimate. Also provide a project specific erosion and sediment control plan (narrative or sketch) on projects disturbing more than 10,000 square feet of soil (or greater than 2,500 sq. ft. of soil in Tidewater Virginia), reviewed and approved in accord with IIM-LD-11. For all projects disturbing greater than one acre, a Storm Water Management Plan must be developed. Form C-99 and the Field Narrative should be reviewed and updated prior to the assembly being turned into the Scheduling and Contract Division for first submission to assure the data reflects existing conditions and supports the information to be used at the project showing. The Field Narrative will become part of the contract assembly.

## PROJECT SCOPING & INITIAL FIELD REVIEW

All projects are to be scoped and an Initial Field Review is to be held in accordance with IIM LD-210. These procedures will define the potential need for field and office engineering as well as right of way and environmental requirements.

## "NO PLAN" PROJECTS

The "No Plan" concept should be used when:

- (a) survey data is not required
- *(b) improvements to roadways do not involve major structures or special design items
- *(c) Hydraulic or River Mechanics Studies are not required.
- (d) rights of way are acquired thru donations and no condemnation is required.
- (e) environmental permits will not normally be required
- (f ) construction activities must be handled in an expeditious manner
- (g) detailed engineering is not required

* Exception - when a project requires an extensive study (survey, hydraulic or river mechanics study, etc.) for a major structure, the "No Plan" concept may be used only if the necessary studies for the structure design are performed. When a major structure is located on a long No Plan project, the site should be treated as a Minimum Plan exception to the No Plan Project.

The Resident Engineer normally obtains any donated right of way by use of the appropriate Right of Way Forms. When a "No Plan" project is to be constructed within existing right of way, a note must be placed on the title sheet indicating that "All construction is to be performed within existing right of way."

Metes and bounds plans are required for right of way from unique clients (e.g. Federal and State agencies, the National Forest, railroads, Virginia Power, etc.) - see VDOT's Road Design Manual Chapter 2E, Section 2E-5.

The construction baseline should generally follow the center of the existing roadway; however, minor relocation and alignment improvements (horizontal and vertical), roadway widening, and turn lanes may be accomplished. The geometrics should comply with the appropriate design standards. However, where it is impractical or not economical to obtain the minimum design and an exception is required, permission shall be secured from the State Location and Design Engineer and, if applicable, from the Federal Highway Administration.

The Resident Engineer, with the assistance of the project designer, determines the typical section and furnishes an estimate of quantities on the "Quantity Support Report" (C-99). Grading should generally be balanced and set up as a lump sum quantity. Form C-99 should indicate an estimate of grading quantities, including anticipated waste quantities, to guide the Scheduling and Contract Division in preparing the construction cost estimate.

When borrow material is anticipated, "Borrow Excavation" is to be set up as a separate bid item in accordance with VDOT's Road and Bridge Specifications. Borrow sources should be located and designated whenever possible in accordance with VDOT's Road Design Manual Chapter 2E, Section 2E-1 - SOIL SURVEY AND PAVEMENT DESIGN.

A unit price for extra excavation is to be established by the Resident Engineer or the District Administrator's staff and entered on Form C-99 for inclusion in the contract assembly by the contract section.

The Resident Engineer is responsible for conducting the utility field inspections and preparing the field inspection reports, determining utility conflicts, method of adjustment, cost responsibility and for obtaining and forwarding all plans and estimates from utility owners to the District Administrator (District Utilities Engineer) for processing. The Resident Engineer is also responsible for advising the District Administrator (District Utilities Engineer) in writing, no later than 60 days prior to the advertisement of the project, when all arrangements have been made with the utility owners to adjust the utilities prior to or in conjunction with project construction. The Central Office Right of Way and Utilities Division will obtain any necessary FHWA authorization for utility work and will furnish the usual utility clearances and estimates to the Scheduling and Contract Division for contract projects and State Force projects with Federal Oversight. If no known utilities and/or railroads are involved, the plans will contain a note so stating.

A general description of the work must be provided on Form C-99 and the Field Narrative to denote the nature of the work to be performed, such as daylighting of slopes; realignment; intersection improvement; or widening of shoulders and ditchlines. For all projects disturbing more than 10,000 square feet of soil, a plan narrative or sketch with profile which must include erosion and sediment control measures and specify placement of those items. "Simple" sketches may be used in lieu of the narrative. Stormwater management facilities may be addressed in a similar fashion provided sufficient detail is included to ensure their proper construction. When this is not practicable, additional sketches shall be included in the no-plan assembly to define the construction of these items.

The responsibility for compliance with applicable regulations, policies and standards is assumed by the District Administrator for "No Plan" secondary projects. The State Location and Design Engineer is responsible for all other roadway classifications. This responsibility is evidenced by affixing the signature of the District Administrator or the State Location and Design Engineer in the appropriate plan signature space.

On Secondary "No Plan" projects, the project designer will transmit the plan assembly directly to the Central Office Plan Coordination Section for processing, construction advertisement or authorization for State Force work on projects with Federal Oversight, whichever is applicable. Primary "No Plan" projects will continue to be transmitted to the Central Office Coordination Section for processing and recommended approval for advertisement. Construction plans will be retained in the District until right of way has been secured and arrangements made for utility adjustments. When retained, status reports (containing applicable correspondence) will be submitted the by District Administrator's staff by the plan-due-date and quarterly until clear.

## "MINIMUM PLAN" PROJECTS

Those sites that require an engineering evaluation should be designated as "Minimum Plan" projects. This will permit the development of required engineering studies and will provide a vehicle for transmitting critical information to the contractor.

Projects that should be developed with the "Minimum Plan" concept include:

(a) locations requiring survey
(b) major stream crossing sites
(c) locations that will require environmental evaluation and/or permits
(d) all projects with "B" and "D" designation numbers
(e) locations requiring Hydraulic or River Mechanics studies
(f) locations that involve the acquisition of right of way and/or condemnation

The basic difference between the "Minimum Plan" and the "No Plan" project is the need for a limited survey and topo to provide sufficient right of way plans necessary to acquire right of way. Form RW-205 or individual deed forms are to be used. If any additional right of way or easements are necessary, the usual right of way certification letter and release for advertisement will be required. If additional right of way or easements are not required, the "Minimum Plan" title sheet is to contain a note indicating that "All construction is to be performed within existing right of way."

"Minimum Plan" projects may include relocation or alignment improvements (horizontal or vertical), roadway widening, and the addition of turn lanes. The intent of the "Minimum Plan" project is for it to be constructed using engineering judgment; however, the complete project should not be required to be redesigned during construction. Special attention should be given to major drainage problems and the limits set for the proposed right of way. The geometrics should comply with the appropriate design standards. However, where it is impractical or not economical to obtain minimum design and an exception is required, permission must be secured from the State Location and Design Engineer and, if applicable, from the Federal Highway Administration.

Quantities, typical sections, entrance profiles and other similar information should be shown on the initial plan and profile sheets. A grade line is required when the grade is to be different than that of the existing road. In areas where right of way is to be obtained and entrance grading is necessary, a profile showing the approximate grade of the proposed entrance should be included in the plan assembly.

When borrow material is anticipated, "Borrow Excavation" is to be set up as a separate bid item in accordance with Section 303 of VDOT's Road and Bridge Specifications. Borrow sources should be located and designated, whenever possible, in accordance with VDOT's Road Design Manual, Chapter 2E, Section 2E-1 - SOIL SURVEY AND PAVEMENT DESIGN.

A unit price for extra excavation is to be established by the Resident Engineer or the District Administrator’s staff and entered on Form C-99 for inclusion in the contract assembly by the contract section.

Utility adjustments shall be handled in accordance with IIM LD- 140 and 203.

A general description of work must be provided on Form C-99 and the Field Narrative to denote additional work that is not covered on the plans.

For all projects disturbing more than 10,000 square feet of soil (or greater that 2,500 square feet of soil in Tidewater Virginia**), an Erosion and Sediment Control Plan must be developed, reviewed, and approved by appropriate qualified personnel in accordance with the latest version of IIM LD- 11.

For all projects disturbing greater than one acre of land, a Stormwater Management Plan must be developed, reviewed, and approved by appropriate qualified personnel in accordance with the latest version of IIM LD- 195.

** Tidewater, VA, as defined by the Virginia Chesapeake Bay Preservation Act, Title 10.1, Chapter 21, Code of Virginia.

**PERMITS AND REVIEWS ("NO PLAN" AND "MINIMUM PLAN" PROJECTS)**

The need for 401, 404, navigation, and other environmental permits is to be considered in accordance with the Guidelines for the Preparation of Permit Application. A Virginia Pollutant Discharge Elimination System (VPDES) permit is required on all projects with a total disturbed area of more than five continuous acres. (Request Form LD-252).

Historical and archaeological reviews are to be made. (Request Forms LD-252 and EQ-429).

For any project that disturbs greater than one acre of soil, (except certain maintenance projects specifically exempted by the General VPDES Construction Permit Regulations - 9VAC25-180-10 et seq.), an Erosion and Sediment Control Plan must be developed, reviewed, and approved by appropriate qualified personnel in accordance with the latest version of IIM LD- 11, and a Stormwater Management Plan must be developed, reviewed, and approved by appropriate qualified personnel in accordance with the latest version of IIM LD- 195.

**PLAN PREPARATION**

The sample plan assemblies for both "No Plan" and "Minimum Plan" projects (See Road Design Manual Volume 2, Metric) provide the manner of showing the minimum essential information and the notes necessary to govern construction. For current versions of these sheets, see the CADD No Plan Directory, which is in Falcon under Engineering Services (eng-ser). Variation may be made to the formats to meet the specific project needs and to best utilize all available sheet space, thereby minimizing the total number of project assembly sheets. Careful attention should be given to the notes shown thereon.

The plan assemblies for both “No Plan” and “Minimum Plan” projects are to be placed in Falcon and transmitted electronically to the Plan Coordination Section in the Central Office. The document assembly instructions are located in Falcon along with the other typical drawings needed for “No and Minimum Plan” projects.

Generally, plan variations from AASHTO guidelines, as set forth in the Geometric Design Standards (See VDOT's Road Design Manual, Appendix A), are not readily apparent in an office review; therefore, it is very important that the variations be defined in the project assembly (consisting of the plan details, Form C-99, cost analysis, and narrative or description of the work) by the Resident Engineer and/or District Administrator.

Aggregate Material No. 21, 21A, 25 or 26 should be set up as a contract item for roadway base or subbase, maintenance of traffic, private entrances, and mailbox turnouts. Normally, one contract item should cover all uses.

**SPECIFICATIONS**

It is intended that modified versions of parts of VDOT's Road and Bridge Specifications will be followed in order to reduce the field engineering and final computations required; however, the use of such modifications must still be consistent with good construction practices in relation to the kind and type of improvement being provided.

A unit price for extra excavation is to be established by the Resident Engineer or the District Administrator's staff and entered on Form C-99 for inclusion in the contract assembly by the contract section.

The Special Provisions for "No Plan and Minimum Plan Projects" (available from VDOT's Scheduling and Contract Division) are approved by the Federal Highway Administration for use on a project by project basis. When additional changes to the Specifications are necessary, such changes should be documented and submitted with the project assembly. (Any additional Special Provisions are to be reviewed by the Scheduling and Contract Division in ample time for inclusion in the project bid proposal.)

"No Plan" and "Minimum Plan" projects will often consist of small quantities of materials; therefore, materials testing requirements for most items will fall within the limits of minimum testing as set forth in VDOT's Materials Manual. Compactive effort must be provided by the Contractor in such a manner as to attain the required densities and random compaction tests will be performed to the extent required to assure proper compaction.

Generally, materials from sources that have proven to be satisfactory in the past will normally be accepted by certification as determined by VDOT's Materials Division, subject to visual inspection at the project site.

The Contractor shall perform all construction surveying on "No Plan" and "Minimum Plan" projects in accordance with the Special Provision "Copied Note" for Section 105.10 of VDOT's (See IIM LD- 152) VDOT's Road and Bridge Specifications.

Prospective bidders may be required to attend the Project Showing as a prerequisite for submitting a bid proposal for "No Plan" and "Minimum Plan" projects. When attendance is required, prospective bidders must register with the Engineer at the project showing and all attending parties are to be noted in the project showing letter. The Project Engineer and the Project Inspector must also attend the project showing. The Field Narrative will indicate if attendance is required.

## PROJECT LAYOUT

If deemed necessary by the District Administrator or Resident Engineer, marked stakes shall be established showing the approximate depth at centerline of major fills and cuts which exceed 4 feet and/or other areas as required. Marked stakes shall be in place at the time of the Project Showing.

Survey work for "Minimum Plan" projects should normally be performed in accordance with the VDOT Survey Instructions Manual or as otherwise determined by the District Administrator or Resident Engineer. The designer should determine in the early stages of the plan development where additional survey is needed in order to alleviate any major problem during construction. Normally, on "Minimum Plan" projects, entrance profiles are taken where right of way donations are not anticipated; however, they should not be plotted unless the need for condemnation is required.

**INSPECTION AND RECORD KEEPING**

Close coordination between the Project Inspector and the Contractor is necessary to assure the success of the "No Plan" and "Minimum Plan" concepts.

Only one loose leaf notebook is normally necessary on a "No Plan" or "Minimum Plan" project and it may be used as a combination diary, materials book, and sketch book provided that electronic versions of these materials are not available.

Alignment and sketches may be entered in accordance with standard procedures or, where feasible, small sketches may be glued into the notebook to properly indicate the work performed.

Where it is determined by the District that "As Built Plans" are more practical, they may be used in lieu of entering alignment, sketches, and summaries in the notebook. When "As Built Plans" are used, any changes, additions, or deletions of any nature are to be clearly indicated on the prints/files furnished to the Inspector with the diary and materials information entered in the notebook.

Upon the completion of a project, all records shall be submitted in accordance with standard procedures; except that after verification of the materials section by the District Materials Engineer, a reproducible copy of the materials section of the notebook/file is to be furnished to the State Materials Engineer in lieu of furnishing the original document/file.

# APPENDIX B – SUBDIVISION STREET DESIGN GUIDE

## List of Tables

Geometric Design Standards for Residential Subdivision Streets



## List of Figures

# APPENDIX B – SUBDIVISION STREET DESIGN GUIDE

## SECTION B – 1 – INTRODUCTION

### INTRODUCTION

This document is an appendix of VDOT's Road Design Manual and is intended for users of VDOT's Subdivision Street Requirements for the development of new subdivision streets functionally classified as "local" streets. All other streets must be developed in accordance with appropriate provisions of the Road Design Manual for the appropriate functional classification.

For the purposes of this document, "Resident Engineer" means that employee who oversees the land development functions for the residency. This may be the Resident Engineer, Residency Administrator or that employee designated to perform the "responsible charge" duties for the residency or other designee as determined by the District Administrator. In the context of this document, the term can also refer to

A. In Districts having centralized functions, it means the Land Development Manager, Residency Permit manager or that employee designated to oversee land development functions.

B. In cities or towns choosing to use this design guide for the design of their subdivision streets, it means the local official responsible for the review and approval of subdivision street design.

In the event of conflict between this appendix and other provisions of the Road Design Manual, Road and Bridge Standards, and the Subdivision Street Requirements, the Resident Engineer shall determine the governing provision. As indicated in the Subdivision Street Requirements, any requirements of the subdivision ordinance of the locality that are greater than these requirements shall govern. The Resident Engineer is provided considerable discretionary authority in the application of standards related to local subdivision streets.

The district administrator is authorized to consider and render a decision on unresolved issues between the developer and the resident engineer that pertain to the interpretation and application of this appendix. All appeals shall be made in writing describing the unresolved issue and include copies of all prior relative correspondence.

All land development proposals should be submitted to the local jurisdiction, which will then coordinate with the local Resident Engineer or Northern Virginia District's Land Development Section for VDOT review and approval. The Resident Engineer or Land Development Office will coordinate with other VDOT sections as needed.

# SECTION B – 2 – DESIGN REQUIREMENTS

## PROJECTED TRAFFIC/CAPACITY ANALYSIS

For the purposes of these requirements, "projected traffic" includes the traffic resulting from the complete development of all land to be served by the subject roadway facility, including traffic forecast to be generated by development, both internal and external, to the subdivision under consideration.

The basis for this forecast will be the governing body's current comprehensive plan or other available information pertinent to the permitted land use and transportation planning for the subdivision and adjacent properties. The trip generation rates in the current version of Trip Generation, published by the Institute of Transportation Engineers (ITE) should be utilized in determining the projection of traffic. The ITE trip generation rate for a single-family detached residential dwelling unit is currently 10 vehicle trips per day. The use of other bona fide traffic studies in determining projected traffic for all types of land development may be considered, subject to their submission for review and approval by the department. In PUD developments, trip generation rates should be developed for each type of land use and combined to determine projected traffic for each of the subdivision streets.

As an alternative to the application of the projected traffic to the applicable geometric design criteria of these requirements, the department will consider subdivision street design based on a capacity analysis concept provided:

1. The governing body permits the utilization of this concept in the design of subdivision streets in the county.
2. The developer furnishes full rationale, from an engineer licensed by the Commonwealth to perform such studies, to support the recommendations of this analysis. The submission should include all pertinent traffic data and computations affecting the design proposal for the subdivision streets involved.
3. An acceptable level of service should be accommodated in the street design proposed under the capacity analysis concept. A minimum level of service “D” as defined by the Highway Capacity Manual is generally acceptable for the design of local subdivision streets. To maintain an acceptable level of service, additional travel lanes, channelized roadways, etc., may be required.

## FUNCTIONAL CLASSIFICATION

The characteristics and magnitude of the service to be provided will be the basis for the department's determination of the functional classification for each subdivision street intended for acceptance into the secondary system. AASHTO’s Geometric Design of Highways and Streets provides guidance in the classification of roads.

The hierarchy of the functional systems consists of principal arterials (for main movement), minor arterials (distributors), collectors and local roads and streets.

Local streets are defined as those streets that provide direct access to adjacent land and serve travel of short distances as compared to the higher systems. Service to through traffic is discouraged. Most subdivision streets fall in the Local Street classification. The geometric design standards contained in this guide should be used for streets classified as local roads. All other street classifications should use VDOT's Road Design Manual for geometric design.

1. **Criteria**
   Urban and rural areas have fundamentally different characteristics. Consequently, urban and rural functional systems are classified separately. Most subdivision streets function similar to an urban area; therefore, the urban classification can be used for high-density development with the concurrence of the locality and Resident Engineer.

2. **Procedures**
   The department's concurrence of the functional classification for each street within a subdivision should be made prior to departmental approval of a subdivision concept plan. To facilitate the effective development of the plats or plans and permit an expeditious review, this concurrence is recommended prior to the initiation of a detail design for the subdivision. To initiate the functional classification process, the developer should submit the following information:

   a. A sketch accurately depicting the general concept for the proposed development of the subdivision, in conformance with the applicable provisions of the governing body's zoning and subdivision regulations. This sketch should include:

      (1.) The general location and configuration of each street proposed within the subdivision, including the terminus and right of way, including but not limited to anticipated average daily traffic volumes, anticipated percentage of trucks, peak hour traffic volumes, and any proposed phased development of streets.

      (2.) The location and area of each type of permitted land use within the subdivision.

      (3.) The location of any proposed transportation facility, within the subdivision's boundaries, included in the current comprehensive plan of the governing body.

      (4.) The proposed functional classification of each street within the subdivision.

(5.) Where the governing body's zoning or subdivision regulations, or both, require submission of a conceptual plan in general conformance with the submission of the concept plan noted, such may be acceptable for review by the Resident Engineer.

b. Other available information pertinent to the intended development of the subdivision.

c. Any street proposed for phased development should be reviewed at this time and be approved for such development by the local government and the department.

3. **Approval**

The Resident Engineer will provide written concurrence to the appropriate county official and the developer, if applicable, regarding the approved functional classification for each street in the subdivision. Approval of the conceptual plan or subdivision sketch should be considered concurrence of the functional classification and general layout of the streets. This approval shall be valid as long as the basic concept for the subdivision's development, as submitted for review, remains unchanged.

## TERRAIN

The desired vertical curve alignment for subdivision street design can be accommodated within most terrains. However, in very rugged areas where the terrain can be classified mountainous, some design exceptions may be allowed. Mountainous terrain is defined as terrain in which longitudinal and transverse changes in the elevation of the ground with respect to a roadway are abrupt, and where the roadbed is obtained by frequent benching or side hill excavation to obtain acceptable horizontal and vertical alignment. The slope, which means the rise and fall of the grade measured both parallel and perpendicular to the centerline of the roadway, generally ranges over 15%.

Geographical location should not be the determining factor in terrain classification. For example, a subdivision street in the Bristol District may or may not have land characteristics of mountainous terrain. Each subdivision should be reviewed individually. Mountainous terrain exceptions are noted on the geometric design tables 1-3. The mountainous terrain classification may be used upon approval by the Resident Engineer.

## SECTION B – 3 – ROADWAY GEOMETRIC DESIGN CRITERIA

### A. COLLECTOR AND ARTERIAL ROADWAYS

Streets functionally classified as a "collector" and "arterial" should be designed in accordance with applicable provisions of VDOT's Road Design Manual.

### B. LOCAL ROADWAYS

Any street functionally classified as "local" shall have a minimum design based on the Geometric Design Standards for Residential Subdivision Streets, Tables 1-3 and other applicable provisions of this guide. These standards are depicted on the subsequent pages. The following criteria shall apply to the design of all subdivision streets functionally classified as "local":

1. A single-unit (SU) truck design vehicle, as defined by AASHTO, should be used for the design of all local subdivision streets. Dimensions for this vehicle are depicted in Exhibit 2-4 of the AASHTO Geometric Design of Highways and Streets 2001, shown as Figure 1.

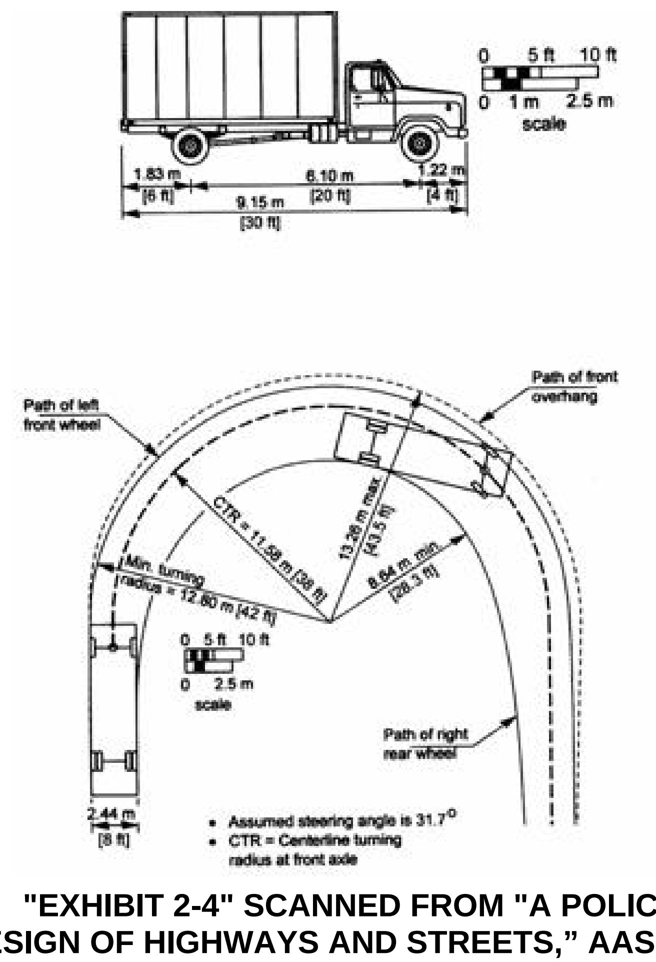



**FIGURE 1 - "EXHIBIT 2-4" SCANNED FROM "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS," AASHTO, 2001**

2. The typical design criteria for each street should be uniform between intersections. The Resident Engineer may consider modifications as required to satisfy changes in traffic volume or as necessary to address environmentally sensitive areas.

3. Roadway designs should be broadly based on two categories, as depicted in Tables 1 and 2.

    a. Shoulder and Ditch Design
    b. Curb and Gutter Design, further defined by the land use served by the street – residential of nonresidential.

4. One-way street design criterion is depicted in Table 3.

## C. TRANSITIONS AND TURN LANES

1. Left or right turn lanes should be provided at intersections when the department or locality determines that projected turning movements or safety warrants their installation. These facilities shall be designed in accordance with the appropriate provisions of Appendix C of the department's Road Design Manual or other traffic impact tools specifically approved for use by the District Administrator. Where necessary, additional right-of-way width shall be provided to accommodate these facilities.

2. Normally where roadway section widths change, the centerline should not be offset. The length of the transition should be calculated using the following formula for design speeds less than 45 mph.

    $L = S^2W \div 60$

    L = length of transition
    S = Design Speed
    W = Width of offset on each side

    Ex. Road narrows from 36' to 30'. Design speed is 25 mph.
    $625 (3) \div 60 = 31.25$ ft

# GEOMETRIC DESIGN STANDARDS FOR RESIDENTIAL SUBDIVISION STREETS (GS- SSR)

## TABLE 1– CURB AND GUTTER SECTION

| | | HORIZONTAL AND VERTICAL CONTROLS<br>MAXIMUM 2:1 CUT OR FILL SLOPE | | | | | CURB AND GUTTER ROADWAYS<br>(SEE SPECIAL WIDTH REDUCTION CRITERIA) | |
|---|---|---|---|---|---|---|---|---|
| PROJECTED TRAFFIC VOLUME (ADT) | MINIMUM DESIGN SPEED (MPH) | CURVE DATA | | SUGGESTED MAXIMUM % GRADE | MINIMUM SIGHT DISTANCE | | MINIMUM WIDTH (CURB TO CURB) (3) (PARKING ASSUMED) | CLEAR ZONE WITHOUT PARKING (MEASURED FROM FACE OF CURB) (6) |
| | | MINIMUM CENTERLINE RADIUS | SUPER-ELEV. | | STOPPING | INTERSECTIONS | | |
| UP TO 400 | 20 | 120’ (5) | NONE | 10 (1) | 125’ | 200’ | 28’ (2) | 3 |
| 401 - 1500 | 25 | 165’ | NONE | 10 (1) | 155’ | 280’ | 36’ | 3 |
| 1501 - 2000 | 30 | 275’ | NONE | 10 (1) | 200’ | 335’ | 36’ | 6 |
| 2001 - 4000 | 30 | 275’ | NONE | 10 (1) | 200’ | 335’ | 40’ (3) | 6 |

NOTES:

For streets with volumes over 4000 or serving heavy commercial or Industrial traffic; use the appropriate geometric design standard. (see VDOT’s road design manual)

The roadway with the highest volume will govern the sight distance.

1. For mountainous terrain, maximum percent of grade may be 16% for ADT up to 400 and 14% for 400-4000 ADT.
2. 26’allowed for streets< 400 vpd with concurrence of local officials.
3. 36’ allowed for streets that are internal to the sub-division, with concurrence of local officials.
4. Pavement widths may be reduced if parking is not allowed. See page 14 for roadway width exceptions criteria.
5. 95’ minimum radius allowed in mountainous terrain
6. For curb and gutter streets with parking lanes, the clear zone is accommodated within the parking lane. However, VDOT has established a 3’ minimum setback requirement behind the curb.

## GEOMETRIC DESIGN STANDARDS FOR RESIDENTIAL SUBDIVISION STREETS (GS- SSR)

## TABLE 2 – SHOULDER AND DITCH SECTION

| | | HORIZONTAL AND VERTICAL CONTROLS<br>Maximum 2:1 Cut or Fill Slope | | | | | SHOULDER AND DITCH ROADWAYS<br>Minimum ditch width should be 4 feet or greater, based on slopes of 3:1 or flatter (Gentler slopes promote homeowner maintenance of ditches) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PROJECTED TRAFFIC VOLUME (ADT) | MINIMUM DESIGN SPEED (MPH) | CURVE DATA | | SUGGESTED MAXIMUM % GRADE | MINIMUM SIGHT DISTANCE | | MINIMUM PAVEMENT WIDTH | MINIMUM GRADED SHOULDER WIDTH | | CLEAR ZONE (measured from edge of roadway pavement) |
| | | MINIMUM CENTERLINE RADIUS | SUPER-ELEV. | | STOPPING | INTERSECTIONS | | FILL W/ G.R. | CUT OR FILL | |
| UP TO 400 | 20 | 120’ (6) | NONE | 10 (2) | 125’ | 200’ | 18’ | 5’ | 4’ (1) | 6’ (3) |
| 401 - 1500 | 25 | 165’ | NONE | 10 (2) | 155’ | 280’ | 20’ (4) | 8’ | 5’ (5) | 7’ |
| 1501 - 2000 | 30 | 275’ | NONE | 10 (2) | 200’ | 335’ | 22’ | 9’ | 6’ | 10’ |
| 2001 - 4000 | 30 | 275’ | NONE | 10 (2) | 200’ | 335’ | 24’ | 11’ | 8’ | 12’ |

NOTES:

For streets with volumes over 4000 or serving heavy commercial or industrial traffic; use the appropriate geometric design standard. (see VDOT’s Road Design Manual)

The roadway with the highest volume will govern the sight distance.

1. When pedestrian facilities are provided behind ditches, the shoulder width may be reduced to a minimum of 2 feet.
2. For mountainous terrain, maximum percent of grade may be 16% for ADT up to 400 and 14% for 400-4000 ADT.
3. Clear zone widths may be reduced with the concurrence of the resident engineer where terrain or social/environmental impact considerations are appropriate.
4. 18’ minimum with < 600 ADT in mountainous terrain.
5. 2’ minimum in mountainous terrain with < 600 ADT.
6. 95’ radius minimum allowed in mountainous terrain.

# GEOMETRIC DESIGN STANDARDS FOR RESIDENTIAL SUBDIVISION STREETS (GS- SSR)

## TABLE 3 – ONE-LANE (ONE-WAY) SUBDIVISION STREETS

| TRAFFIC | PROJECTED RAFFIC VOLUME (ADT) | DESIGN SPEED (MPH) | HORIZONTAL AND VERTICAL CONTROLS Maximum 2:1 cut or fill slope | | | | ROADWAY SECTION CRITERIA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. CURVE RADIUS W/O SUPER-ELEV. | MAX. % GRADE SUG. | MINIMUM SIGHT DISTANCE | | SHOULDER AND DITCH ROADWAYS Minimum ditch width should be 4 feet or greater, based on slopes of 3:1 (Gentler slopes promote homeowner maintenance of ditches) | | | | CURB AND GUTTER ROADWAYS | |
| | | | | | STOPPING | INTER-SECTION | MINIMUM PAVEMENT WIDTH | FILL W. G.R. | CUT OR FILL W/O G.R. | CLEAR ZONE (FROM EDGE OF TRAVELWAY) | CURB TO CURB WIDTH, WITH OR WITHIOUT PARKING ON ONE SIDE | CLEAR ZONE (FROM FACE OF CURB) |
| ONE-WAY (1- LANE) | ≤ 400 (5) | 20 | 120’ | 10% (2) | 125’ | 200’ (4) | 16’ | 5’ | 4’ (1) | 6’ (3) | 22’ | 3’ |

GENERAL NOTES:

These design standards may also be used for one-way divided pairs, such as subdivision entrances with wide medians.

For streets anticipated to serve mixed residential-commercial, commercial, or industrial traffic, use the appropriate urban standard in the road design manual. In such settings, where

- On-street parking is anticipated; a parking lane width not less than 7 feet should be used.
- Normal minimum shoulder widths and construction practices make parking along rural typical roadway sections inappropriate if not illegal.

FOOTNOTES:

1. When pedestrian facilities are provided behind ditches, the shoulder width may be reduced to a minimum of 2 feet.
2. The maximum percent grade suggested may be adjusted to 16% in mountainous terrain.
3. Clear zone widths may be reduced with the concurrence of the resident engineer where terrain or social/environmental impact considerations are appropriate
4. The roadway with the highest volume will govern the sight distance
5. For traffic volumes > 400 vpd, pavement widths will be established by the resident engineer

## D. SIGHT DISTANCE

1. **Stopping sight distance** – Stopping sight distance shall be based on a height of eye of 3.5 feet and an object height of 2.0 feet along the center of the travel lane.

2. **Intersection sight distance** – Intersection sight distance should be measured presuming a stop condition of the minor roadway. Sight distance shall be based on a height of eye of 3.5 feet and an object height of 3.5 feet. Dedicated right of way may be required to preserve appropriate sight distance at intersections. The Resident Engineer may consider an easement as an alternative to dedicated right of way.

3. **Sight Distance Triangles**

   The intersection sight distance is measured along the major roadway, based on the major roadway's design or, in the case of existing roadways, the operation speed limit.

   Decision points (A, B and C in the figure 2) represent the position of drivers along the major and minor roadways. Two sight distance triangles are considered, one in each direction of the major roadway from decision point A, which represents the driver exiting the minor roadway.

   Decision point A is located 4 feet from the centerline or left edge of pavement of the minor roadway and 20 feet from the middle of the nearest travel lane of the major roadway. (For reference purposes, AASHTO defines this point as 14.4 to 17.8 feet from the edge of the travel lane of the major roadway.)

   Decision point B is located in the middle of the nearest travel lane of the major roadway.

   Decision point C is located in the nearest right to left movement lane of the major roadway, 4 feet from the centerline or the left edge of pavement.

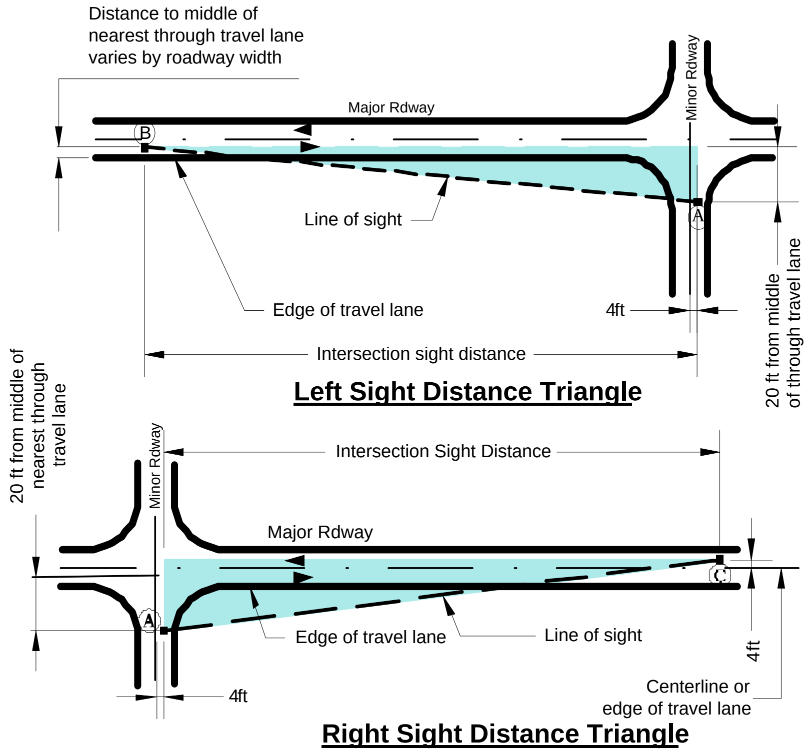



**FIGURE 2 SIGHT DISTANCE TRIANGLES**

4. Additional information regarding sight distance requirements is available in AASHTO's Policy on Geometric Design of Highways and Streets.

## SECTION B – 4 – ELEMENTS OF TYPICAL SECTION

### A. PAVEMENT DESIGN

1. Pavement design for new subdivision streets shall be developed using the Pavement Design Guide for Subdivision and Secondary Roads in Virginia.

2. Standard crown" means the cross slope of the roadway pavement and should be 1/4 inch per foot (2%), unless otherwise increased by the Resident Engineer.

### B. PAVEMENT WIDTH

1. Except as may be permitted in this subsection, the minimum pavement widths should be as shown in Tables 1 through 3.

2. Unless otherwise indicated, the use of curb and gutter anticipates on street parking. Parking along streets with shoulder and ditch design is normally considered prohibited.

3. Special Pavement Width Reduction for Residential Street
   A reduction in the width of curb and gutter streets serving residential property may be approved by the Resident Engineer provided:

   a. Any such reduction has been specifically approved by the locality in consultation with emergency services.

   b. The length of the street is less than 0.5 miles. The term "length" means the travel distance from the most distant point of trip origin to an intersecting street.

   c. Sufficient off-street parking shall be provided to accommodate normal demand for vehicular parking space but not less than three such spaces, exclusive of any garage for a single-family residence, shall be provided in the proximity of the dwelling unit they are intended to serve. On-street parking on adjacent streets shall only be considered for properties located on corner lots.

   d. For the purposes of this subsection, widths may be reduced as follows:

      (1) For any street with a projected traffic of 250 ADT or less, a curb-to-curb width of 22 feet on a right-of-way of not less than 30 feet may be approved.

      (2) For any street with a projected traffic of 251-400 ADT, a curb to curb width of 24 feet on a right-of-way of not less than 30 feet may be approved.

(3) For streets with a projected traffic between 401 and 2000 ADT, a curb to curb width of 30 feet on a right-of-way not less than 40 feet may be approved.

e. Without regard to the length of the street, any other reduction of width of curb and gutter streets may only be considered if

(1) Parking on the street is restricted and

(2) Access to the street is limited to street connections.

If significant on street parking occurs on streets specifically designed with the presumption on street parking would be minimal, restrictions may be required if operational problems develop. In addition, parking restrictions may be necessary for some maintenance operations.

In the cities and towns that maintain their own streets, pavement reductions in accordance by their own streets, pavement reductions in accordance with this section are approved their designated “resident engineer” as defined in the Subdivision Street Requirements.

## C. PARKING LANE WIDTHS (CURB AND GUTTER ONLY)

1. The use of curb and gutter anticipates on-street parking will be accommodated, using the following widths for the parking lane:

Residential Streets – 7 feet in width measured from the face of curb

Commercial and mixed use – 8 feet in width measured from the face of curb

## D. INTERSECTIONS

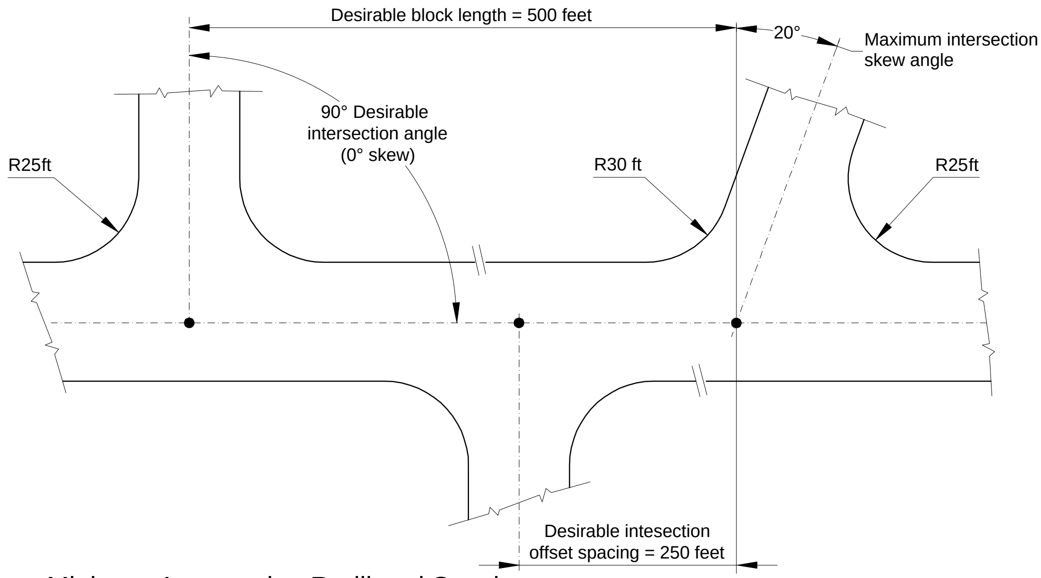
1. Angle of intersection

Streets should intersect at right angles; however, intersecting angles between 70 and 90 degrees are allowed.

A landing, a minimum of 50’ in length and having a maximum vertical grade of 2%, should be provided at each intersection. Sign islands may be permitted if approved by the Resident Engineer.

2. Spacing (i.e. Minimum distance between intersecting roadways)

Offset intersections are discouraged. Desirable spacing between streets entering from opposing side of the major street is 250 feet. Desirable block lengths, or spacing between streets entering from the same side of the major street is 500 feet. For low volume local streets with ADT <1500vpd the minimum spacing between streets entering from opposite sides of the major street should be no less than 125 feet and block length should be no less than 250 feet. Figure 3 illustrates the desirable spacing.




Minimum Intersection Radii and Spacing

**FIGURE 3 – INTERSECTION DESIGN**

3. Minimum Radii

Normally, intersection radii should be the same on all quadrants of an intersection. However, roadway alignments, traffic volumes along the respective legs, and other factors may warrant consideration of using different radii and may be considered. For subdivision streets the following considerations shall apply:

a. For skew intersections, radii should be not less than 25 feet for the acute angle and 30 feet for the obtuse angle of the intersection street.

b. For turns from roadways with less than 1500 vpd onto roadways under 1500 vpd.

(1) The minimum intersection radii on subdivision streets should normally be 25 feet. If intercity buses or standard 65-passenger school buses are expected to use the street, the minimum radius should be increased to accommodate the turning radius of such vehicles. Minimal encroachment into the opposing lane of traffic of the receiving street is expected. A larger radius or additional pavement at the intersection may be required on shoulder and ditch sections to avoid shoulder rutting.

(2) When the traffic volume of the receiving street is less than 400 vpd or when a turn lane from the exited street is available, greater encroachment into the opposing lane may be acceptable and a radius not less than 15 feet may be used. However, when a radius less than 25 feet is proposed, an auto-turn diagram should be used to demonstrate the impact of a single unit design truck on the opposing lane of the receiving street and the sufficiency of the street widths to accommodate said vehicle without running off of pavement or scrubbing curbs.

c. For turns from or onto roadways carrying 1500 or more vpd.

The minimum intersection radii shall be that required to accommodate a single unit truck design vehicle without encroaching into the opposing lane of the receiving street. This is typically a 30’ radius. The sufficiency of the street widths to accommodate said vehicle shall be demonstrated with an appropriate diagram. If intercity buses or standard 65-passenger school buses are expected to use the street, the minimum radius shall be increased as necessary to accommodate the turning radius of such vehicles. Minimal encroachment into the opposing lane of traffic of the receiving street is expected.

## E. CONCENTRIC DESIGN

Normally, the design of principal roadway elements of subdivision streets should be concentric about the center of the right-of-way. However, certain circumstances and special development goals, such as phased development may justify arrangements that require one side of the right of way to differ from the other, when based on a typical centerline between travel lanes. The normal typical section may be varied as necessary to provide for vehicular or pedestrian safety or both and traffic channelization features, e.g., turn lanes, intersection radius, etc.

## F. CUL-DE-SACS AND TURNAROUNDS

1. To afford the greatest flexibility in design, various types of turnaround designs may be used on subdivision streets. Additional right-of-way shall be provided as required by the turnaround design to continue the right of way limits around the perimeter of the turnaround. Acceptable Cul-de-sac designs include:

a. Circular Type Turnarounds

For circular turnarounds, a well-defined identifiable street segment, equal to the normal lot width along the intersected street that serves the cul-de-sac or 50 feet whichever is greater, shall extend from the intersected street to the turning area. A minimum radius of 30 feet, measured to the edge of pavement or face of curb, shall be used for circular turnarounds on residential cul-de-sac streets serving less than 25 dwellings and less than 0.25 mile in length. If standard 65 passenger school buses are expected to use the cul de sac, the minimum radius should be increased. For circular turnarounds on all other residential cul-de-sac streets, as well as any nonresidential cul-de-sac street, this minimum radius shall be 45 feet.

b. Cul de sacs with unpaved centers (Islands)

When a circular turnaround is proposed with an unpaved area in the center, the roadway around the center should be considered a one-way street and designed according to table 3. Pavement widths may be increased by the Resident Engineer to accommodate turning radii of single unit truck design vehicle. Parking should be restricted to the outside of the curve. Cul de sacs with curb and gutter should have a raised curb along the circumference of the island.

The unpaved area should have a minimum radius 30 feet and maximum radius of 120 feet. Unpaved center areas should have a ten-foot clear zone around the circumference of the circle. Any non-travel areas included within turnarounds, should be included in the dedicated right-of-way of the facility.

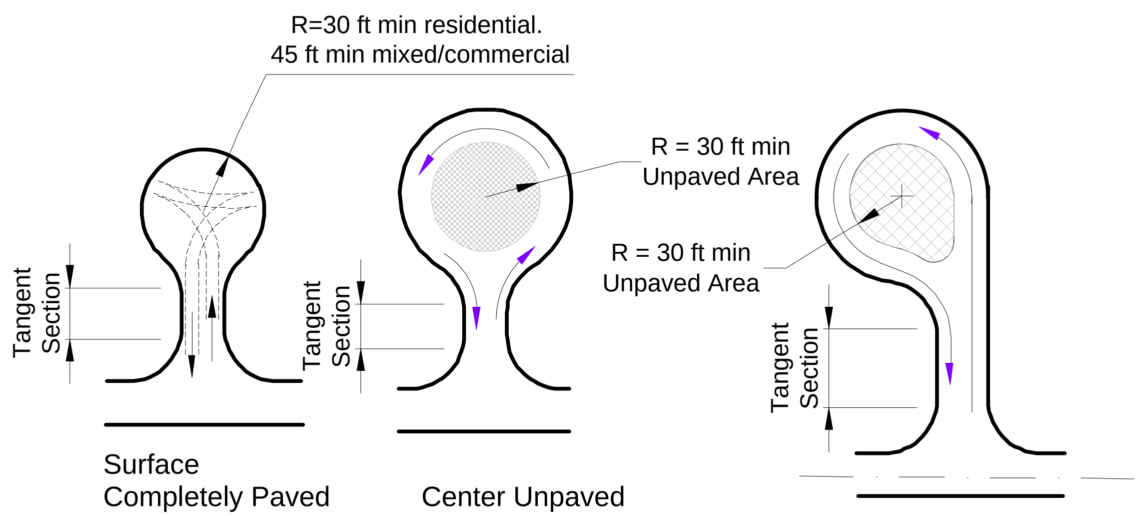
If the center radius is greater than 120 feet, the street will be considered a loop street and should be designed in accordance with tables 1 and 2 for two-way traffic.

c. Alternative Turnarounds (for Residential streets only)

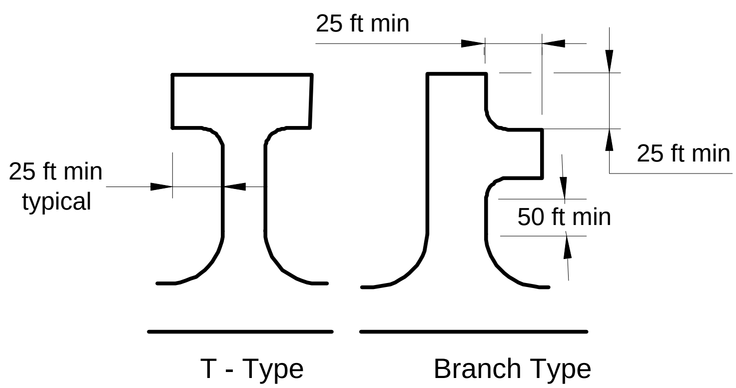
"T," and "Branch" type turnarounds may be considered for short streets less than 0.25 miles in length. Other proposals must be judged on their merits. However, when proposed, the ability of single unit truck design vehicles to reverse direction on these alternative types of turnarounds, without leaving the pavement area should be proven.

d. Temporary turnarounds and stub streets

A turnaround should be provided for any temporary or stub street longer than 150' from the point of intersection to the end of pavement. Any portion of the turnaround outside the dedicated right of way for the stub street may be placed in an easement.




**Concentric Bulb Cul-de-sac** **Offset Bulb Cul-de-sac**




**Alternative Turnarounds**

**FIGURE 4 – CUL-DE-SAC DETAILS**

## G. CURB AND GUTTER DESIGNS

The department does not require the use of curb and gutter on subdivision streets but recognizes that it is an acceptable design alternative and preferred in high density developments. Curb and gutter shown in figure 5 are appropriate for Subdivision streets.

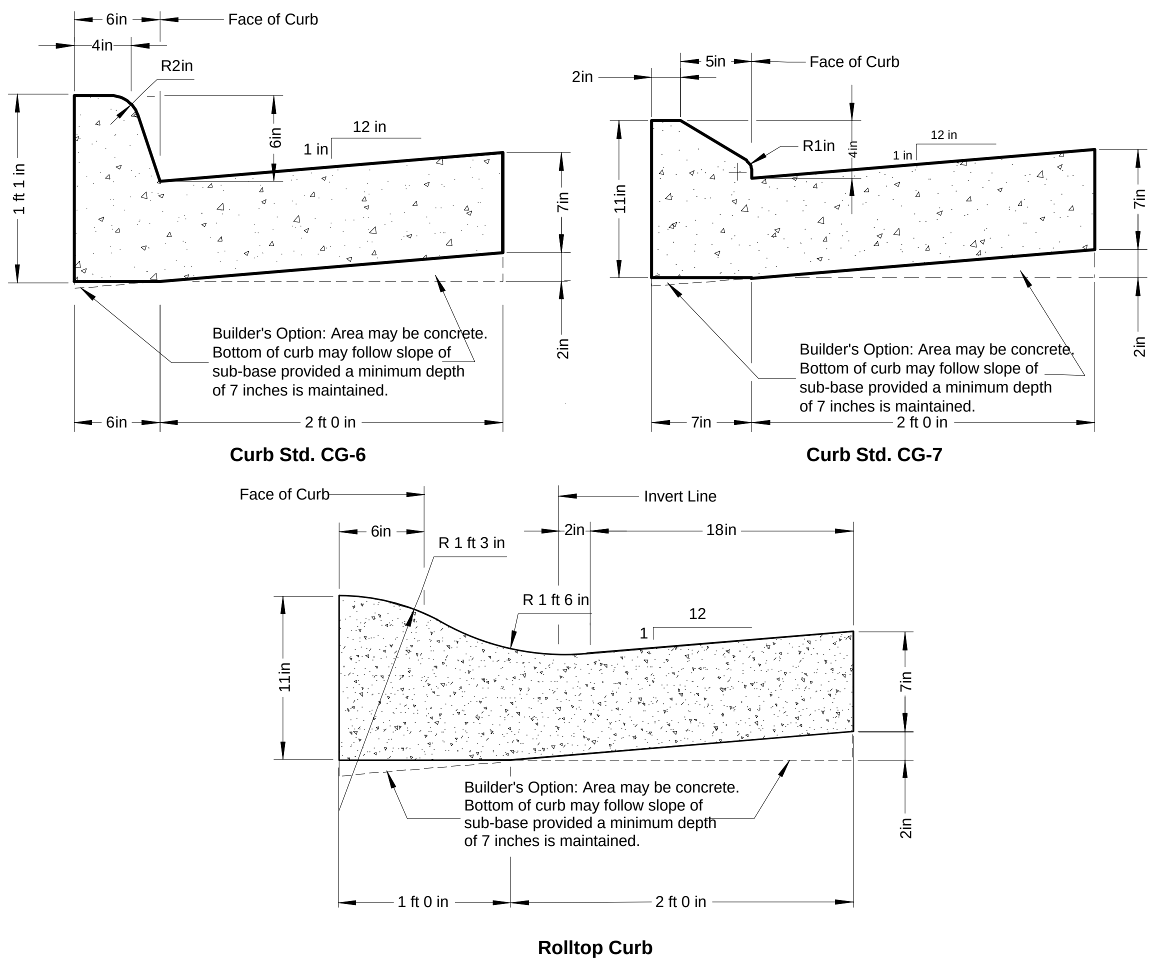



**FIGURE 5 CURB AND GUTTER DETAILS**

The following notes apply to CG-6, CG-7 and Rolltop curb:

1. Curb and gutter may be precast of Class A4 hydraulic cement concrete or cast in place using Class A3 hydraulic cement concrete.

2. When used with stabilized, open-graded drainage layers, the bottom of the curb and gutter shall be constructed parallel to the slope of the sub-base courses and to the depth of the pavement but not less than the thickness shown.

3. Use of curb and gutter has a direct relation to the design speed of the roadway of which it is a part, as follows:

   c. CG-6 may be used in urban and suburban settings (including subdivisions) on streets having a design speed not greater than 45 mph. When used along rural highways, CG-6 shall be limited to design speeds not greater than 40 mph.

   d. CG-7 may be used in lieu of CG-6 but must be used along all roadways having a design speed in excess of 40 mph in rural settings and 45 mph in urban and suburban settings (including subdivisions).

   e. Rolltop curb and gutter may be used along subdivision streets having a design speed not greater than 30 mph.

4. All curb and gutter designs shall transition to match entrance gutters or another curb and gutter type or standard curb openings within 10 feet of the change in gutter type.

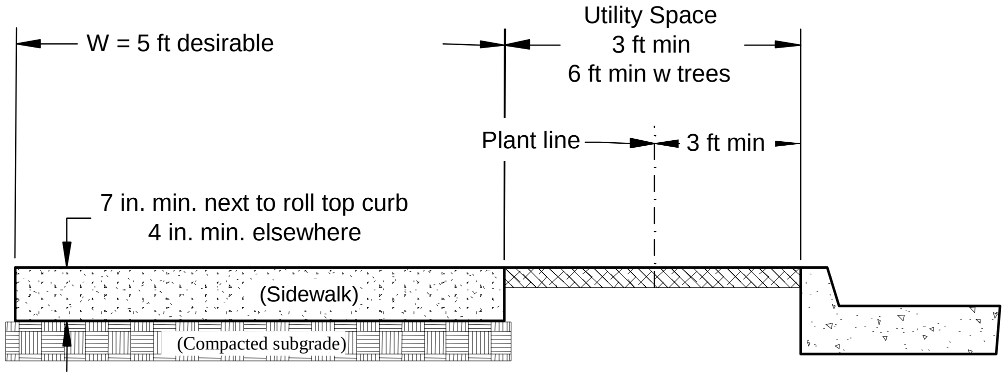
5. Curb ramps

   All streets that incorporate accessible routes for pedestrian use shall include curb ramps at intersections for use by persons with disabilities, without regard to the curb design used. Curb ramps should be constructed in accordance with Standard CG-12. Further guidance on the design of curb ramps may be found in Location and Design IIM–LD–55.7.

6. Treatment behind curbs

   Where curb and gutter is used, a 1/4 inch per foot (2%) graded area, at least 3 feet in width, should be provided behind the back of curb.

   Where sidewalk is used in conjunction with curb and gutter, a utility strip shall be included behind the curb as shown in figure 6. This utility strip may be paved with a suitable material approved by the Resident Engineer but should not be considered to be part of the prescribed width for sidewalks.




* If the utility space is paved, construction shall be on compacted subgrade and the thickness shall match that of the sidewalk, however, the area will not be considered part of the minimum width required for sidewalk.

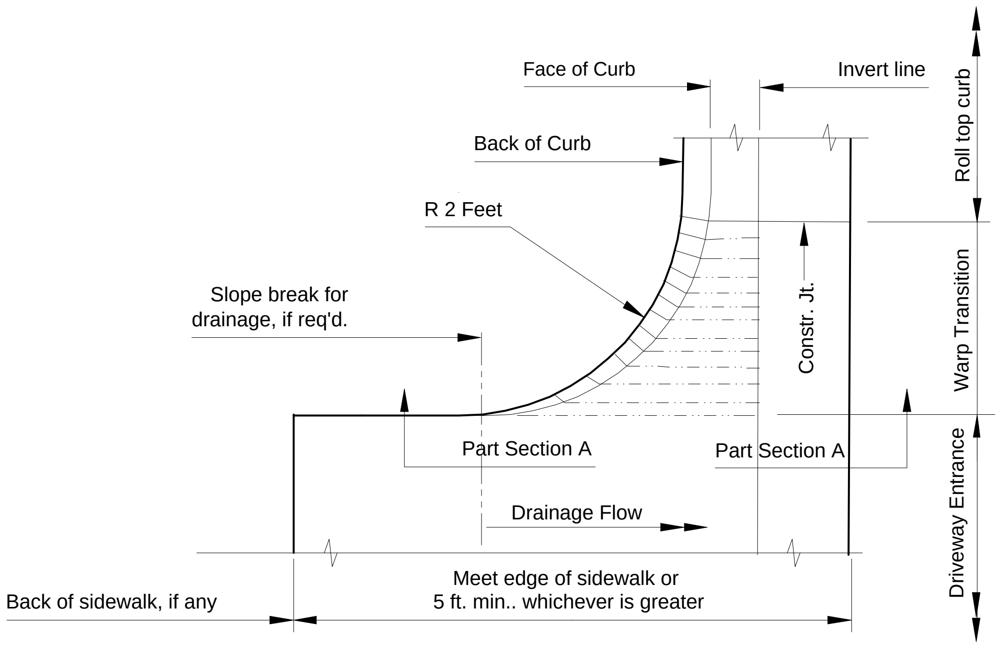
If trees are planted in paved pedestrian areas, they shall be planted in tree wells that include a planting grate, approved by the resident engineer. However, the width of sidewalk passing the tree well shall be at least 3 feet in width.

FIGURE 6 –DETAIL BACK OF CURBS

## H. PRIVATE ENTRANCES

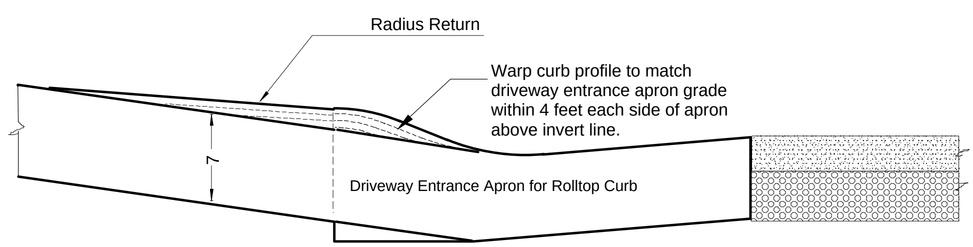
1. Curb and gutter private entrances

At all driveway entrances, standard entrance gutter (Std. CG-9B through CG-9D) shall be used with Standard CG-6 and CG-7 curb and gutter. A special design entrance gutter shall be submitted to the Resident Engineer for approval when roll top curb is used, similar to that shown in Figures 7 and 8.




Part Plan of Entrance Transition

**FIGURE 7 - ROLL TOP CURB ENTRANCE DETAIL**




Part Section A-A

**FIGURE 8 ROLLTOP CURB ENTRANCE DETAIL SECTION**

2. Ditch section private entrances

All private entrances shall be designed to serve one or two individual lots on a local subdivision street. All private entrances should be designed and constructed as shown in figure 9. Entrance radius should be 20' except in high density areas where a 12' radius can be allowed. All entrance pipe culverts will be sized to accommodate the run off expected from a 10-year frequency storm.

All entrance grades shall start back of the shoulder line. If drainage is necessary, the ditch line may be moved back to provide cover for pipe. Entrances shall be at least 12 ft. wide and shall be tied into the roadway smoothly. The driveway entrance surface shall extend from the edge of the roadway to the right of way line. Entrance surface can be crusher run aggregate or paved.

3. Driveway entrance grades

In the interest of assuring an adequate, convenient, and safe access to public roads, VDOT recommends the grades along driveways not exceed 10%.

Notes:

See VDOT Road and Bridge Standards, Std. PE-1 for cut/fill details.

All entrance grades shall start back of the shoulder line.

If drainage is necessary, the ditch line may be moved back to provide 9 inches (min.) cover over pipe.

Entrances shall be 12 ft wide and transition smoothly into the roadway surface. Driveway entrance pavement shall extend to the right of line. When an existing street is re-developed and modification of an existing driveway entrance is required, the entrance pavement shall be extended to the right of way line or the extent of disturbance to the existing driveway.

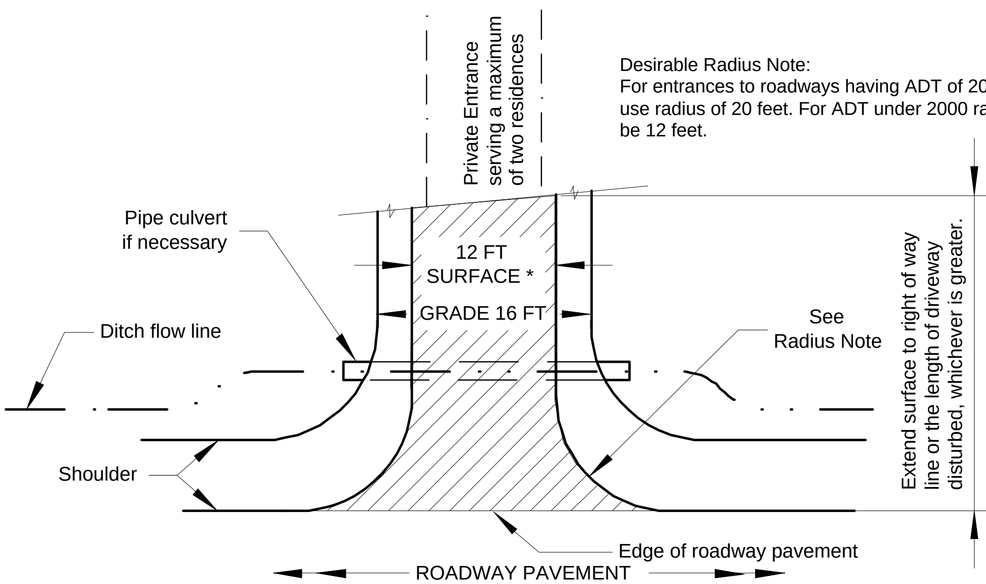



**FIGURE 9 – PRIVATE ENTRANCE DETAIL**

## I. PEDESTRIAN AND BICYCLE FACILITIES

1. Sidewalk Standards

   a. Sidewalks proposed for VDOT maintenance shall be completely contained within the right of way. Sidewalks should generally conform to the vertical alignment of the adjacent roadway.

   b. Sidewalks along curb and gutter streets shall be constructed in accordance with the department's specifications for hydraulic cement concrete sidewalk, on a compacted subgrade, and include underdrains in accordance with the department's Standard UD-3.

   c. Sidewalks should be 5 feet in width. Sidewalks less than 5 ‘ shall have appropriate passing areas in accordance with ADA requirements and Location and Design IIM-LD-55.7. In no case shall a sidewalk be less than 3’.

   d. Sidewalks shall not be less than 4 inches thick, except when used in conjunction with roll top curb, in which case the thickness shall be 7 inches. See detail under the curb and gutter design section – detail behind curbs.

   e. Sidewalks are normally at least 3 feet behind the back of curb on curb and gutter sections and, if trees are to be planted between the curb and the sidewalk, the sidewalk shall be not less than 6 feet behind the back of curb with the trees planted so that the center of the tree trunk is not less than 3 feet behind the curb. Sidewalk placed adjacent to the curb must be 8 feet in width to meet recommended sidewalk width.

   f. Sidewalks along ditch section streets shall be constructed in accordance with the department's specifications for asphalt concrete sidewalk, on a compacted subgrade, and include underdrains in accordance with the department's Standard UD-3.

   g. Sidewalks constructed along a shoulder and ditch section shall be placed behind the ditch in a manner that will be compatible with the roadway if the roadway is converted to a curb and gutter section. (Note: Placement of sidewalk within the shoulder area is not permitted.)

   h. Sidewalks located on a fill section requiring guardrail shall be located in front of the guardrail.

   i. On shoulder and ditch sections, construction of sidewalk within the prescribed shoulder area of the roadway will not be permitted.

2. Shared use paths

Shared use paths are paved facilities within the rights of way with minimal cross flow by motor vehicles. Users of these paths may include bicyclists, inline skaters, roller skaters, wheelchair users (motorized and non-motorized) and pedestrians including walkers, runners, people with baby strollers and people walking dogs. Shared use paths are most commonly designed for two-way travel and the following guidance assumes a two-way facility.

When two-way shared use paths are located adjacent to a roadway, wide separation is desirable to demonstrate to both the bicyclist and the motorist that the path functions as an independent facility for bicyclist and others. For curb and gutter streets, the shared use path shall be a minimum of 6 feet from the back of the curb.

The minimum pavement width for a shared use path should be 10 feet. A minimum 2 foot wide graded shoulder should be maintained adjacent to both sides of the trail. A minimum 3 foot clear zone should be maintained from the edge of the path. Where the path is adjacent to slopes steeper than 3:1, a 5 foot wide shoulder is needed. The vertical clearance should be a minimum of 8 feet. However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In under-crossings and tunnels, a 10 foot vertical clearance is desired.

Shared use paths should be designed for a selected speed that is at least as high as the preferred speed of the faster bicyclists. In general a design speed of 20 mph should be used. Long grades should be kept to a minimum. Grades greater than 5 percent are undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent or comfortable. In locations where grades exceed 5 %, table 4 shows recommended maximum grade lengths.

**TABLE 4 - MAXIMUM GRADE LENGTHS FOR SHARED USE PATHS**

| | |
|---|---|
| 5 – 6% | For up to 800 feet |
| 7% | For up to 400 feet |
| 8% | For up to 300 feet |
| 9% | For up to 200 feet |
| 10% | For up to 100 feet |
| 11+% | For up to 50 feet |

Further design details for shared use paths may be found in Section A-5 Bicycle Facility Guidelines of VDOT’s Road Design Manual.

3. Pedestrian tunnels

a. Pedestrian tunnels to separate pedestrian crossings from roadway traffic are being encouraged by some localities to improve pedestrian safety on high volume streets. The Subdivision Street Requirements provide criteria for VDOT acceptance of these pedestrian tunnels under certain conditions. All underpass structures intended for pedestrian use, whether they are accepted for maintenance as part of the roadway or accepted under the terms of an agreement should have the following characteristics:

(1) Have entrances visible from the side of the roadway above.

(2) Be aligned to the pedestrian corridor such that the interior of the tunnel is visible to pedestrians from a distance of not less than 25 feet and preferably for its entire length.

(3) If located at a school, be equipped with security gates so that school authorities may regulate the hours it is available for use.

b. All underpass structures intended for acceptance of maintenance by the department as an integral part of the roadway, even if some features are to remain the responsibility of local government, should also include the following:

(1) Have a grade not greater than 3%.

(2) Have a non-skid paved surface comparable to the finish of a sidewalk.

(3) Have continuous handrails.

(4) Have a clear height not less than 8 feet.

(5) Have a clear width, exclusive of any area used or reserved as a utility corridor, not less than 10 feet.

(6) Have security lights with explosion proof fixtures if the tunnel is more than 25 feet in length or if the tunnel is available for use after dark.

(7) Be accessible to persons with disabilities from sidewalks associated with the roadway above or, as an alternative, by a circuitous route.

(8) Pedestrian ramps should be provided at all pedestrian separation structures.

(9) When warranted and possible, a stairway can be provided in addition to a ramp. Ramps should be deleted only when it would be infeasible for mobility-limited persons to reach the pedestrian separation structures due to unusual topographical or architectural obstacles or when alternate safe and reasonably convenient means are provided to cross the highway.

(10) The ramp should have a maximum slope of 12:1 with a maximum rise of 30 in. between landings. Landings should have a minimum length of 5 ft and should be of sufficient width to allow wheelchairs to maneuver.

4. Bicycle lanes

On local streets, bicyclists should be considered a normal part of the vehicle mix on the street. On collector roads, bike lanes may be established with appropriate pavement markings and signing. Bike lanes should be one-way facilities and carry bike traffic in the same direction as adjacent motor vehicle traffic.

The recommended width of a bike lane is 5 feet from the face of a curb to the bike lane stripe. If parking is permitted, the bike lane should be placed between the parking area and the travel lane and have a minimum width of 5 feet. Bike lanes should never be placed between the parking lane and the curb line.
Further design details for Bicycle lanes may be found in Section A-5 Bicycle Facility Guidelines of VDOT's Road Design Manual.

5. Non-compliant sidewalks.

As indicated in the Subdivision Street Requirements, non-compliant sidewalks that are not built in accordance with these standards or meander on and off the right of way may be permitted; however, the department will not accept responsibility for their maintenance. A permit, which clearly specifies the applicant's responsibility for the sidewalk's maintenance and related activities, shall be obtained from the department to the extent it encroaches upon the street's right-of-way. The permit applicant shall be a county, incorporated town, or other entity, which has perpetual maintenance capability. These sidewalks may be constructed of asphalt, concrete, gravel, or other stabilizer convenient to the applicant.

## J. BRIDGE AND CULVERT DESIGN CRITERIA

1. Loading

All bridges and culverts shall be of HS 20-44 loading or alternate military loading, or both, in accordance with the current AASHTO Bridge design specifications and VDOT modifications. To facilitate the department's review, all pertinent calculations for a structure's design shall be submitted with each bridge plan or other nonstandard drainage structure.

2. Width

Clear roadway widths of all structures shall be in accordance with the department's design manual.

## K. ROADWAY DRAINAGE

1. Policy and procedures

All drainage facilities shall be designed in accordance with VDOT's Drainage Manual and supplemental directives as amended. The VDOT Location and Design Division Instructional and Informational Memorandum for Pipe Criteria and Drainage Instructions and the Virginia Erosion and Sediment Control Handbook shall also be used in designing drainage systems.

2. Criteria

Standards appropriate to the functional classification of the street and the potential impact on adjacent property shall apply.

3. Design

Specific reference is made to the following design requirements:

a. Roadside and median ditches should provide sufficient hydraulic capacity to contain the estimated runoff from a 10-year frequency storm. The estimated runoff and attendant velocity for the 2-year frequency storm is to be used for determining the needs, type and dimensions of special ditch lining for erosion control. Geometric configurations shall conform to appropriate safety standards.

   Where standard ditches have insufficient capacity for the 10-year runoff, a storm sewer system shall be provided. Open channels may be considered in lieu of a storm water system, if their construction can be accomplished without creating a hazard or condition detrimental to the appearance of the subdivision.

b. An acceptable easement shall be provided from all drainage outfalls to a natural watercourse. The department normally accepts and maintains the portion of a drainage system that will be constructed within the limits of the dedicated right of way for a subdivision street.

c. Curb drop inlets – the spread of water on the pavement shall be limited to the width of one-half of the travel lane and the gutter width (if any) in each direction or 8 to 10 feet from the face of curb, whichever is less, for a rainfall intensity of 4 inches per hour. Under certain conditions, the drop inlet may need to be designed and/or checked using a rainfall intensity of 6.5" per hour. See Chapter 9 of the VDOT Drainage Manual for the applicability of this requirement.

d. Where the roll top or mountable curb and gutter section is used, drop inlets must be spaced so that the 10-year frequency gutter flow does not exceed a four inch depth at the face of curb.

e. Storm Sewers should be designed to convey the 10-year runoff without surcharge; however, the system should be designed for the 50-year runoff and checked for the 100 year runoff in situations where it would be necessary to prevent flooding of underpasses or other depressed roadways where ponded water can only be removed through the storm sewer system.

f. Storm Sewer System Pipe sizes – 15” pipe or equivalent elliptical shape shall be considered the minimum acceptable size. 12” or equivalent size may only be used as the initial pipe in a system or as a lateral line when necessary, provided there is 50 ft. or less between access points.

g. Access points – Generally, distance between points of access in storm sewer trunk lines shall be limited, based on pipe diameter, to:

| | |
|---|---|
| 12” pipes, | 50 feet |
| 15” to 42” pipes, | 300 feet |
| 48” and larger pipes, | 800 feet |

4. Documentation

All drainage design computation shall be complete, properly documented and presented to the Resident Engineer for review.

5. Storm water management

All storm water management facilities located on the right of way must be designed in accordance with Chapter 11 of the VDOT Drainage Manual. See the Subdivision Street Requirements to determine the need for any special agreements related to stormwater management.

6. Dams

In addition to the VDOT Drainage Manual, all dams must be designed in accordance with all applicable provisions of the Department of Conservation and Recreation's Virginia stormwater Management Handbook and Virginia's Dam Safety program, which is administered by the Department of Conservation and Recreation (www.dcr.virginia.gov) Pertinent information is posted on their web site. See the Subdivision Street Requirements to determine the need for any agreements related to dams.

## L. RIGHT-OF-WAY

1. Width

The minimum right of way should be 40 feet or the width necessary to accommodate all roadway elements, including the clear zone, and extend 3 feet behind any feature intended to be maintained by VDOT as part of the roadway, whichever is greater. In no case shall the right of way extend less than one foot behind any feature to be maintained by VDOT. Reduced right of way may be allowed with specific approval of the locality and the Resident Engineer as defined in Elements of a Typical Section, section B.3 of this Guide. As indicated in the Subdivision Street Requirements, easements may be used in lieu of dedicated right of way to accommodate slopes or sight distance.

Dedicated right of way for roadways to the extent they occupy dams is not acceptable. All such right of way shall be platted as an ingress/egress easement.

2. Spite strips

Plans that include a reserved or "spite" strip which prohibits otherwise lawful vehicular access to a street from the adjacent properties, whether within or outside the subdivision, will not be approved.

## SECTION B – 5 – OTHER DESIGN CONSIDERATIONS

### A. CLEAR ZONE (i.e. Setback for non-breakaway fixed objects)

Except as may be authorized by land use permit, the right of way along public streets and highways maintained by VDOT must remain clear of all obstacles that are not designed to break away under impact. For the purposes of this section, breakaway structures are defined as a single 4"x4" square or 4" diameter wooden post or a standard strength, metal pipe post no greater than a 2" diameter. When curbing is used, the clear zone is measured from the face of the curb, except where a bike lane or parking lane exists between the curb and the traveled way. In such a case, clear zone may be measured from the edge of the traveled way. For shoulder and ditch sections, clear zone is measured from the edge of pavement.

Mailboxes and newspaper boxes may be placed on VDOT right of way. Placement should not interfere with safety, maintenance and use of the roadway. No more than two mailboxes may be mounted on a support structure. However, lightweight newspaper boxes may be mounted on the side of the support structure. Breakaway structures noted above will be acceptable as a mailbox post.

Traffic volume, operational or design speed of the street, and the typical cross section of the street determines the required clear zone. The geometric design sheets on pages 11-13 provide clear zone requirements for subdivision streets. Any structures or landscaping, including fences, stone or brick mailbox posts, columns or walls that do not meet breakaway requirements may not be located within the clear zone and will require review by the Resident Engineer to placed on the right of way. If approved by the Resident Engineer, a land use permit must be issued for any such obstacle. However, no obstacles, even if they meet breakaway requirements, will be placed within the 3-foot clear zone of a shared use path.

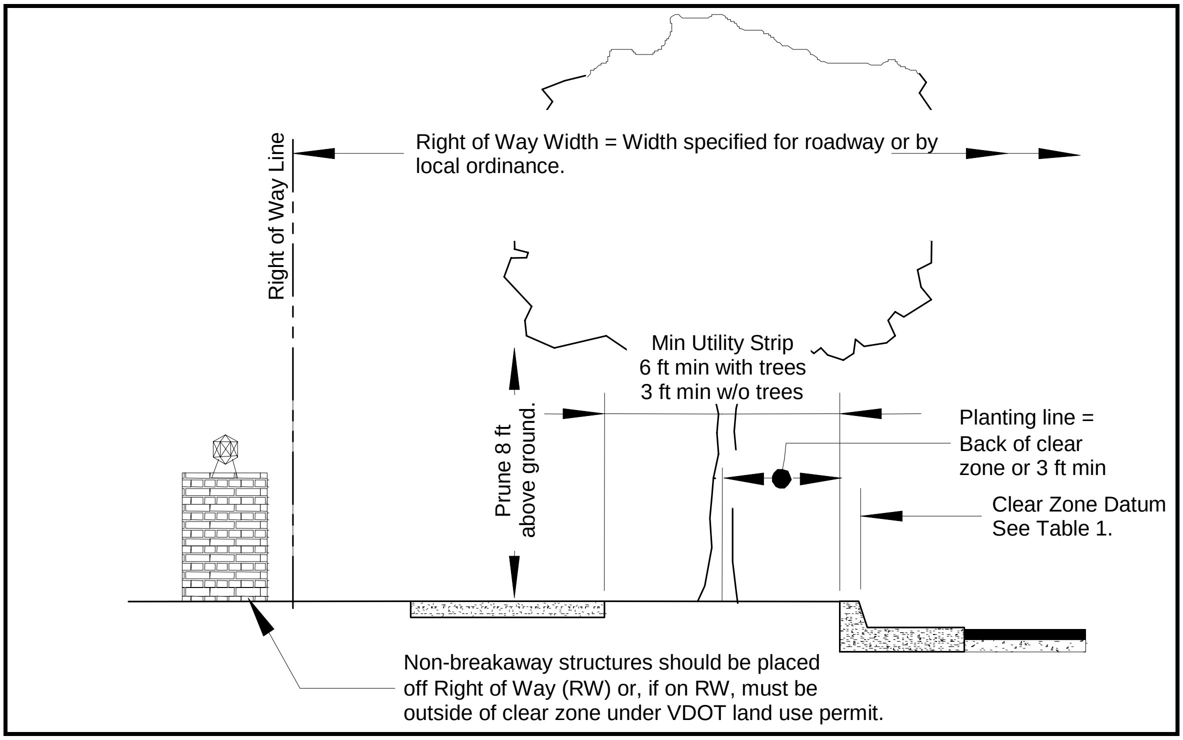



**FIGURE 10 - SETBACK DETAILS WITH CURB AND GUTTER**

Note: Driveway entrance curbing, regardless of height, shall not be permitted past sidewalks or within the area 3 feet behind curb and gutter.

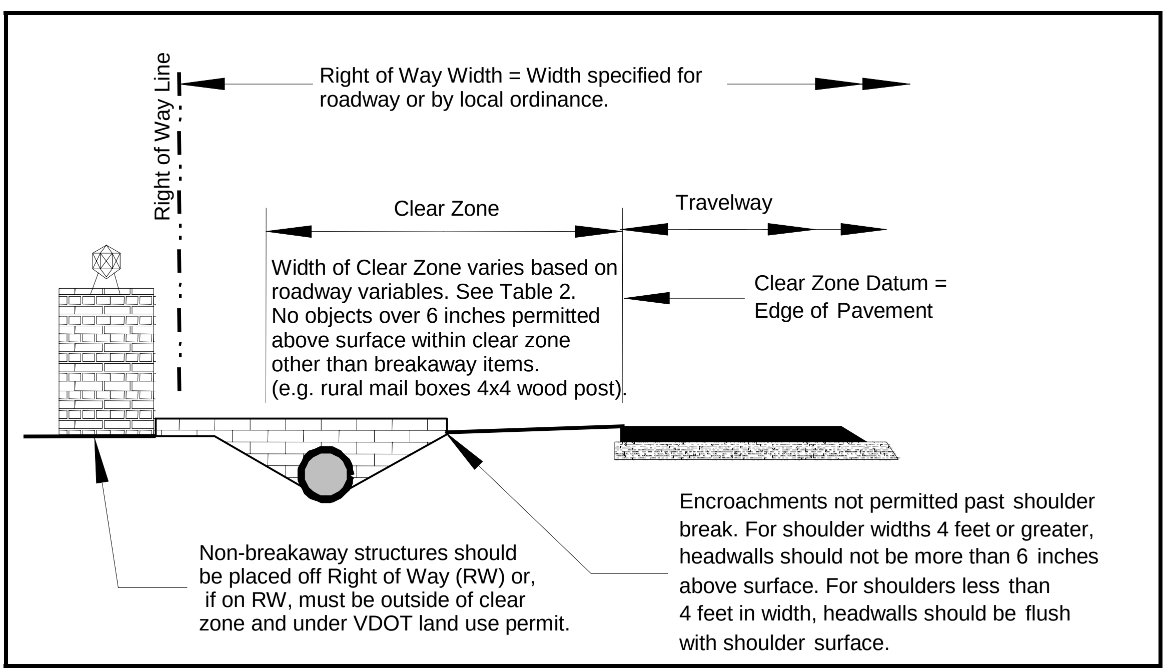



**FIGURE 11 – SETBACK DETAILS WITH SHOULDER AND DITCH**

## B. GUARDRAIL

Guardrail shall be provided and installed by the developer as necessary for the safety of the traveling public as determined by the Resident Engineer. Plans should indicate proposed guardrail location. Generally, when fill slopes are 3:1 or flatter, a barrier is not required unless there are hazardous obstacles within the clear zone limits. The developer is encouraged to examine alternatives that eliminate potential hazards in order to avoid the need for guardrail.

In urban and suburban settings with speeds of 45 mph or less that include curb or curb and gutter, the use of guardrail is not recommended. Standard CG-6 is normally used in these areas and is referred to as barrier curb because it has a 6” vertical face and is intended to discourage motorists from deliberately leaving the roadway, Even when mountable curb is used in suburban settings, it is impractical to install guardrail in an attempt to protect pedestrians walking along sidewalks due to the lack of accessibility caused when placing guardrail and terminals adjacent to accessible routes. Sometimes hazards, such as ponds or steep embankments, which need to be shielded, exist on subdivision streets with sidewalk/ sidewalk space. In situations like this, guardrail can be placed behind the sidewalk.

The use of guardrail types that are aesthetically compatible with the surrounding areas should be considered. One acceptable type is "Corten" or weathering steel rail with treated timber post. Alternate types may be considered provided they (i) conform to applicable VDOT standards or the criteria prescribed in the National Cooperative Highway Research Program Report 350, (ii) blend in with their surroundings and (iii) do not create an undue maintenance problem.

## C. TRAFFIC CONTROL

All plans should indicate appropriate traffic control signage and devices as designated by the Manual for Uniform Traffic Control Devices (MUTCD) and the Virginia supplement to the MUTCD.

## D. STREETSCAPE

Development trends promote the use of trees, sidewalks, bicycle facilities, and shared paths adjacent to but typically set back from vehicle corridors. Trees may also be proposed within unpaved medians and center islands in cul-de-sac designs. Landscaping within the right of way is often allowed by land use permit and maintained by the permittee.

Planting strips, located between the curb and sidewalk and parallel with the street, shall be 6 feet or more in width. Care should be used to ensure that larger planting strips to not push pedestrian crossing areas back from the intersections by requiring a larger curb radius. On streets with design speeds of 20 mph or less, or on streets with on-street parking, small street trees may be planted within 3 feet of the back of the curb and should generally by planted along the centerline of the planting strip. To maintain sight lines, trees and other objects should be restricted from corners for distances of 30 feet on all sides. Along all planting strips, the area between 2 and 7 feet above ground should be maintained as a clear zone to preserve sight lines and accommodate pedestrians.

Trees, landscaping, and other encroachments onto the right of way can obscure pedestrians or other vehicles preparing to enter the roadway from adjacent property or side streets. To protect the safety of pedestrians, bicyclist, and motorists alike, it is appropriate for vehicle operators to have an unobstructed view along the full length required by the sight distance triangle. On-street parking is considered a temporary condition and is an exempt factor.

When trees are planted along streets, especially in association with sidewalks, species selection is critical. When attracted to fruits, nuts and berries produced by some species, congregations of birds may cause potentially undesirable conditions for pedestrians Also, species that leach sap tend to damage the finishes on parked cars and, when wet, the leaves of some species may damage automotive finishes.

## E. LANDSCAPE CONSIDERATIONS

Listed below are trees that have been successfully used as street trees in Virginia. This list is only general guidance as to the type of tree to be considered for street plantings, and should not be considered an exclusive list of approved trees for landscaping. Other considerations should be made with any landscape plan.

Due to the constant improvement of varieties as well as the spread of disease and plant pathogens via interstate and intrastate trade, no tree should be utilized without the verification of local factors. Thus, developers or their representatives should have their plan prepared by a local certified landscape architect, and/or confirmed by a certified arborist, nurseryman, or agricultural extension office for advise on site suitability with regard to plant hardiness, soils, soil moisture, available root zone, exposure, known diseases in the area, etc.

A general list does not take into consideration the fact that Virginia spans six temperature zones. Trees listed are not all appropriate for all temperature zones. The temperature range of areas in which a plant performs the best is defined as its “hardiness zone.” Thus, while the list below represents a broad array of possible species, it does not indicate any division of use based upon “hardiness zone.”

Actual species selection for a given project is often based upon availability. It is strongly suggested, therefore, that developers or their representatives check on availability of species prior to submitting a plan as to prevent last minute changes to the contract and the possible provision of undesirable species.

Considerable care should be exercised in the selection of plantings for placement within the proximity of utilities and should be coordinated with the utility companies potentially affected to ensure the selection of species will be compatible with the needs of the utility companies.

a. Medium to Large Street Trees: These trees are a few examples of perhaps hundreds that have been shown to have good qualities for use as "Street Trees," such as less obstructive leaf litter, mostly due to a smaller and/or thinner leaf structure. Though all trees will have some amount of leaf drop and other “liter”, these selections have shown superior form and tolerance of urban conditions that should outweigh concern over other issues. These trees may be placed in planting strips or medians provided they are located outside the clear zone; however, care should be taken to ensure these trees have space for adequate root development.

- Acer rubrum — Red Maple
- Acer saccharum — Sugar Maple
- Betula nigra — River Birch (Single Trunk)
- Fraxinus pennsylvanica — Green Ash
- Fraxinus americana — White Ash
- Ginko biloba — Ginko (Male Only)
- Platanus acerifolia — London Planetree
- Quercus phellos — Willow Oak
- Quercus palustris — Pin Oak
- Tilia cordata — Little leaf linden
- Ulmus parvifolia — Lacebark Elm
- Zelkova serrata — Zelkova

b. Small to Medium Street Trees: These trees are also suitable for street tree planting where overhead utilities may be nearby, thus requiring a smaller crown. These trees may be planted in the planting strip between the roadway and the sidewalk, provided they are outside the clear zone.

- Cercidiphyllum japonicum — Katsuratree
- Pistacia chinensis — Chinese Pistache (Male Only)
- Acer buergerianum — Trident Maple
- Koelreutaria panniculata — Golden Raintree
- Quercus accutissima — Sawtooth Oak

c. <u>Flowering Trees suitable for accent or focal area:</u> While having a low branching pattern, these trees are generally large enough at maturity to reach above the height above a pedestrian, or compact enough to remain within a confined space. Care should be taken when locating very low branched or multi-stem varieties as not to obstruct sight lines, and to keep heavily fruiting varieties away from sidewalks. These trees may be planted in the planting strip between the roadway and the sidewalk.

- Aesculus x carnea — Red Horse Chestnut
- Aesculus parvifolia — Bottlebrush Buckeye
- Amelanchier canadensis — Serviceberry
- Cercis canadensis — Eastern Redbud
- Cercis chinensis — Chinese Redbud
- Cornus florida — Flowering Dogwood
- Cornus kousa — Korean Dogwood
- Chionanthus virginicus — White Fringetree
- Halesia tetraptera — Carolina Silverbell
- Lagerstromia indica — Crape Myrtle
- Improved fruitless varieties of Pyrus calleryanna such as “Chanticleer” or “Cleveland Select”
- Prunus yedoensis — Yoshino Cherry
- Prunus serrulata — Kwanzan Cherry

d. <u>Other Large Trees suitable for use in large open spaces:</u> These trees are appropriate for use where setbacks are available for the growth of very large trees; where trees with attractive qualities other than “Street Tree” form is desired; where bark texture and color for seasonal interest is desirable; and/or where leaf litter will not obstruct storm drainage, or drop onto a sidewalk. Such species, while appropriate for the backdrop of a subdivision entrance, or other open “common space”, would not, however, be desirable between a sidewalk and street.

- Betula nigra — River Birch (Multi-Trunk)
- Cedrus deodora — Deodar Cedar
- Celtis occidentalis — Common Hackberry
- Platanus occidentalis — Sycamore
- Liriodendron tulipifera — Tulip Poplar
- Magnolia grandiflora — Southern Magnolia
- Juniperus virginiana — Red Cedar

This list literally represents thousands of new and improved varieties and cultivars of available species in the industry. For this reason, only the common or “generic” species names are given above. Any selection must take into consideration all the factors of a given site, plant availability, and conform to any applicable local ordinance as well as these guidelines. These considerations should be confirmed by a local expert.

## F. TRAFFIC CALMING

During street layout and design, the issue of traffic calming should be considered. Early consideration can minimize future speeding problems and improve the livability of the neighborhood. If the street layout cannot be designed to encourage target speeds, traffic calming treatments may be appropriate. The type of treatment chosen for incorporation in the design depends on the function and traffic volume of the roadway segment.

Subdivision streets should be designed to encourage 85$^{th}$ percentile speeds in the range of 25 to 30 mph. This can be accomplished with attention to three major design areas – the width of the paved roadway surface, the length of tangent sections and the vertical grade.

The width of pavement should be the minimum to safely accommodate the proposed traffic. If this is not practical for other reasons, the road width can also be restricted at specific points through the use of chokers or raised median islands.

Tangent lengths should ideally not exceed 500 feet. Studies indicate that operating speeds were 30 mph or less when the tangent sections were no longer than 500 feet. Long tangent sections can be segmented by conditions that require a complete stop, such as T intersection or by conditions that require reduced speeds such as a traffic calming device. Devices that are suggested for new subdivisions with an average daily traffic between 600 and 4,000 vehicles per day include roundabouts, chokers, raised median/island, crosswalk refuges or raised pedestrian crosswalks.

Steep downgrades should be avoided in subdivision street design as vehicle speeds tend to increase on downward slopes and vehicles can quickly exceed desirable speeds. Speed humps should be avoided in favor of raised crosswalks. Four-way stop conditions should be avoided on low volume streets because there will be a tendency for the stop to be ignored and that has potential to train drivers that 4-way stops don’t really mean “stop.” Any proposal for four-way stops must be reviewed by the District Traffic Engineer.

Roundabouts are used at intersections to calm traffic as well as to control traffic. Minimum dimensions for roundabouts are shown in figure 13. Proposed designs should be based on Federal Highway Administration Publication Number FHWA-RD-00-067, Roundabouts: An Informational Guide. When roundabout design is proposed, the Resident Engineer should consult the District Location and Design Engineer.

Common characteristics of acceptable roundabouts include (a) a domed center that is sufficiently clear to not compromise sight distance and (b) a paved traversable apron not less than 4 feet in width, the radius of which is sufficient to serve the turning radius of school buses and single unit design vehicles. If the percentage of trucks anticipated to use the road exceeds 5%, that radius should be sufficient to serve those vehicles.

Further design details for all types of traffic calming measures may be found in VDOT's Traffic Calming Guide. Since the Traffic Calming Guide primarily represents retrofit designs, not all traffic calming design features in the guide are appropriate for new construction. The figure 12 illustrates when certain types of traffic calming treatments are appropriate for new construction.

| Traffic Calming Treatments | | | |
|---|---|---|---|
| **Type Treatment** | **401 – 1500 ADT** | **1500 – 2000 ADT** | **2000-4000 ADT** |
| Choker or raised median | ☑ | ☑ | ☑ |
| Chicane | ☑ | ☑ | ☑ |
| Raised Crosswalk | ☑ | | |
| Raised Crosswalk w. refuge | ☑ | ☑ | ☑ |
| Roundabout or traffic circle | ☑ | ☑ | ☑ |

Traffic Calming Details

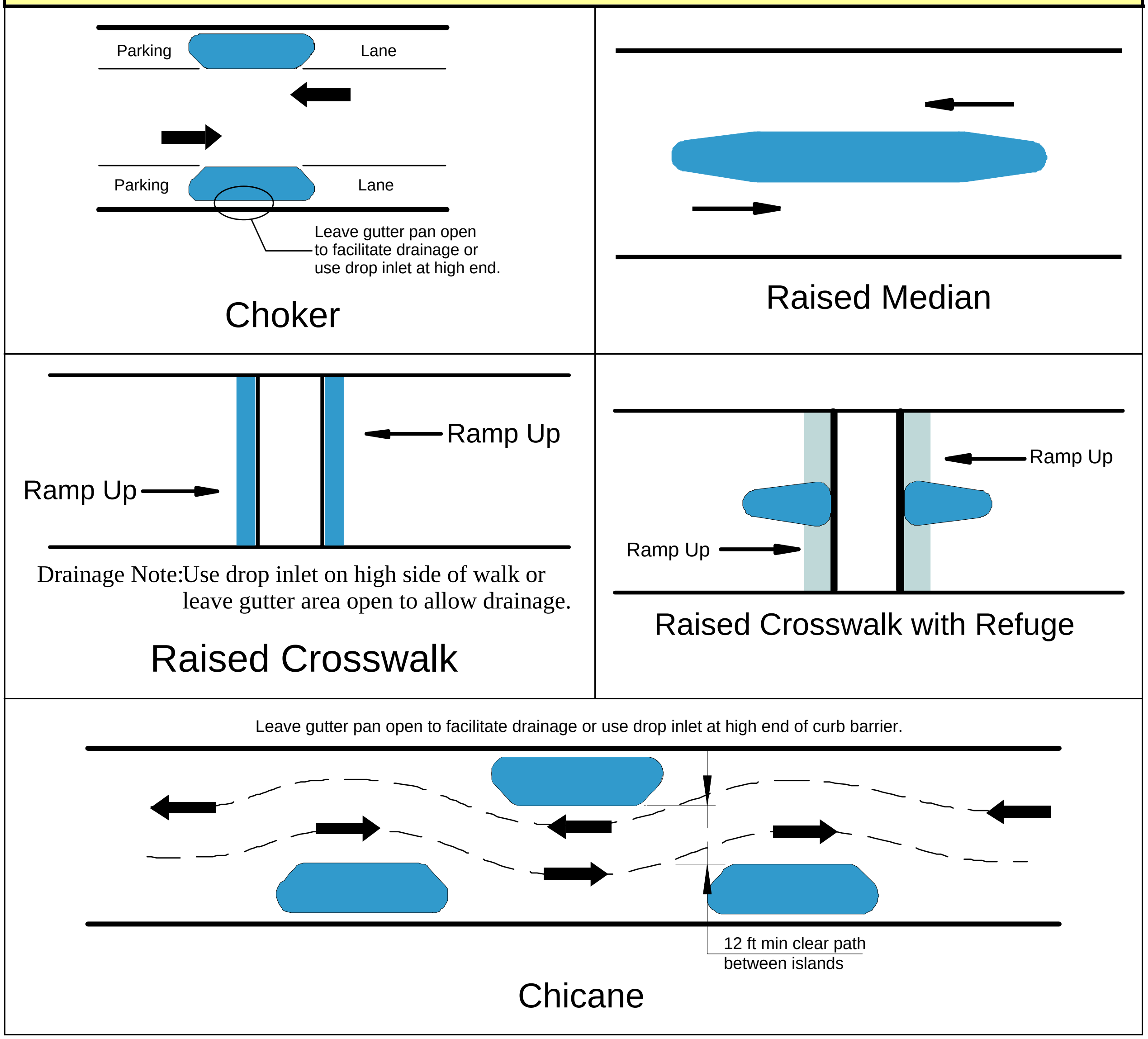
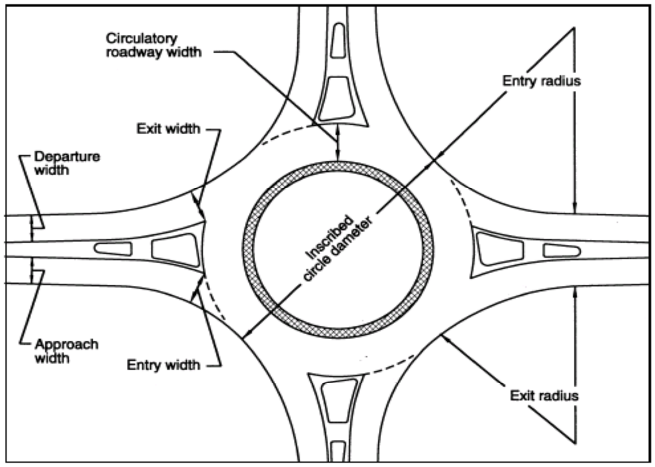
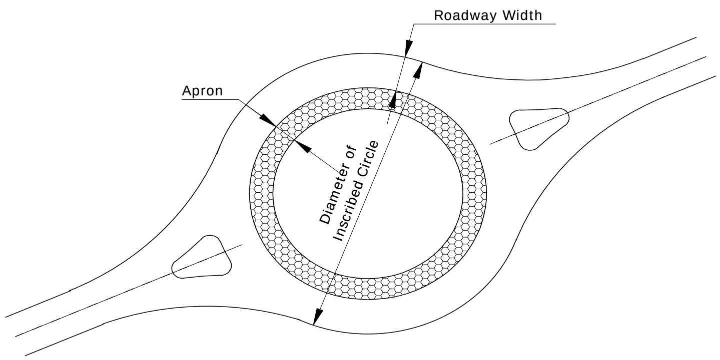



**FIGURE 12 TRAFFIC CALMING DETAILS**




| Minimum Dimensions for Roundabouts and Circular Islands | |
|---|---|
| Inscribed circle diameter | 100 feet |
| Entry lane width | 14 – 16 feet |
| Apron | 4 feet |
| Circulatory lane width | 20 feet |
| Splitter island length | 50 feet |

**FIGURE 13 ROUNDABOUT DETAILS**

## G. UTILITIES

As indicated in the Subdivision Street Requirements, local governments, the development community, and the utility community are encouraged to coordinate and consolidate their interests as part of the initial development plan. All utility locations should be indicated on the plans. Utility lines should be located to minimize need for later adjustment and to permit servicing such lines with minimum interference to traffic or destruction of roadway surfaces.

a. Underground utilities

The department allows the placement of underground utilities within the dedicated right of way of streets.

Underground utilities should normally be located outside of the travel lanes and desirably beyond the pavement. However, if the governing body has established adequate requirements for the design, location, and construction of underground utilities within the right-of-way of subdivision streets, including provisions that ensure adequate testing and inspection is performed to minimize future settlement, those requirements shall become the department's requirements and govern unless those requirements conflict with a requirement of the department.

When location of the utilities outside of the pavement area is not practical and is endorsed by the local government through their requirements, such installations:

(1) Are acceptable within the parking area and the shoulders along the street.

(2) May be acceptable beneath the travel lanes of the street when provisions are made to ensure adequate inspection and compaction tests and

(a) Longitudinal installations and manholes are located outside of the normal travel lanes, or

(b) Longitudinal installations and manholes are placed in the center of an undivided roadway out of the wheel path.

(3) Open-cutting of hard-surfaced roadways

The Department usually prohibits the open-cutting of hard-surfaced roads except in extenuating circumstances. Therefore, all underground utilities within the right-of-way, as determined necessary by good engineering practice to serve the complete development of adjacent properties, shall be installed during the street's initial construction and prior to the application of its final pavement surface course. This shall include extensions of all necessary cross-street connections or service lines to an appropriate location beyond the pavement and preferably the right of way line.

In the event it is necessary to open the street pavement to work on utilities after the surface has been placed, additional compaction tests and paving as necessary to restore the integrity and appearance of the roadway may be required at the discretion of the Resident Engineer.

(4) Cross-street conduits

To facilitate the placement of future underground utilities, cross-street conduits are encouraged with placement of such conduits occurring on each street at intersections and approximate every 1000 feet along the length of a street.

b. Above ground utilities

All above ground utilities shall be installed behind the sidewalk or as close as possible to the limits of the street's right-of-way.

## H. ROADWAY LIGHTING

Since lighting on subdivision streets, whether roadway, pedestrian or security, is generally for the benefit and convenience of the development and not necessary for traffic safety, the installation, maintenance and operation of the lighting shall be provided by and at the sole expense of others.

VDOT will allow roadway lighting within the rights of way by land use permit only. VDOT will review and approve all roadway lighting plans regardless of maintenance and operational responsibility. On curb sections, poles shall be placed behind the curb and preferably behind the sidewalk. For shoulder sections, the pole shall be placed a minimum of 10 feet from the edge of pavement and behind the ditch line. All lighting proposed within the rights of way must be designed in accordance with the AASHTO guide for Roadway Lighting and shall meet the current Illuminating Engineering Society of North America (IESNA) Standards.

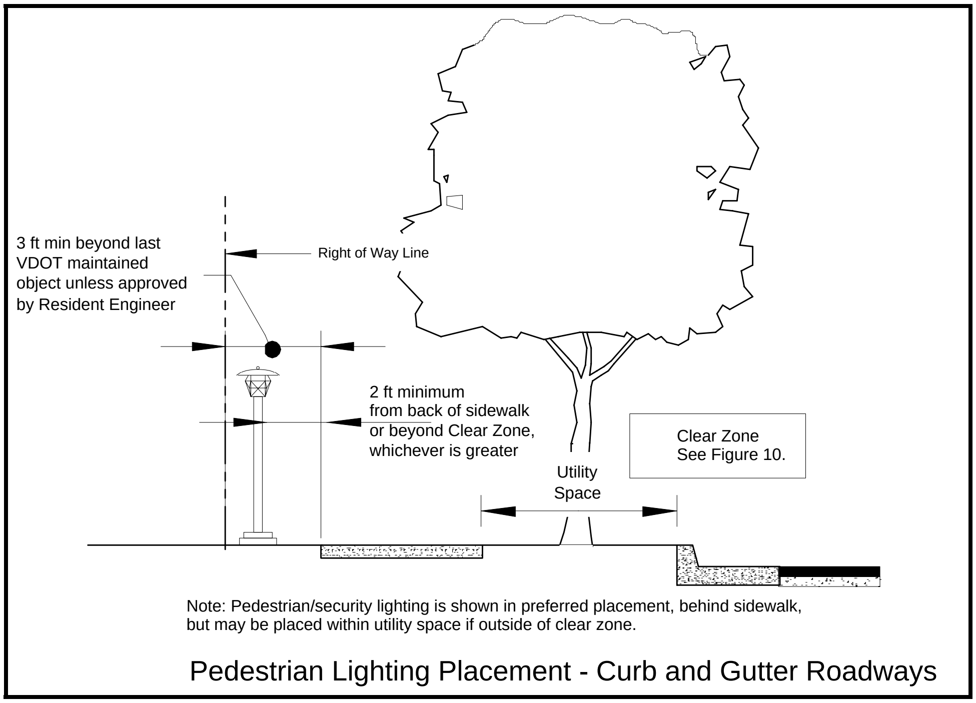



**FIGURE 14 – LIGHTING ALONG CURB AND GUTTER SECTIONS**

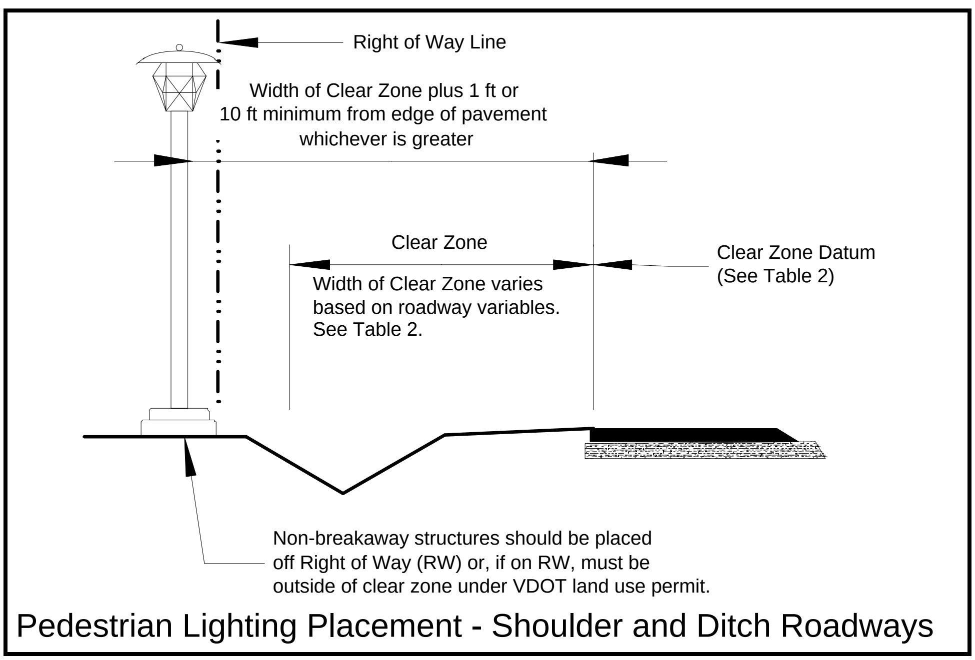



**FIGURE 15 – LIGHTING ALONG SHOULDER AND DITCH SECTIONS**

## SECTION B – 6 – NEOTRADITIONAL NEIGHBORHOOD DESIGN

Any Neotraditional Neighborhood Development proposal should be presented to the locality and VDOT in its entirety. It is recognized that each neotraditional development is unique and will require individual review, discussion and approval of unique features. However, any county interested in neotraditional development is encouraged to submit their county wide proposal of the basic features they would like to see allowed in neotraditional type development for VDOT review.

A Neotraditional Neighborhood Development is a multi use, walkable community with moderate to high residential densities and a mixed-use core. Compared with conventional suburban developments, Neotraditionals have a higher potential to increase modal split by encouraging and accommodating alternate transportation modes. Neotraditionals also have a higher potential for capturing internal trips due to the increased employment, educational, and recreational facilities located within the development, thus reducing vehicles miles traveled.

A dense network of narrower streets with reduced curb radii is a key feature of Neotraditional Neighborhood Development design. This network serves to both slow and disperse vehicular traffic and provide a pedestrian friendly atmosphere. Such alternate guidelines are encouraged when the overall design ensures that non-vehicular travel is to be afforded very practical accommodation that does not adversely affect safety considerations.

Neotraditional Neighborhood Developments have a high proportion of interconnected streets, sidewalks and paths. Street and rights of way are shared between vehicles (moving and parked), bicycles, and pedestrians. The dense network of Neotraditional Neighborhood Development streets functions in an interdependent manner, providing continuous routes that enhance non-vehicular traffic. Most Neotraditional Neighborhood Development streets are designed to minimize through traffic by the design of the street and the location of the land uses. Streets are designed to only be as wide as needed to accommodate the usual vehicular mix for that street while providing adequate access for moving vans, garbage trucks, emergency vehicles and school busses.

In addition, the following features are characteristic of Neotraditional Neighborhood Developments and may be allowed within these subdivision guidelines.

A. All or most streets must be part of a dense interconnected pattern. The degree of interconnectivity should be maximized to permit multiple routes, diffuse traffic and shorten walking distances. Most Neotraditional Neighborhood Development streets are designed to minimize through traffic.

B. One-way street pairs are often used. The design features for one-way streets are shown on table 3.

C. Alleys are encouraged to provide site access, though alleys will not be accepted by VDOT for maintenance in the secondary system. The alley network also ensures minimal service vehicle access on the neighborhood street.

D. Large vehicular corridors are usually found within the core are and near the perimeter of the proposed development. Neotraditional Neighborhood Developments typically include transit availability within a 15-minute walk of most areas of the development so a good network of streets that can accommodate busses is important.

E. All or most low volume streets should have short block lengths of between 250 and 500 feet.

F. Traffic calming – Many of the previously identified traffic calming devices may be utilized in a Neotraditional Neighborhood Development to promote pedestrian movement. Loop streets or eyebrows are often used in neotraditional neighborhood development and may be considered acceptable ancillary pavement areas used only with curb and gutter sections. These features are not normally considered separate streets but may be used within the internal subdivision street network and should not adjoin any existing road.

G. Curb Extensions – Curb extensions at intersections are frequently used in Neotraditional developments.  Curb Extensions are usually found on higher volume streets where they are used to protect parking areas or reduce pedestrian crossing times.  For intersections with curb extensions, a minimum 35' radius should be used as in the sketch below. Intersection chokers or curb extensions can also be used to calm traffic and to shorten the distance pedestrians must travel to cross a street.

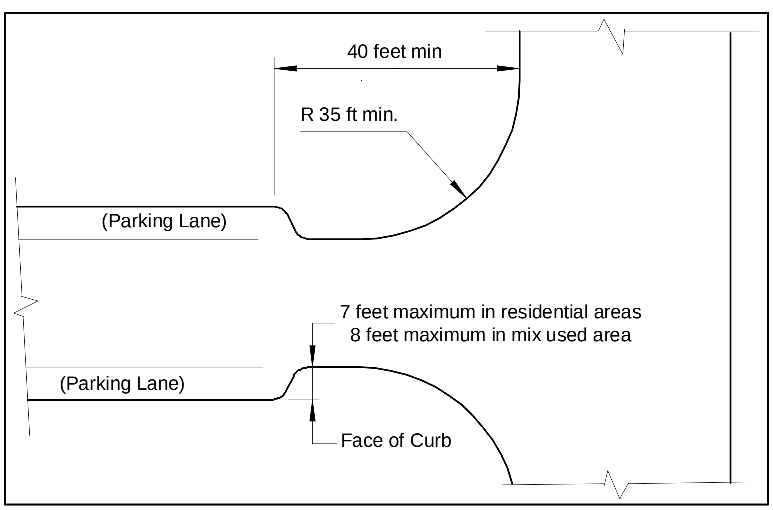



**FIGURE 16 - CURB EXTENSION DETAIL**

## SECTION B – 7 – INNOVATIVE DESIGN PROPOSALS

This Guide sets out design criteria and guidance for local subdivision streets based on VDOT standards and other applicable design references. If a development proposes use of a recognized acceptable concept or material not previously approved for VDOT use, a request shall be submitted to VDOT's Resident Engineer or designee for review. The Resident Engineer or designee, through consultation with appropriate divisions, will determine if the request will be approved for a VDOT maintained street. If it is determined that the non-standard item may be installed within the dedicated right of way and should be maintained by others, a permit will be required.

## APPENDIX C

### SECTION C-1-DESIGN FEATURES



### SECTION C-2-ENVIRONMENTAL



### SECTION C-3 RIGHT OF WAY

**SECTION C-4-WATER RELATED PERMITS**

**Page**



**SECTION C-5 SAFETY PROJECTS**

**Page**



**SECTION C-6- SITE PLAN REVIEW**

**Page**

## LIST OF FIGURES

# APPENDIX C

## SECTION C-1-DESIGN FEATURES

### CROSSOVER SPACING

Criteria Table C-1-1 shows crossover spacing and sight distance requirements to be applied on all divided highways without full control of access. The minimum sight distance requirement indicated in Table C-1-1 must be met at all crossover locations. Crossover spacing less than shown as minimum will be considered when required by intersecting public highways or streets with a current ADT of 100 or greater. Other crossovers will only be allowed after an individual traffic safety and operational study.

The following are some factors, but not all inclusive, that should be considered in the study, if applicable: Operating speed, volume of traffic for crossover and through routes, signal operation/progression, accidents with and without additional crossover, number of U-turns, weaving maneuvers, alternative solution, capacity analysis, type of vehicles such as school buses, trucks, etc. Final approval will be required by the Mobility Management Engineer and the State Location and Design Engineer.

| DESIGN SPEED of HIGHWAY (MPH) | CROSSOVER SPACING | | MINIMUM SIGHT DISTANCE (FEET) |
|---|---|---|---|
| | DESIRABLE (FEET) | MINIMUM (FEET) | |
| 70 | 1250 | 1000 | 825 |
| 60 | 1100 | 900 | 710 |
| 55 | 1000 | 800 | 650 |
| 50 | 900 | 700 | 590 |
| 45 | 800 | 650 | 530 |
| 40 | 700 | 600 | 475 |
| 35 | 600 | 500 | 415 |

**TABLE C-1-1 CROSSOVER SPACING CRITERIA**

Sight distance determinations apply both horizontally and vertically and are to be based on a height of driver's eye of 3.5’ and a height of object 3.5’ measured each way.

All plans at the field inspection stage are to show only those crossovers at public highways and streets which meet these criteria or at other locations that preliminary planning and traffic studies have warranted. The determination of additional crossovers will be the result of field inspection recommendations of the District Administrator, Mobility Management Engineer, (or other appropriate Engineer) and the State L & D Engineer.

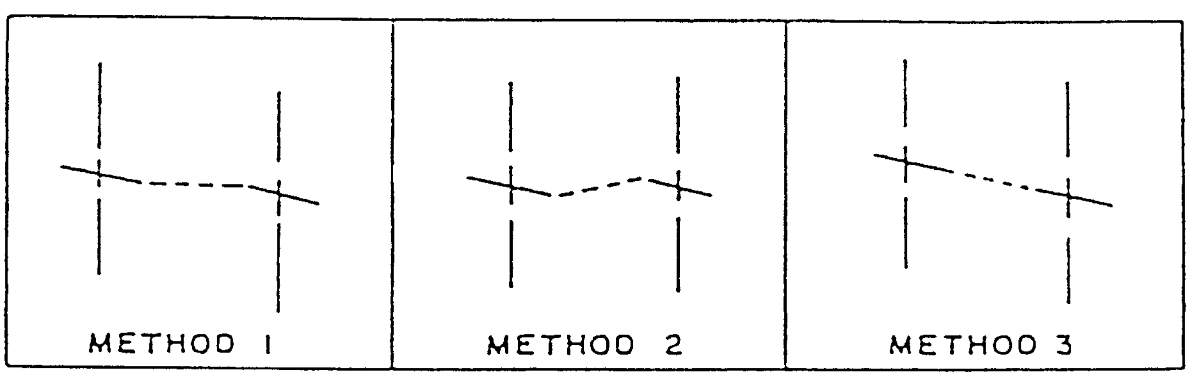
The approval of the crossovers is the responsibility of the State Mobility Management Engineer and the State L & D Engineer, with the final responsibility for the location of crossover layout on plans resting with the State L & D Engineer.

Plans at right of way stage are to indicate the crossovers as determined and approved by the above criteria. Any plans that are revised for crossovers during construction are to be approved as indicated above. When construction has been completed, the approval of the addition or deletion of crossovers will be the responsibility of the Mobility Management Engineer (or other appropriate Engineer) with the concurrence of the State Location and Design Engineer. It will be the responsibility of the Traffic Engineer to coordinate such changes with the State Location and Design Engineer in order that these revisions of crossovers may be properly recorded on the original plans.

**CROSSOVER GRADES**

On divided highways with depressed medians, there are generally three methods by which superelevation is determined for the opposing traffic lanes.

One method is for the median pavement edges to be held at the same, or close to the same, elevation. A second method is for each baseline elevation to be approximately the same, with a corresponding difference in elevation of the median pavement edges. The third method is for the superelevation of all lanes to be obtained along a single plane. Thus, the grade of the lane on the outside of the curve is higher than the inside lane. The various methods are illustrated below:



The designer is to study the requirements of each particular situation. In the case of a facility without crossovers, the first method above is generally acceptable on superelevated curves. This will allow the median area to be properly graded without creating an adverse design situation.

Method 2 generally results in an undesirable situation and must be used with caution.

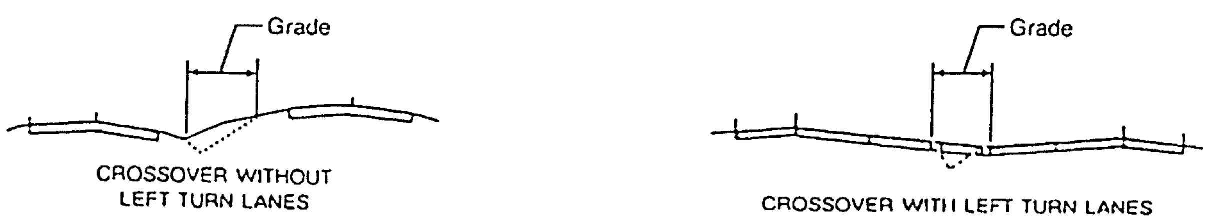
In a case where a crossover is proposed, particularly in conjunction with a connecting road within the limits of a superelevated curve, the designer shall pay particular attention to the path which must be traversed by vehicles using the crossover.

In most cases, the application of the superelevation in a single plane (Method 3) is the acceptable method. This will allow a vehicle to cross from one lane to the other without negotiating several different gradients. As noted herein, this will require the adjustment of the mainline grades.

The desirable grade on a crossover is between 0.5% and 5%. The maximum grade should never exceed 10% as safe turning movements above this level are difficult. It is especially important at locations, such as truck stops and other businesses generating large vehicular traffic, that crossover grades fall in the category of less than 5%. A desirable maximum algebraic difference of a crossover crown line is 4 or 5 percent, but it may be as high as 8 percent at the locations where there are few trucks or school buses and low speeds. Additionally, sight distances must be checked for values shown in table for "Sight Distances along Major Road at Intersection with Minor Road and Crossovers and Commercial Entrances." (See Sight Distance Table C-1-5). Any deviation from these values is to be brought to the attention of the State Location and Design Engineer.

The grade on a crossover is measured from the edge of shoulder to the edge of shoulder, unless left turn lanes are provided, in which case the grade is applied from the edge of pavement of the left turn lane to the edge of pavement of the opposite left turn lane. This is more clearly shown in the following diagram:

Determination of Grade on a Crossover




In preparing plans for field inspection, the gradient at each crossover is to be plotted graphically.

## INTERSECTING CROSS ROAD GRADES

The grade of a connecting facility must be carefully studied when approaching an intersection where the mainline is superelevated. A smooth grade tie-in is desirable, with sufficient area on a relatively flat grade for a vehicle to stop before entering the main roadway. Also, when a connection is on the outside of a superelevated curve, the grade must be designed so that the connection is visible to a driver on the main roadway desiring to turn onto the connection.

Every attempt must be made to provide an adequate area for this vehicular stoppage, giving full consideration to the horizontal and vertical sight distances.

The desirable tie-in is one that is no steeper than the pavement cross slope whether this is superelevated or the normal crown. The maximum difference between the pavement cross slope and the approach road grade shall not exceed 8% at stop intersections, or 4% at continuous-movement intersections. The stoppage area should be a desirable minimum of 50’ before beginning the steeper grade. (See AASHTO's <u>A Policy on Geometric Design of Highways and Streets</u>)

## LEFT-TURN LANES

As a general policy, left-turn lanes are to be provided for traffic in both directions in the design of all median crossovers on non-access controlled divided highways using controls as shown in Figure C-1-1. Left-turn lanes should also be established on two-lane highways where needed for storage of left-turn vehicles and/or prevention of thru-traffic delay.

LENGTH OF STORAGE

Rural - For Design Speeds 50 MPH or Higher — *L - 200' min. (For 240 or fewer vehicles during peak hour, making turn)

- For Design Speeds Less than 50 MPH — *L - 100' min. (For 60 or fewer vehicles during peak hour, making turn)

*Distance L to be adjusted upward as determined by capacity analysis for Left-Turn Storage.

Urban - Length determined by capacity analysis for Left-Turn Storage

TAPER - Rural and Urban

- For Design Speeds 35 MPH or Higher — **T - 200' Min.

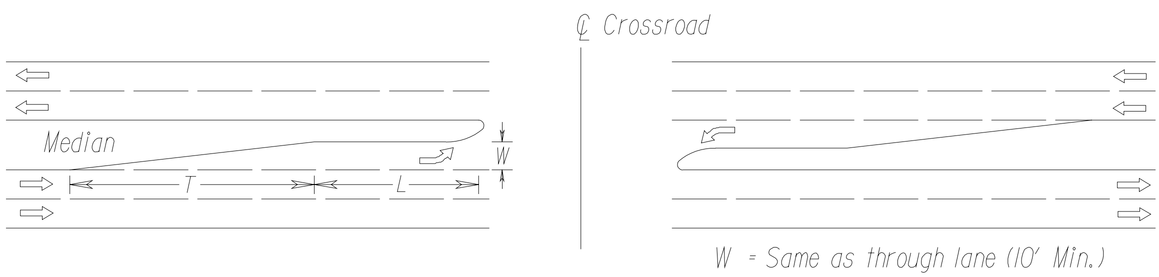
- For Design Speeds Less than 35 MPH — **T - 100' Min.

**Tapers are to be straight-line unless local policy requires reverse curves. In congested areas the taper length may be reduced to increase storage length.

**FIGURE C-1-1**

Dimension "L" to be adjusted upward as determined by Figure C-1-1.1 or by capacity analysis for left-turn storage.

A capacity analysis is defined as a detailed analysis of the location in accordance with the guidelines contained in the current issue of the Highway Capacity Manual for intersection capacity and signalization requirements.



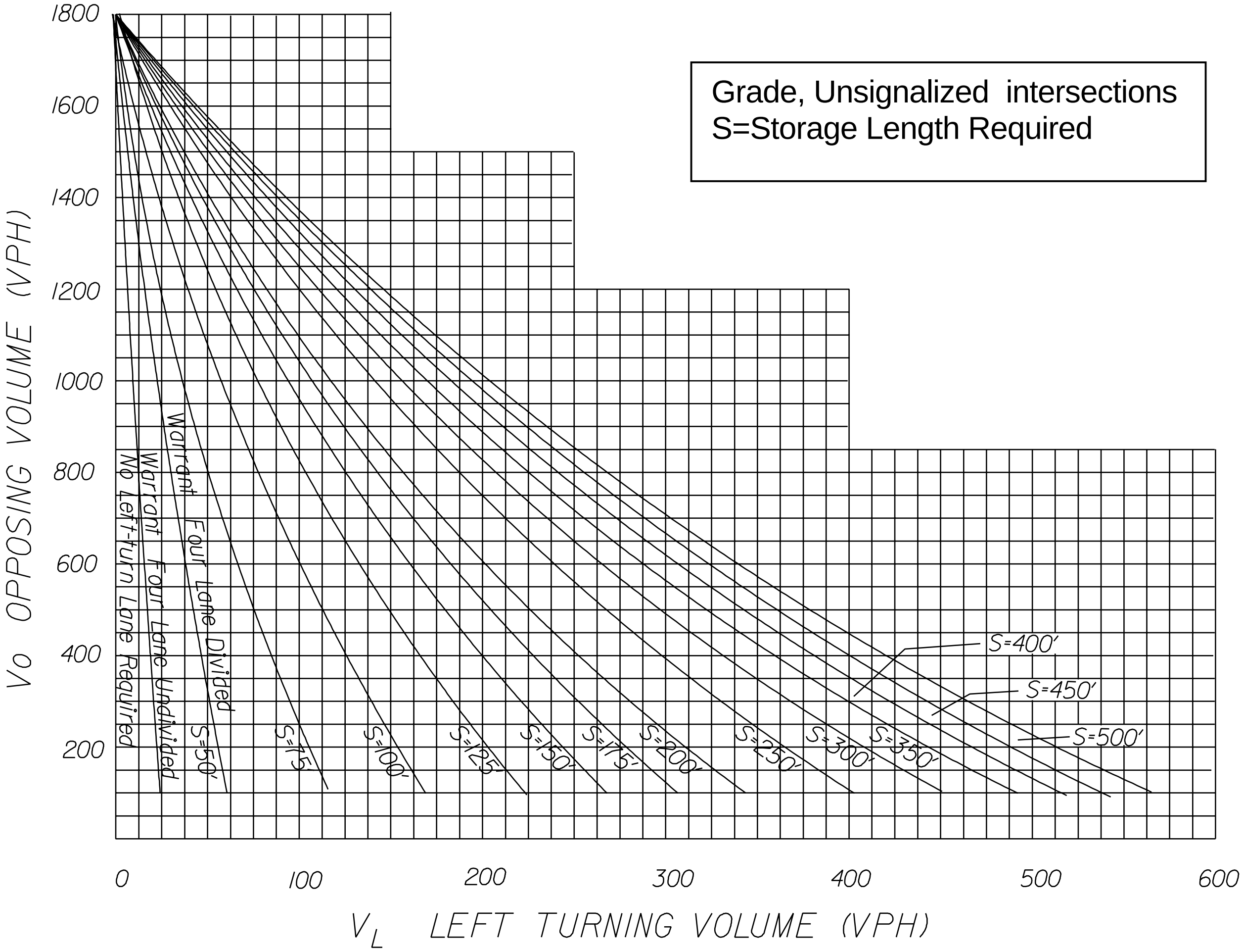



**FIGURE C-1-1.1 WARRANT FOR LEFT TURN STORAGE LANES ON FOUR-LANE HIGHWAYS**

When the Average Running Speed on an existing facility is available, the corresponding Design Speed may be obtained from IIM LD- 117.

For plan detail requirements when curb and/or gutter are used, see VDOT's Road Design Manual, Volume 1, Section 2E-3.

Left-turn lanes should also be established on two-lane highways where traffic volumes are high enough to warrant them in accordance with the guidelines shown in Table C-1-2.

## WARRANTS FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

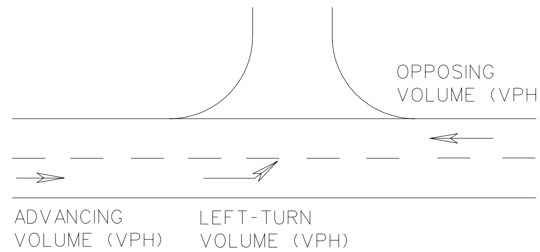
The warrants in Table C-1-2 are taken from the AASHTO "Green Book", Exhibit 9-75. They were derived from Highway Research Report No. 211, Figures 2 through 19, for required storage length determinations.

The No. 211 study was undertaken to provide consistent volume warrants for left-turn storage lanes at unsignalized intersections.

| VPH OPPOSING VOLUME | ADVANCING VOLUME 5% LEFT TURNS | 10% LEFT TURNS | 20% LEFT TURNS | 30% LEFT TURNS |
|---|---|---|---|---|
| | 40-MPH OPERATING SPEED/DESIGN SPEED* | | | |
| 800 | 330 | 240 | 180 | 160 |
| 600 | 410 | 305 | 225 | 200 |
| 400 | 510 | 380 | 275 | 245 |
| 200 | 640 | 470 | 350 | 305 |
| 100 | 720 | 515 | 390 | 340 |
| | 50-MPH OPERATING SPEED/DESIGN SPEED* | | | |
| 800 | 280 | 210 | 165 | 135 |
| 600 | 350 | 280 | 195 | 170 |
| 400 | 430 | 320 | 240 | 210 |
| 200 | 550 | 400 | 300 | 270 |
| 100 | 615 | 445 | 335 | 295 |
| | 60-MPH OPERATING SPEED/DESIGN SPEED* | | | |
| 800 | 230 | 170 | 125 | 115 |
| 600 | 290 | 210 | 160 | 140 |
| 400 | 365 | 270 | 200 | 175 |
| 200 | 450 | 330 | 250 | 215 |
| 100 | 505 | 370 | 275 | 240 |

*SPEED LIMIT MAY BE USED IF APPLICABLE, I.E. ADDING LANES TO EXISTING FACILITIES.

**TABLE C-1-2 WARRANTS FOR LEFT-TURN LANES ON TWO-LANE HIGHWAYS**




Example:

Two-lane highway with 40-MPH operating speed

Opposing Volume (VPH) - 600
Advancing Volume (VPH) - 440
Left-Turn Volume (VPH) - 44 or 10% of Advancing Volume

With opposing volume (VPH) of 600 and 10% of advancing volume (VPH) making left turns, and advancing volume (VPH) of 305 or more will warrant a left-turn lane.

Figure C-1-1.3 (page C-7) denotes that a 100’ storage length is required.

Figures C-1-1.2 through C-1-1.19 provide warrants for left-turn storage lanes on two-lane highways based on 5 to 40 percent left-turn volumes and operating speeds of 40, 50, and 60 MPH. Table C-1-2.1 provides the additional storage length required for 10 to 50 percent truck volumes.

Intersections with poor visibility and/or a bad accident record may require the designer to use engineering judgment when volume conditions alone do not warrant a storage lane.

For additional information see 2001 AASHTO Green Book, Exhibit 9-75.

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

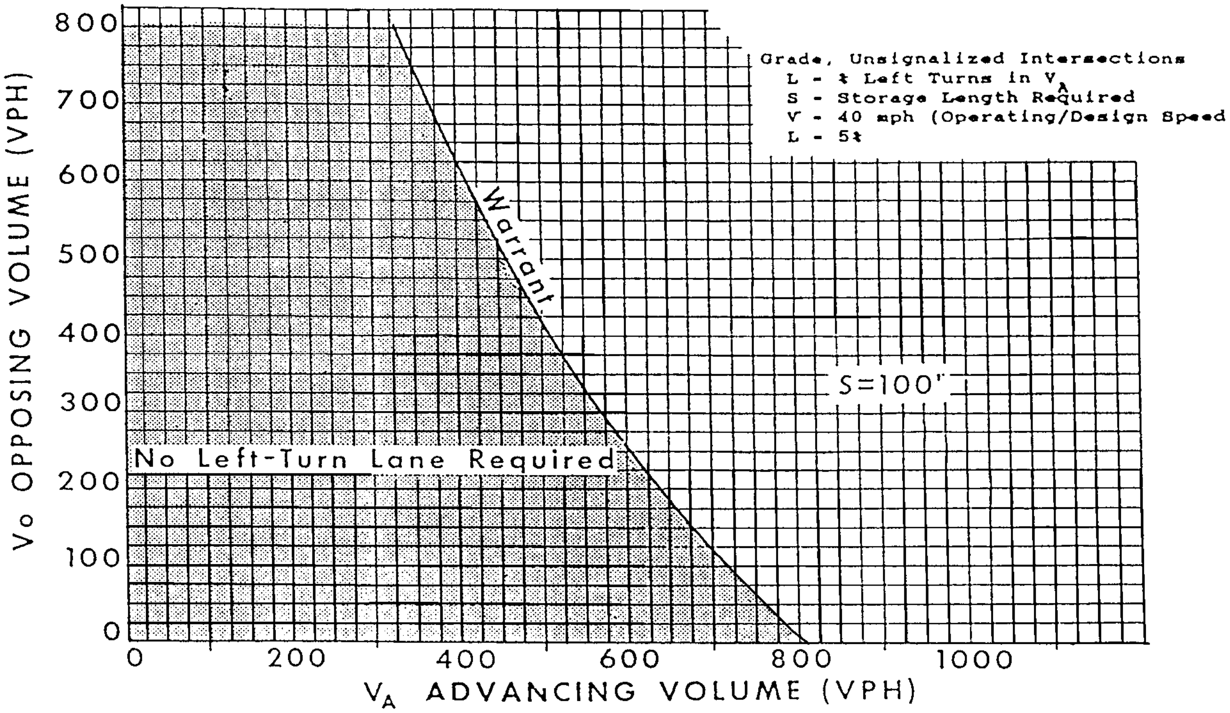



FIGURE C-1-1.2

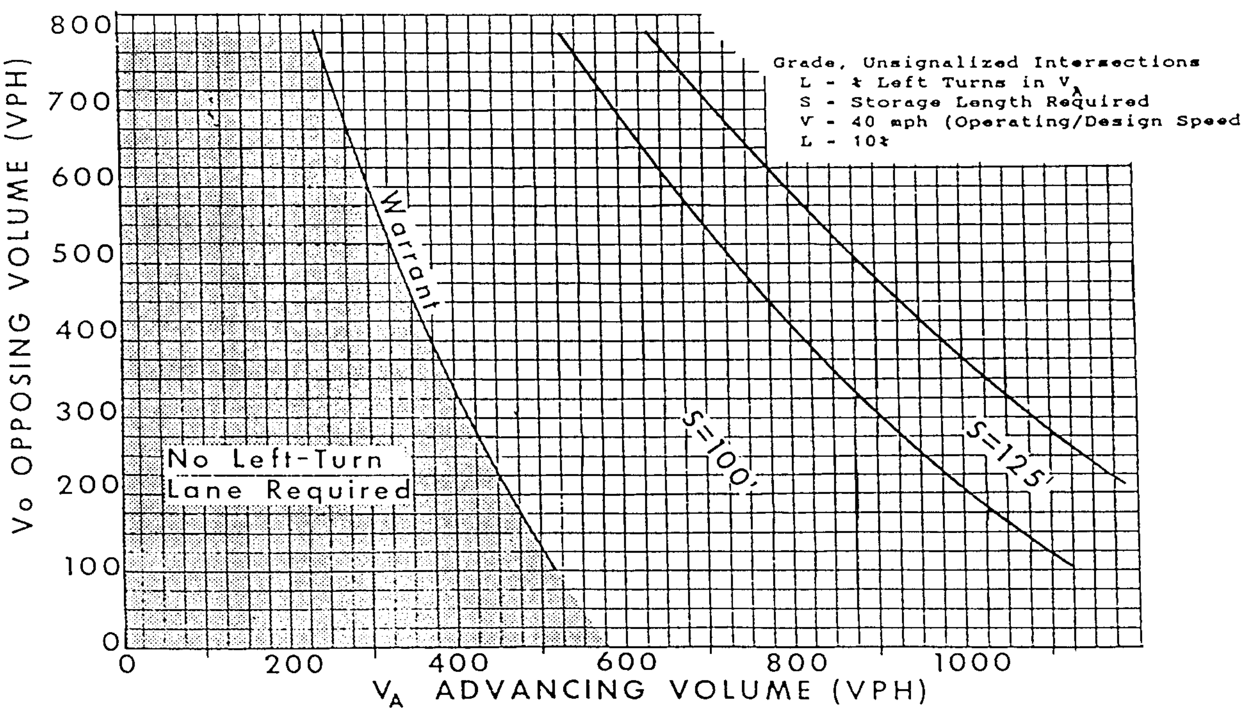



FIGURE C-1-1.3

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

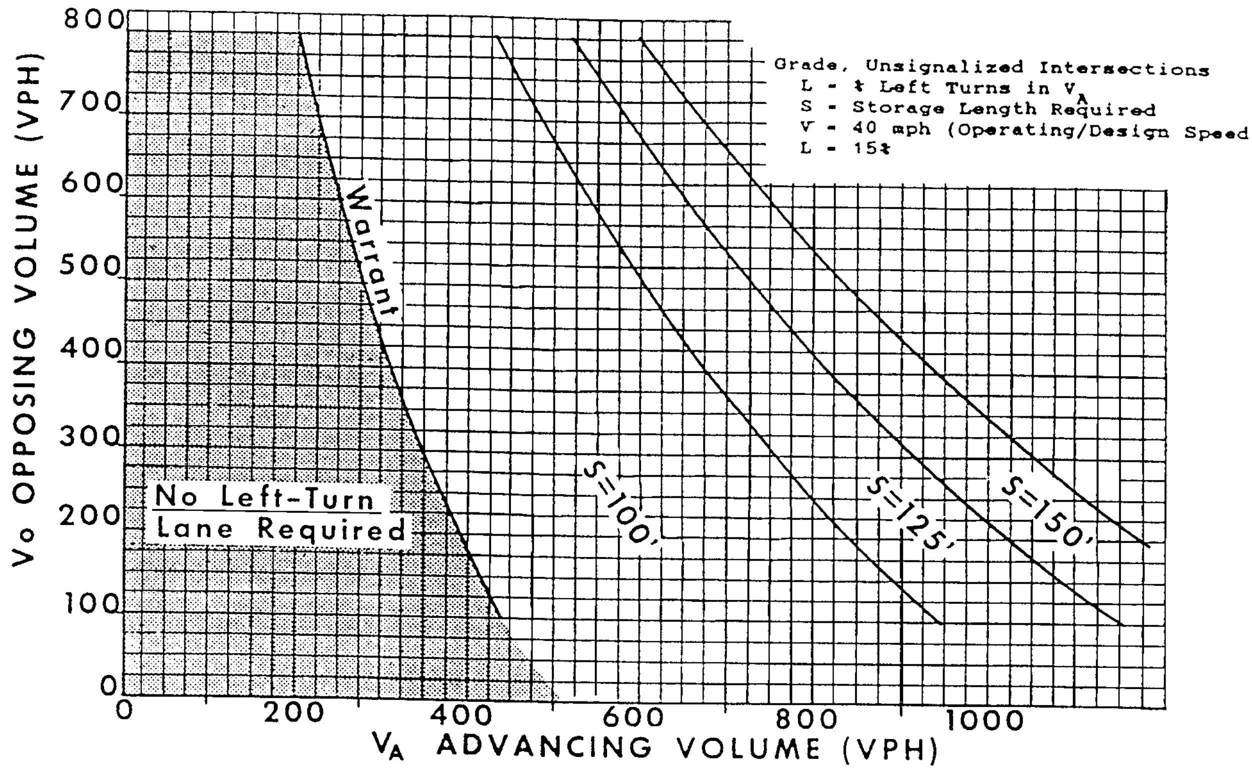



FIGURE C-1-1.4

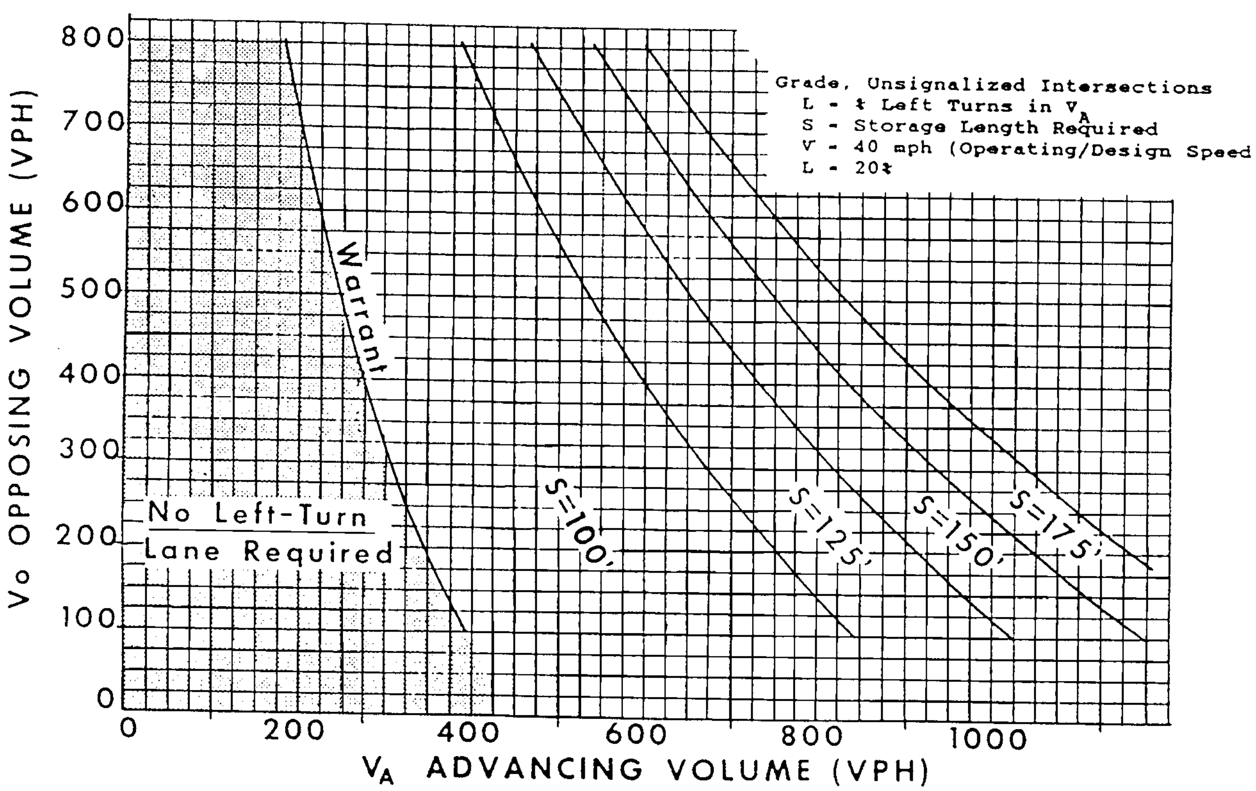



FIGURE C-1-1.5

# WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

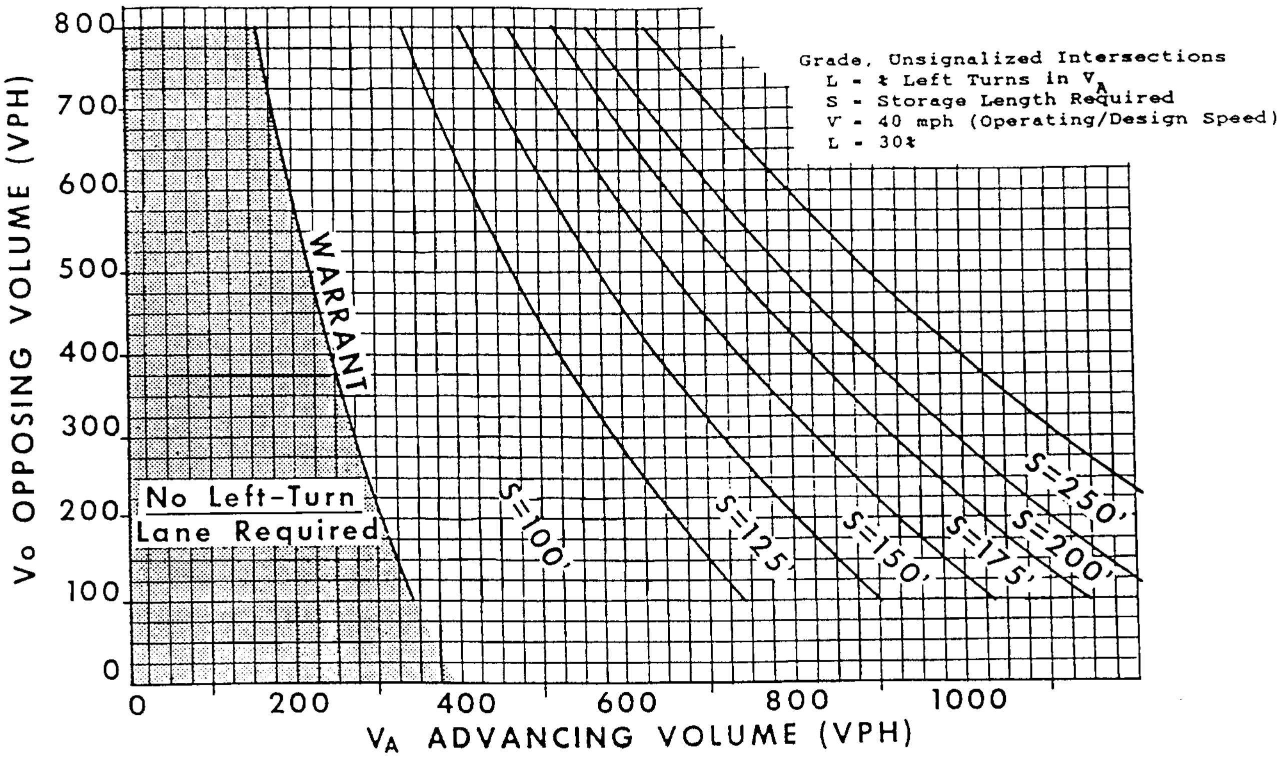



FIGURE C-1-1.6

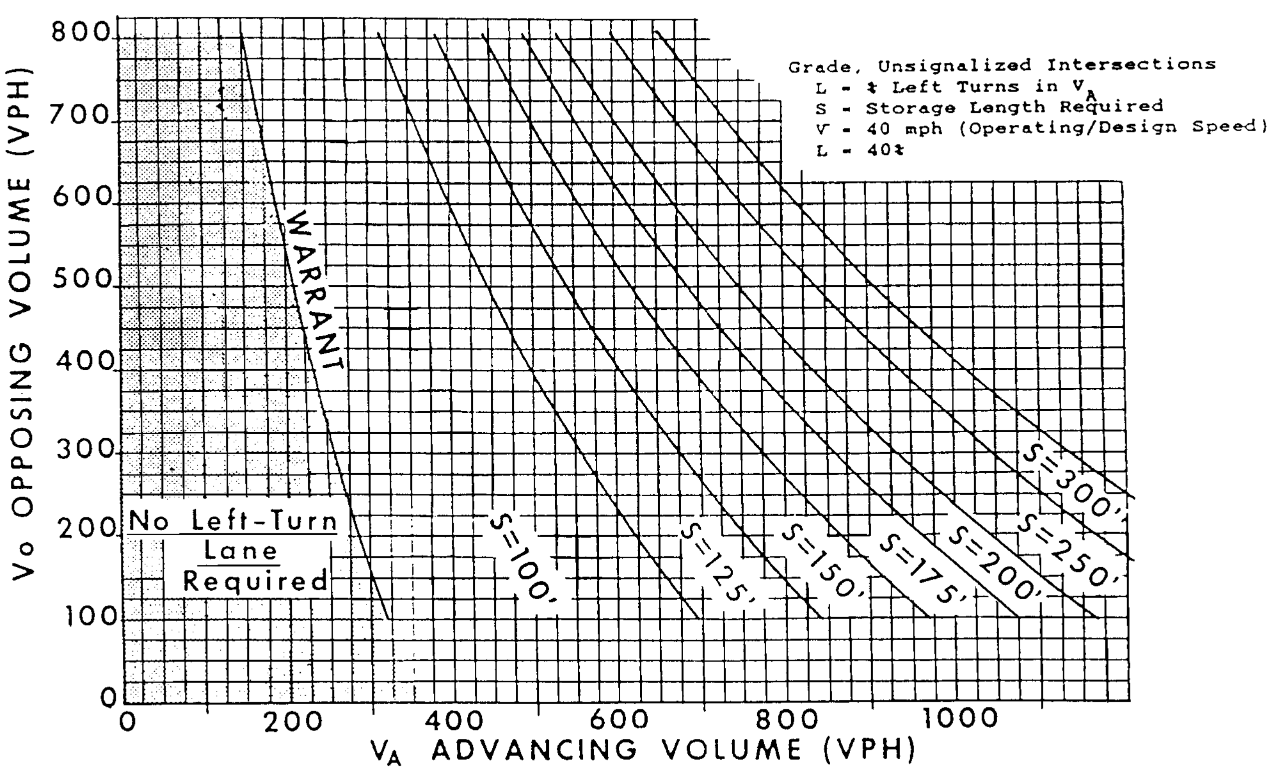



FIGURE C-1-1.7

# WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

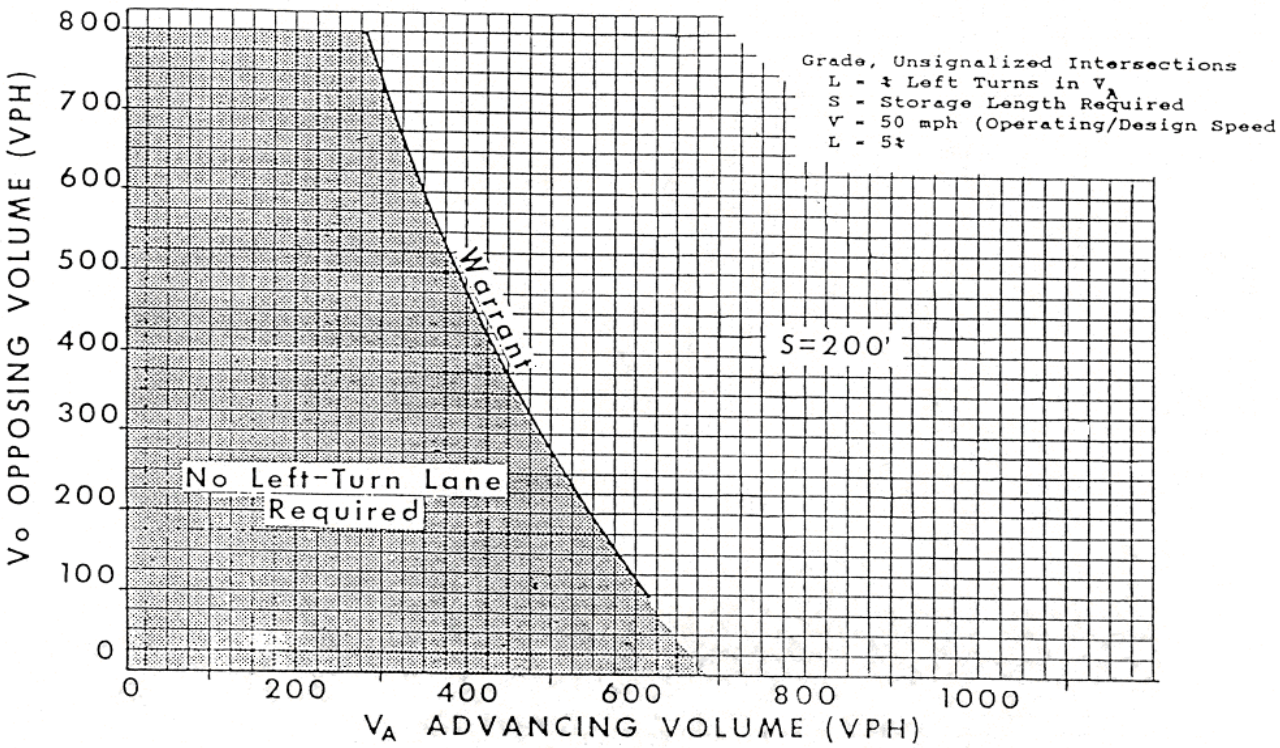



FIGURE C-1-1.8

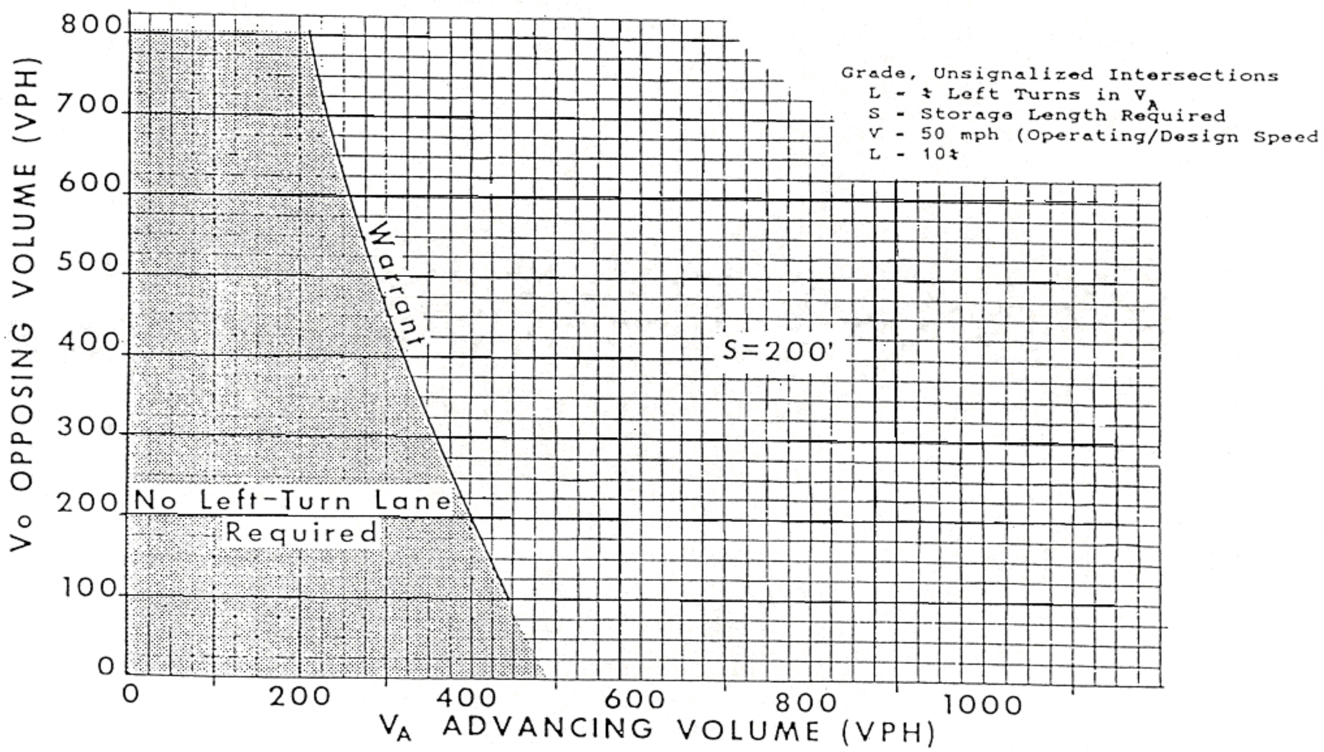



FIGURE C-1-1.9

# WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

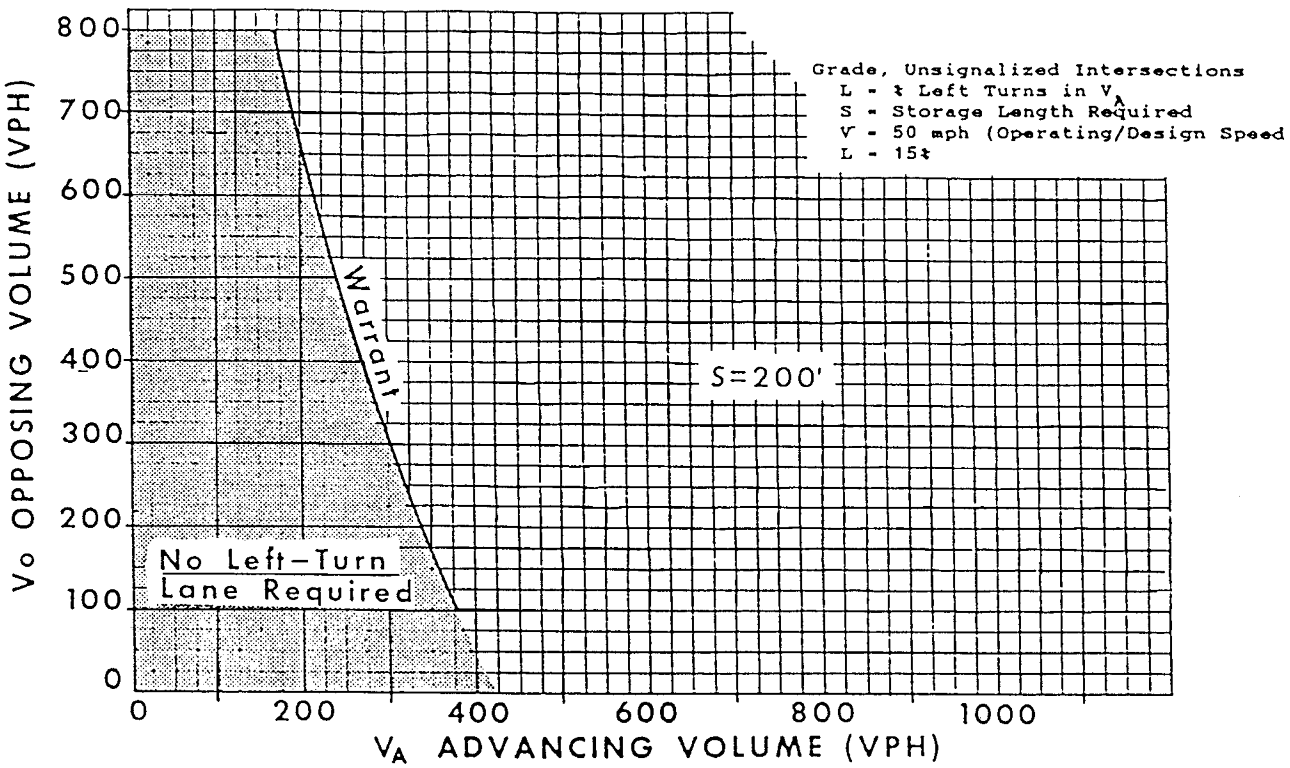



FIGURE C-1-1.10

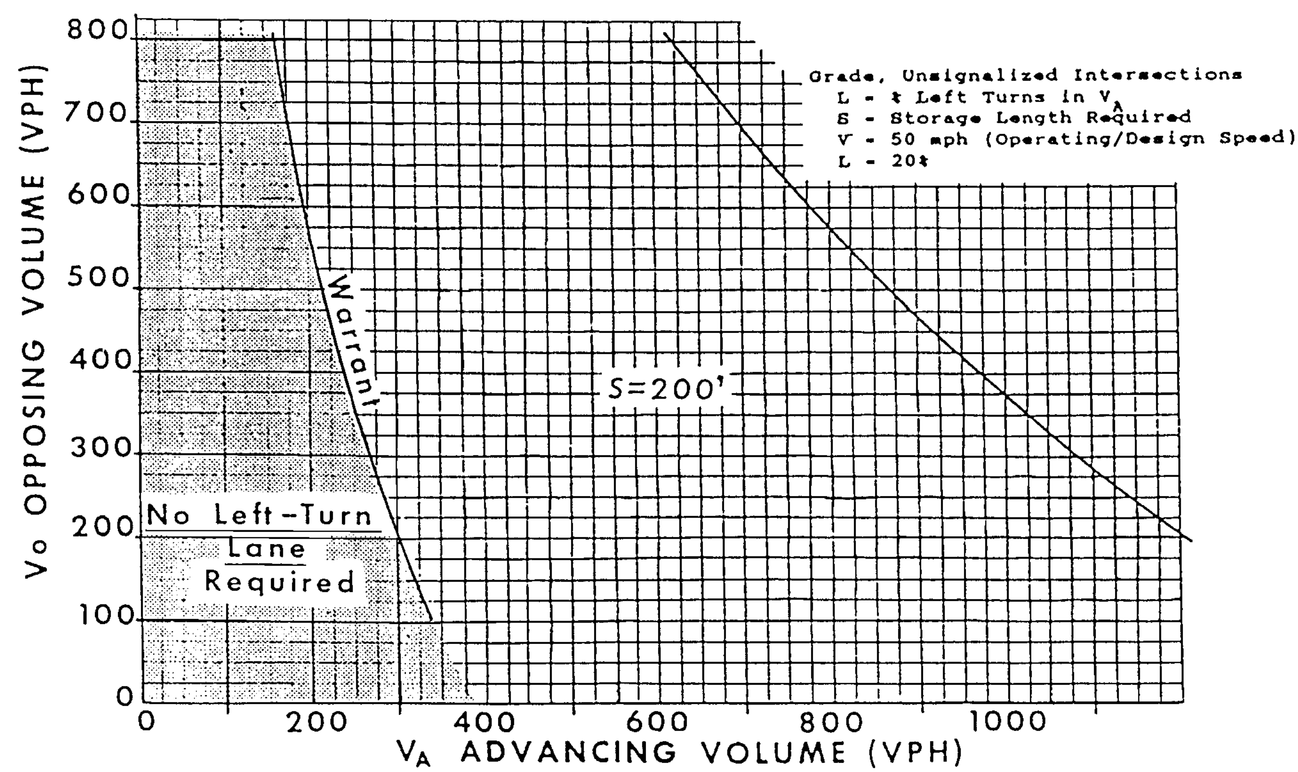



FIGURE C-1-1.11

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

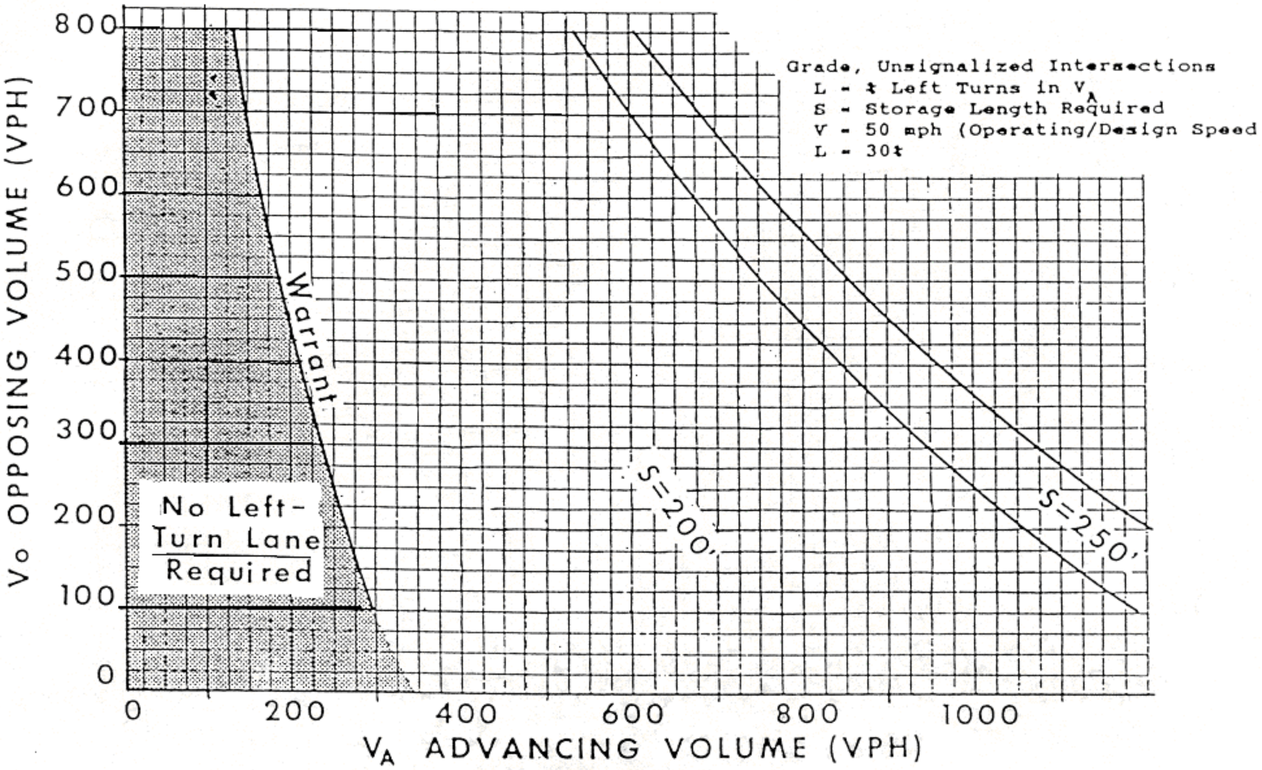



FIGURE C-1-1.12

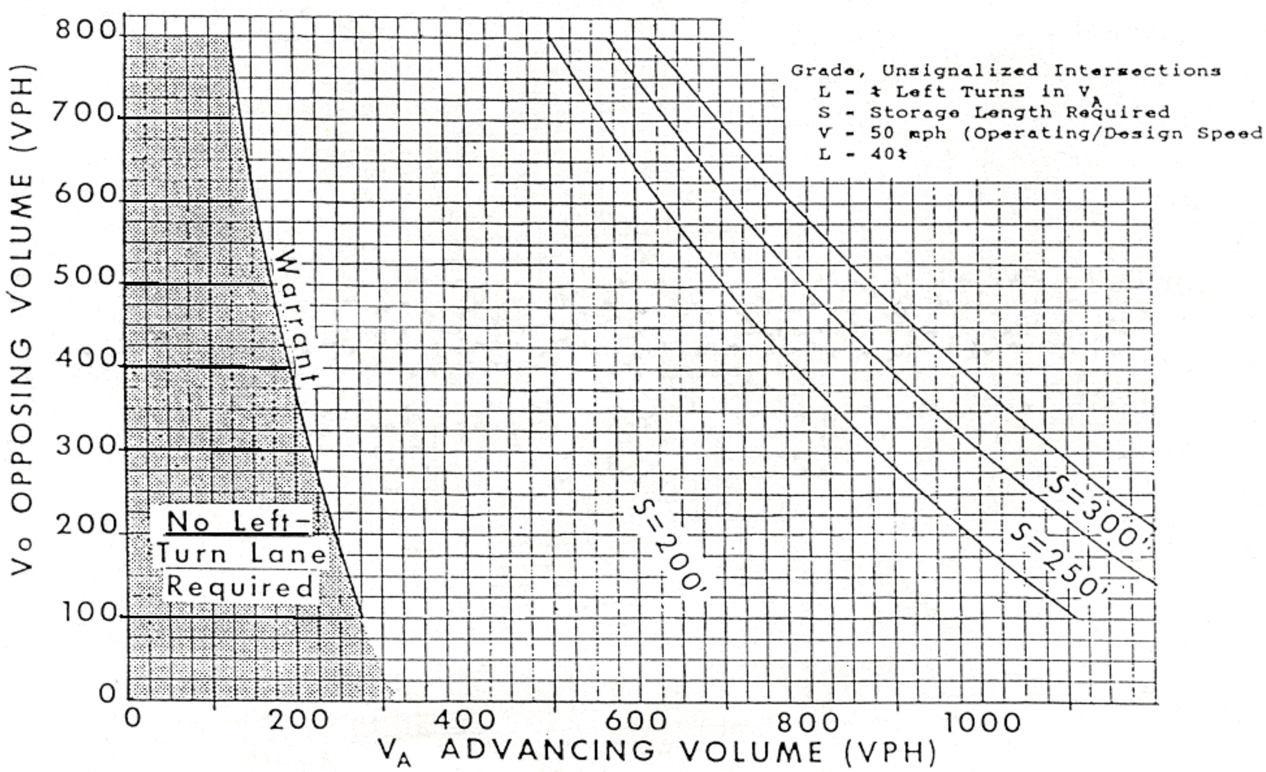



FIGURE C-1-1.13

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

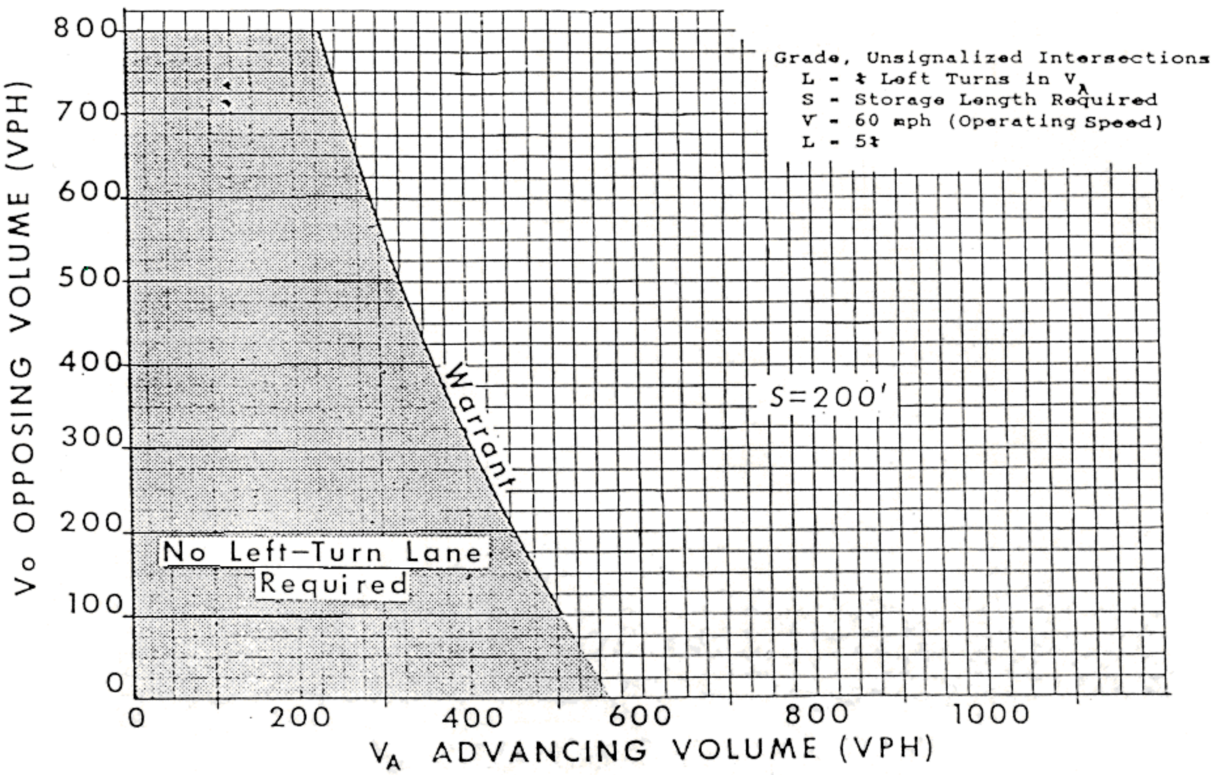



FIGURE C-1-1.14

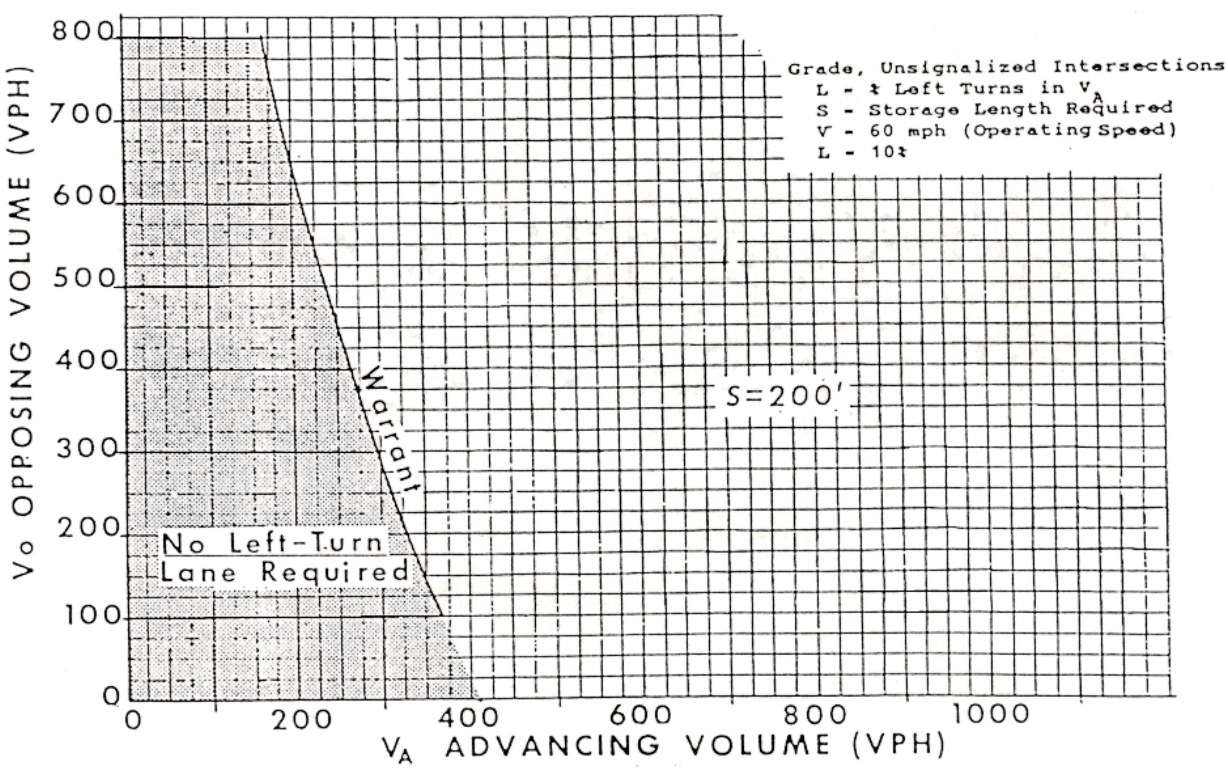



FIGURE C-1-1.15

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

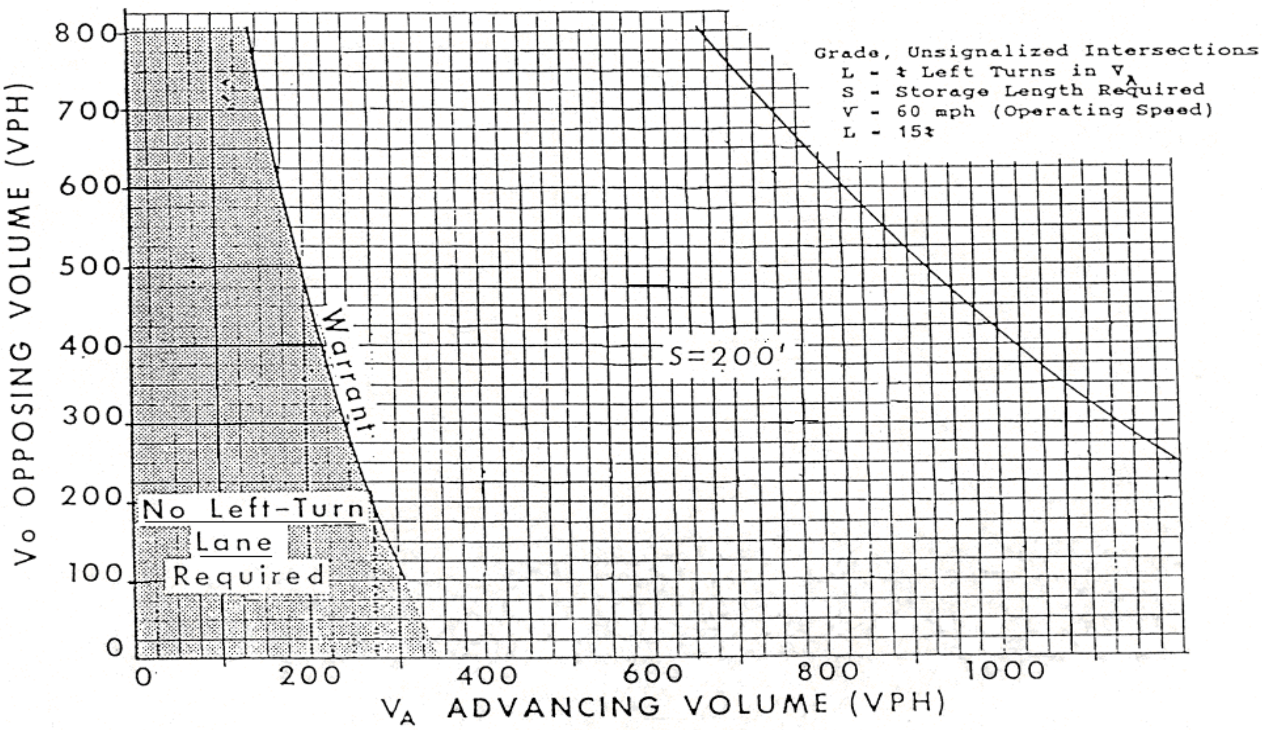



**FIGURE C-1-1.16**

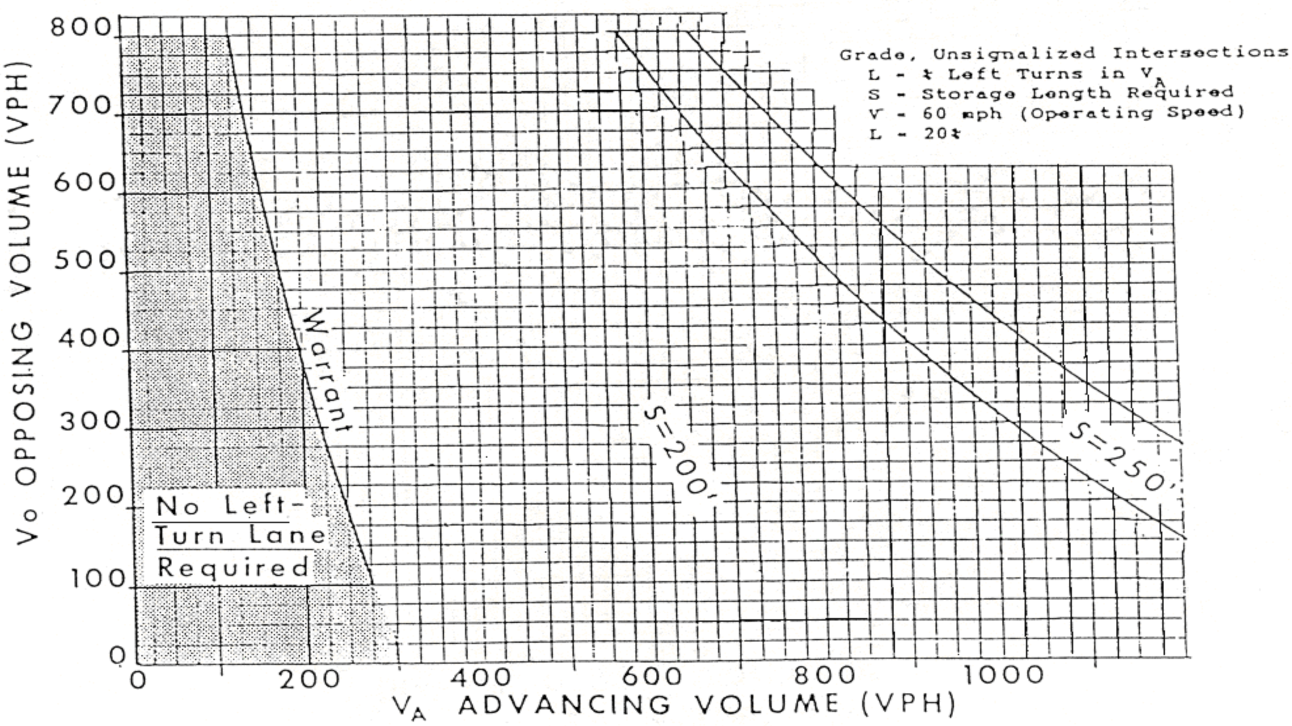



**FIGURE C-1-1.17**

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS

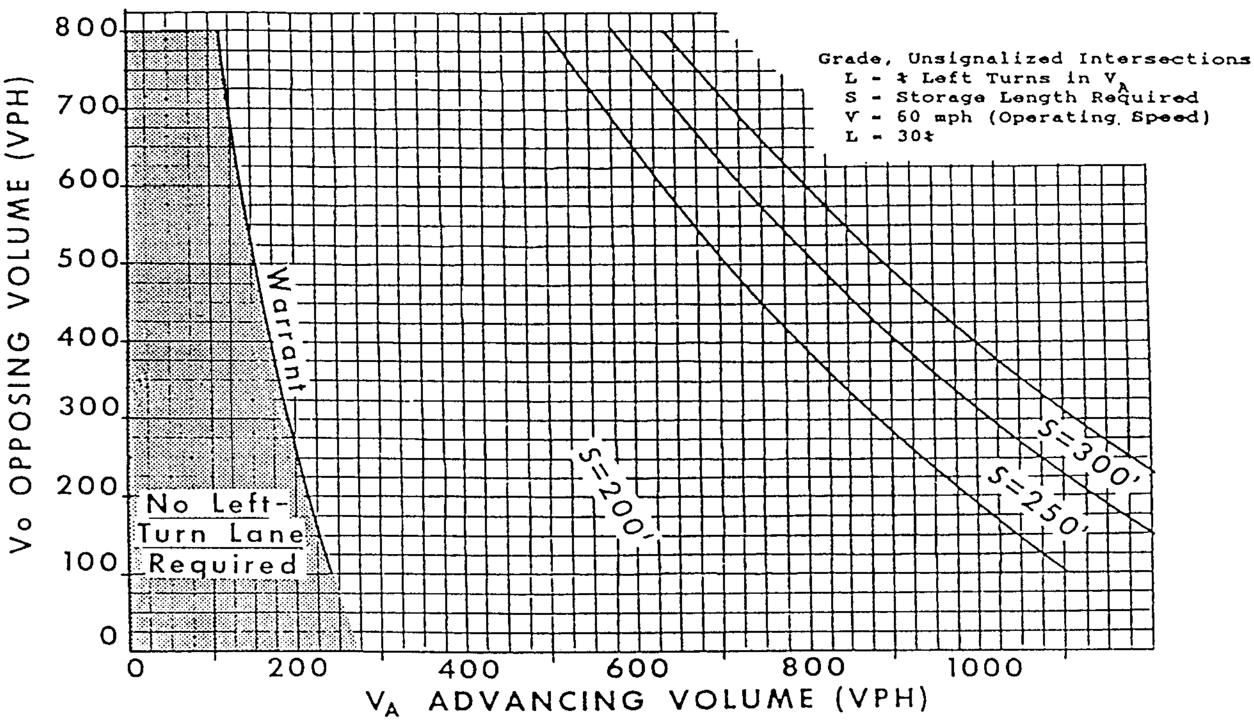



**FIGURE C-1-1.18**

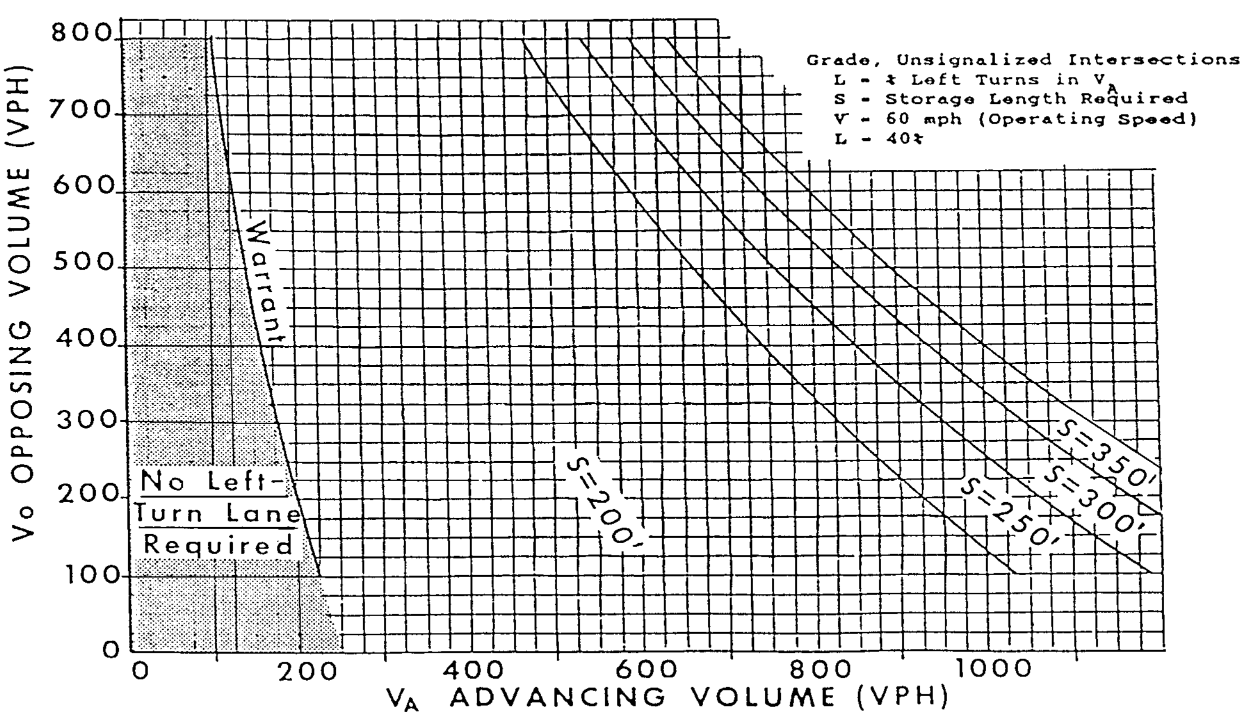


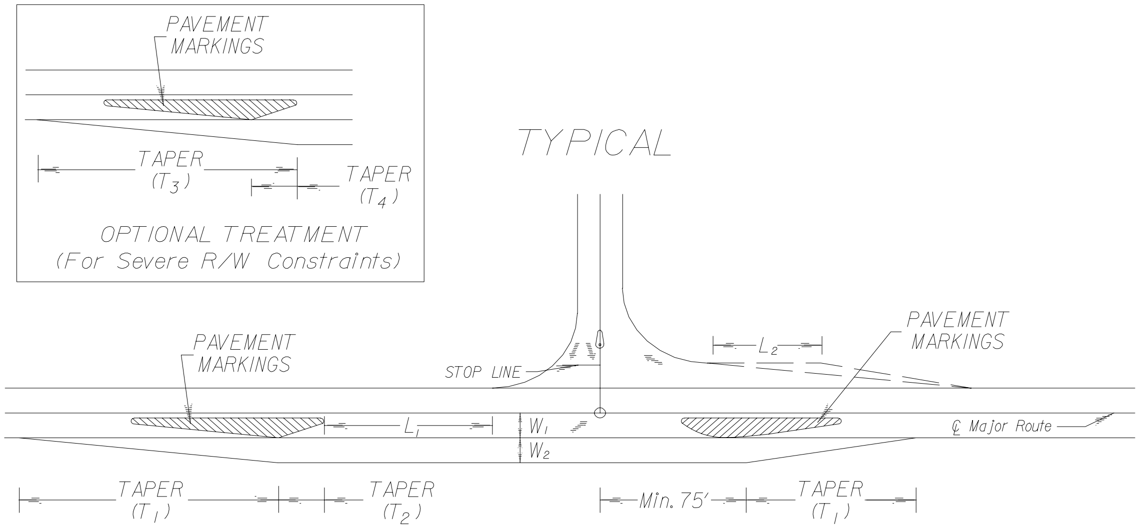

**FIGURE C-1-1.19**

| CHART VALUE OF STORAGE LANE REQUIRED | % TL=% TRUCKS IN VPH turning left | | | | | |
|---|---|---|---|---|---|---|
| | 0% | 10% | 20% | 30% | 40% | 50% |
| 100’ | 0’ | 25’ | 25’ | 50’ | 50’ | 50’ |
| 125’ | 0’ | 25’ | 25’ | 50’ | 50’ | 75’ |
| 150’ | 0’ | 25’ | 50’ | 50’ | 75’ | 75’ |
| 175’ | 0’ | 25’ | 50’ | 75’ | 75’ | 100’ |
| 200’ | 0’ | 25’ | 50’ | 75’ | 100’ | 100’ |
| 250’ | 0’ | 25’ | 50’ | 75’ | 100’ | 125’ |
| 300’ | 0’ | 50’ | 75’ | 100’ | 125’ | 150’ |
| 350’ | 0’ | 50’ | 75’ | 125’ | 150’ | 175’ |
| 400’ | 0’ | 50’ | 100’ | 125’ | 175’ | 200’ |
| 450’ | 0’ | 50’ | 100’ | 150’ | 200’ | 225’ |
| 500’ | 0’ | 50’ | 100’ | 150’ | 200’ | 250’ |

**TABLE C-1-2.1 TRUCK ADJUSTMENTS**

STORAGE LENGTH TO BE ADDED TO CHART VALUES OF LEFT-TURN LANE STORAGE LENGTHS (Length in Feet)

For additional information see Highway Research Report Number 211, Volume Warrants for the Left Turn Storage Lanes at Unsignalized Grade Intersections.




| TAPER LENGTH (ft.) | DESIGN SPEED , S (mph) | | | |
|---|---|---|---|---|
| | 30 | 40 | 50 | 60 |
| $T_1$ | 200 | 325 | 600 | 725 |
| $T_2$ | 100 | 200 | 200 | 200 |

| TAPER LENGTH (ft.) | DESIGN SPEED , S (mph) | | | |
|---|---|---|---|---|
| | 30 | 40 | 50 | 60 |
| $T_3$ | 200 | 550 | 600 | 725 |
| $T_4$ | 100 | 200 | 200 | 200 |

Notes:

1. $L_1$ - Length of storage lane to be determined by figures C-1-1.2 through C-1-1.19 by capacity analysis for Left-Turn Storage. Minimum Length = 100'.
2. $L_2$ - Length of storage lane to be as needed to maintain speed and provide smooth traffic operations.
3. Design speed is the preferred criteria, but operating speed or speed limits may be used if applicable, i. e., adding lanes to existing facilities.
4. Storage lanes are controlled by the turning radius begin point.
5. $W_1$ - Same as through lane.
   $W_2$ - Through lane pavement width.

PASSING / LEFT TURN LANE ON TWO - LANE HIGHWAY

**FIGURE C-1-1.20**

## DOUBLE (DUAL) LEFT-TURN LANES

Double (dual) left-turn lanes (DLTL's) shall be considered when left-turn demand exceeds 300 vph, and are desirable where peak left-turn movements exceed 350 vph. DLTL's require a protected (exclusive) signal phase, a 28' minimum median width, and a width of at least 30' on the acceptance lanes (see Figure C-1-2). The length of storage should accommodate at least 1.5 times the expected vehicles making left turns per cycle based on peak 15-min. periods. When DLTL's are required, a capacity analysis of the intersection should be performed to determine what traffic controls are necessary (i.e. - signalization, separate phasing) in order to have this double left-turn lane function properly.

### Continuous Left-Turn Lanes (Two way, used for left-turn lane in either direction)

Continuous two-way median left-turn lanes (C2WMLTL's) should be considered on low-speed arterial highways (25 to 45 MPH) with no heavy concentrations of left-turn traffic. C2WMLTL's also may be used where an arterial or major route must pass through a developed area having numerous street and driveway intersections, and where it is impractical to limit left turns. The minimum desirable width shall be 12' (16' maximum).

C2WMLTL's shall only be used with roadways having a maximum of 2 through lanes in each direction, and shall be shown in accordance with Figure C-1-2.1.

In commercial and industrial areas where property values are high and rights of way for wide medians are difficult to acquire, a paved flush traversable median 10' to 16' wide is the optimum design. Successful operation of a continuous left-turn lane requires adequate lane marking.

**Advantages are:**

- Reduced travel time.
- Improved capacity.
- Flexibility of using as temporary detour during closure of through lane.
- Does not control or limit the number of left turns.
- Minimizes interference to through traffic lanes.
- Separates opposing traffic flows by one full lane.
- Public preference (both from drivers and owners of abutting properties.)
- Reduced accident frequency, particularly rear-end collisions.

**Disadvantages:**

- Poor visibility (corrected by using proper delineation)

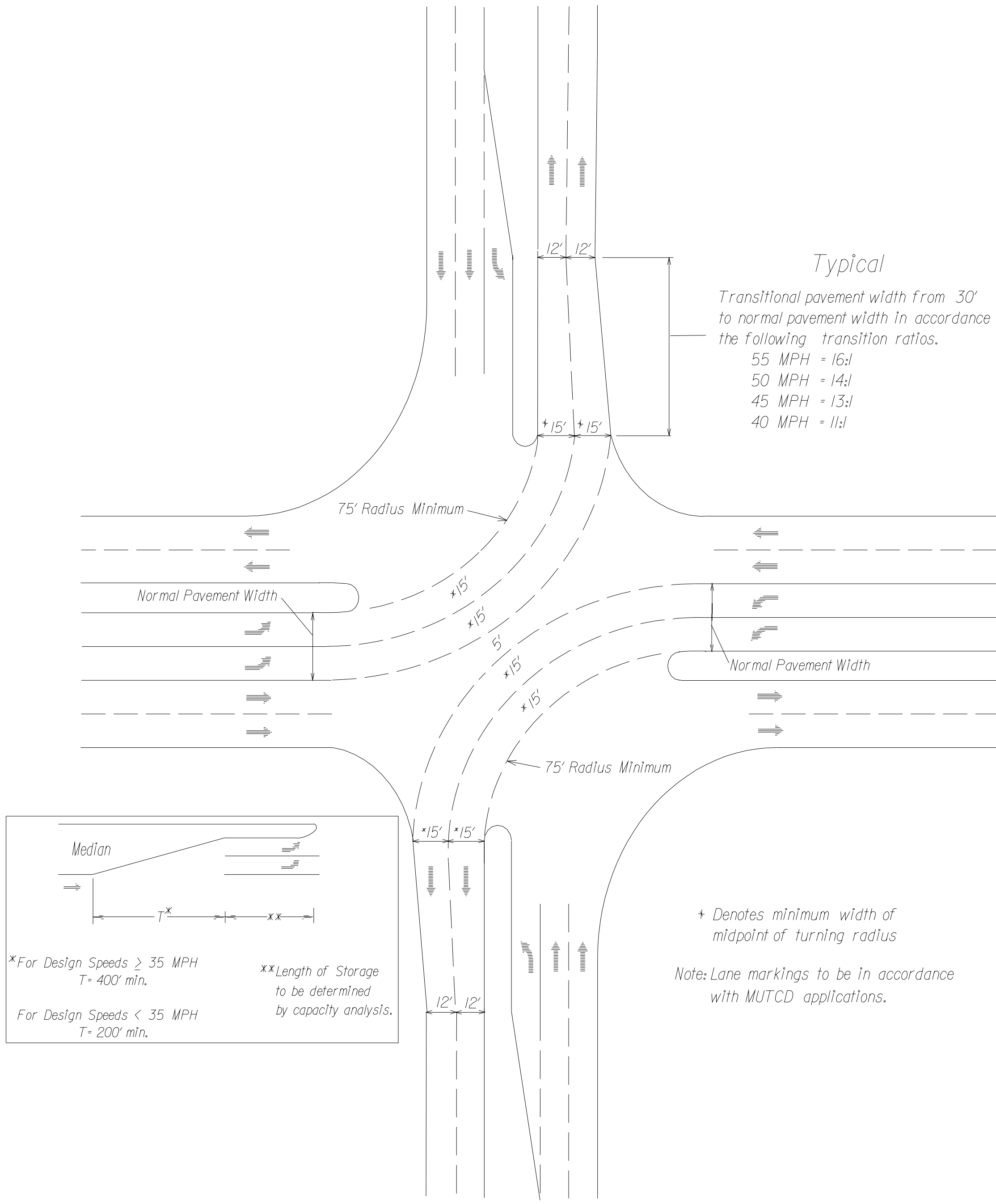
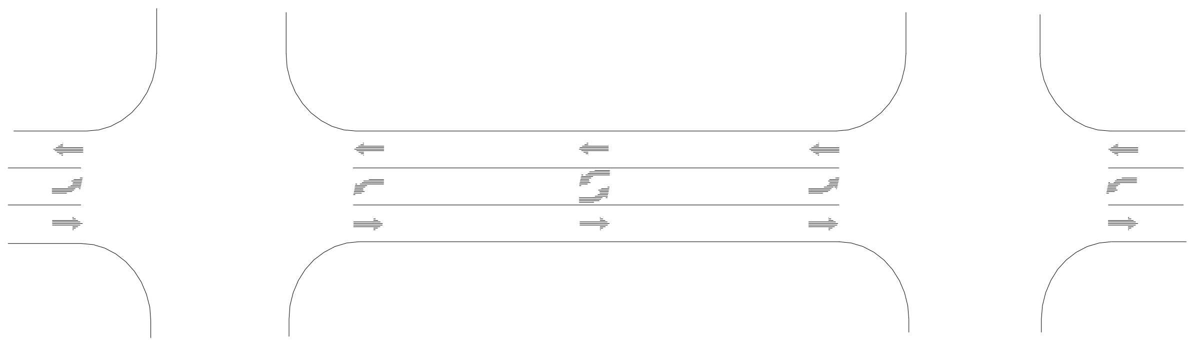
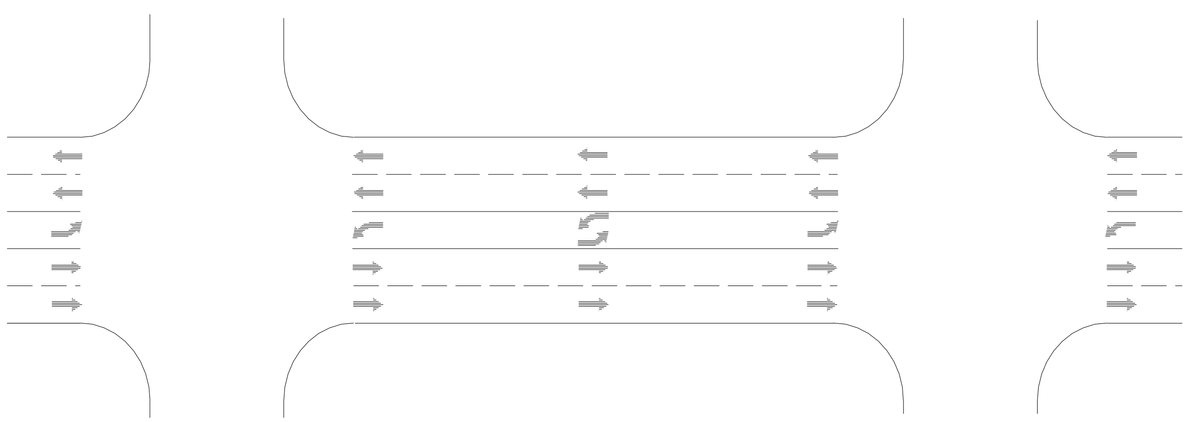



**FIGURE C-1-2 DOUBLE LEFT-TURN LANES**



Typical 3-Lane Configuration
W/Left Turn Provisions for the Minor Street



Typical 5-Lane Configuration
W/Left Turn Provisions for the Minor Street

**FIGURE C-1-2.1 CONTINUOUS TWO-WAY MEDIAN LEFT-TURN LANES**

(Lane markings to be in accordance with MUTCD application)

## CROSSOVERS WITHOUT AND WITH CONNECTIONS

In commercial and industrial areas where property values are high and rights of way for wide medians are difficult to acquire, a paved flush traversable median 10' to 16' wide is the optimum design. Successful operation of a continuous left-turn lane requires adequate median openings should be designed with a minimum length of 40'. The shape of the median end should generally be symmetrical when the median width is less than 10' and the median opening length is not excessive, but the bullet nose can be effectively used to reduce the opening. For a median width of 10' or more, the bullet nose design should be used instead of a semicircular design. At 3-leg and 4-leg intersections, the length of the crossover and the shape of the median end is controlled by the width of the median and the turning radii. (See Figure C-1-3). A wide median opening can be reduced at skewed intersections by utilizing modifications of the bullet nose design. Additional information may be obtained from AASHTO's A Policy on Geometric Design of Highways and Streets (Median Openings).

## INTERSECTION DESIGN

At-grade intersections must provide adequately for anticipated turning and crossing movements. Figures C-1-4 and C-1-5 provide the designer with the basic types of intersection designs and recommendations pertinent to dimensions, radii, skews, angles, and the types of island separations, etc., to be considered. AASHTO's A Policy on Geometric Design of Highways and Streets (Intersections) should be reviewed for additional information to be considered in the design since the site conditions, alignment and grades, sight distance, the need for turning lanes and other factors enter into the type of intersection design which would satisfy the design hour volume of traffic, the character or composition of traffic, and the design speed.

Sufficient offset dimensions, pavement widths, pluses, and radii shall be shown in the plans by the designer to insure that the sign island is properly positioned.

Care should be taken in the design of four-lane roadways with intersecting two-lane roadways. If traffic conditions clearly warrant a four-lane divided design for the two-lane road at the intersection, the divided design must be constructed for a sufficient distance to allow for the approaching divided design and the subsequent stop condition ahead to be properly signed. The four-lane divided design should not be constructed unless it is clearly warranted and the approaches can be properly signed or the minor road is expected to be improved to a divided status in the near future.

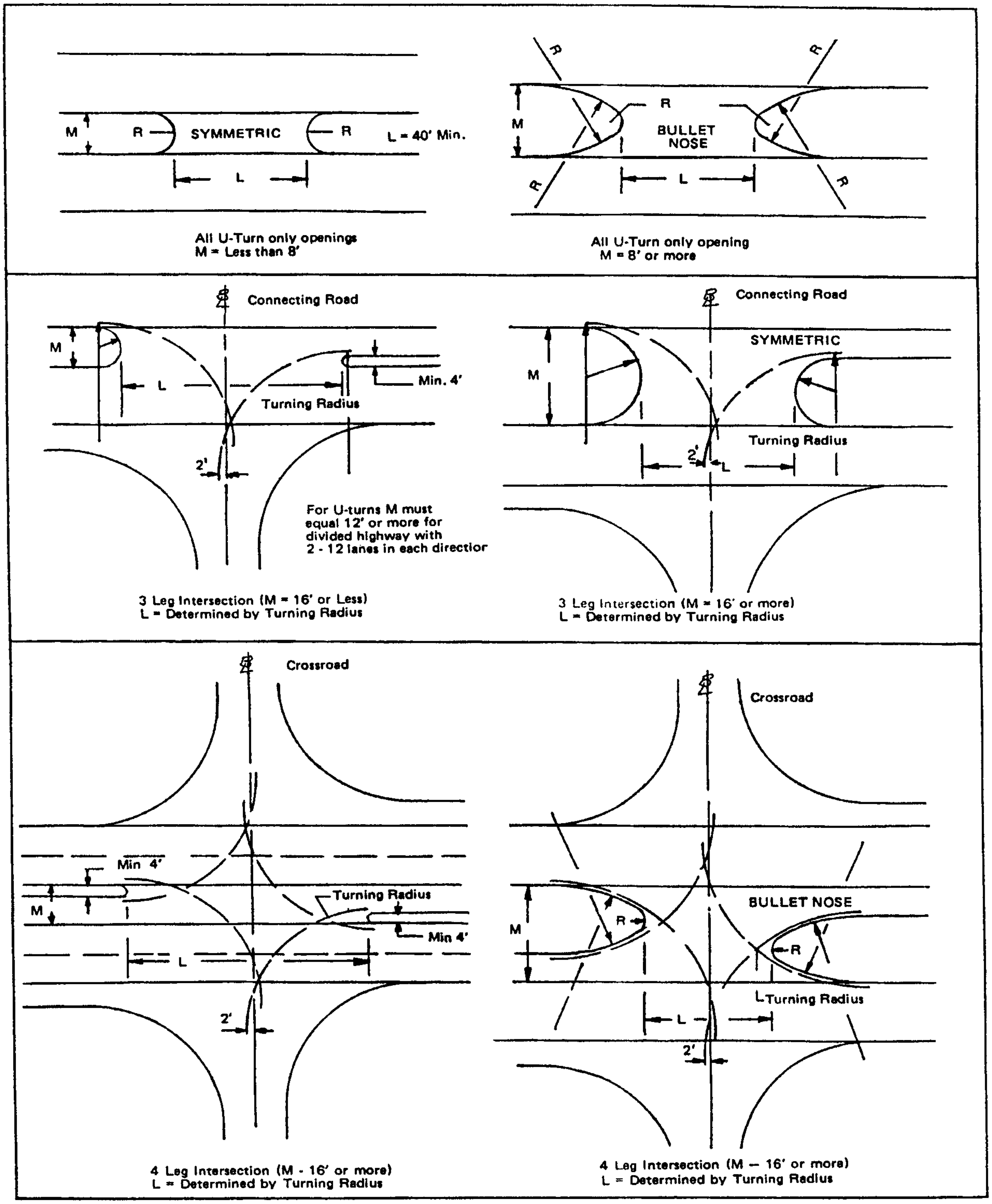
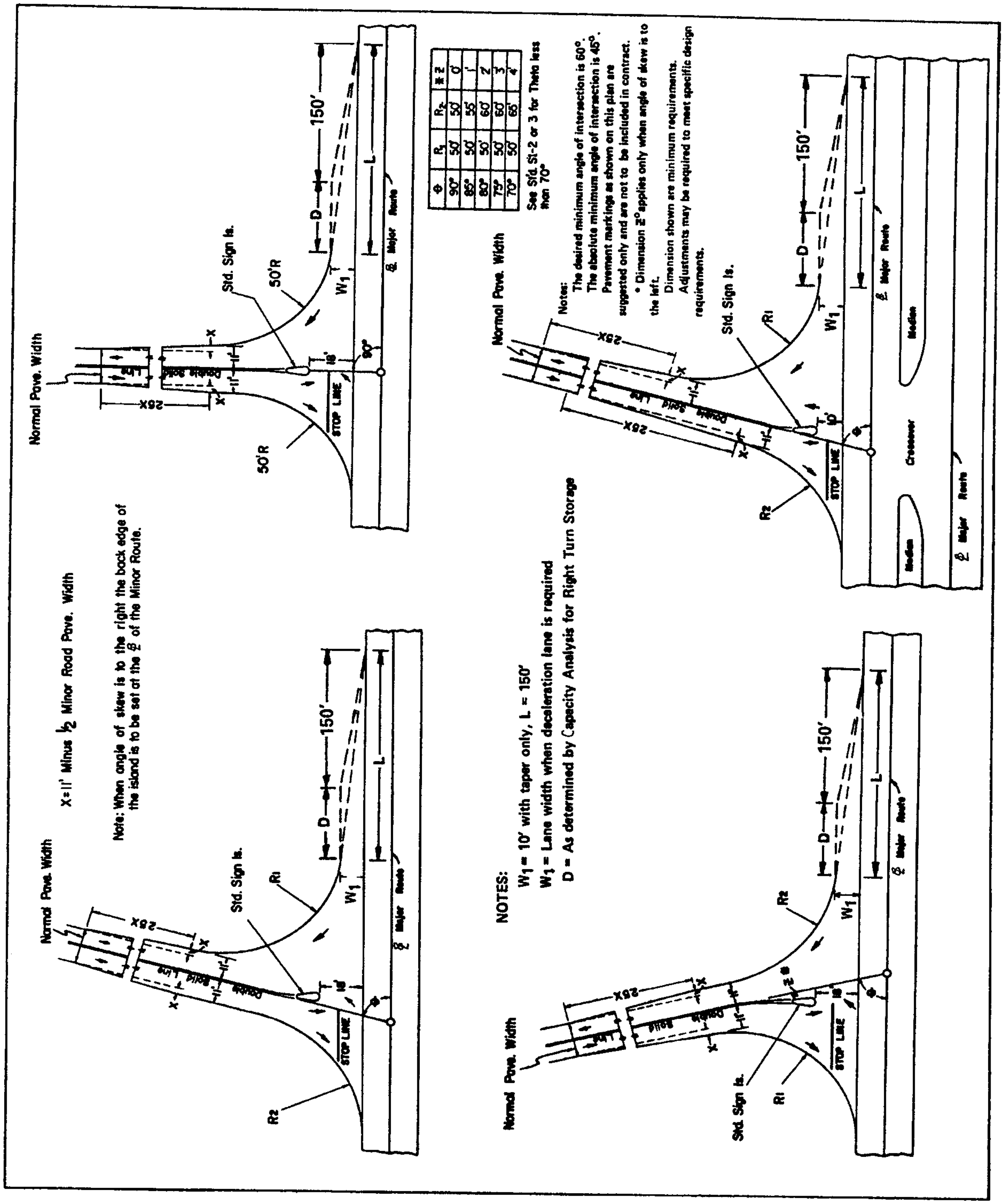



FIGURE C-1-3 CROSSOVERS WITHOUT AND WITH CONNECTIONS




| Θ | R1 | R2 | * Z |
|---|---|---|---|
| 90° | 50' | 50' | 0' |
| 85° | 50' | 55' | 1' |
| 80° | 50' | 60' | 2' |
| 75° | 50' | 60' | 3' |
| 70° | 50' | 65' | 4' |

**FIGURE C-1-4 INTERSECTION DESIGN**

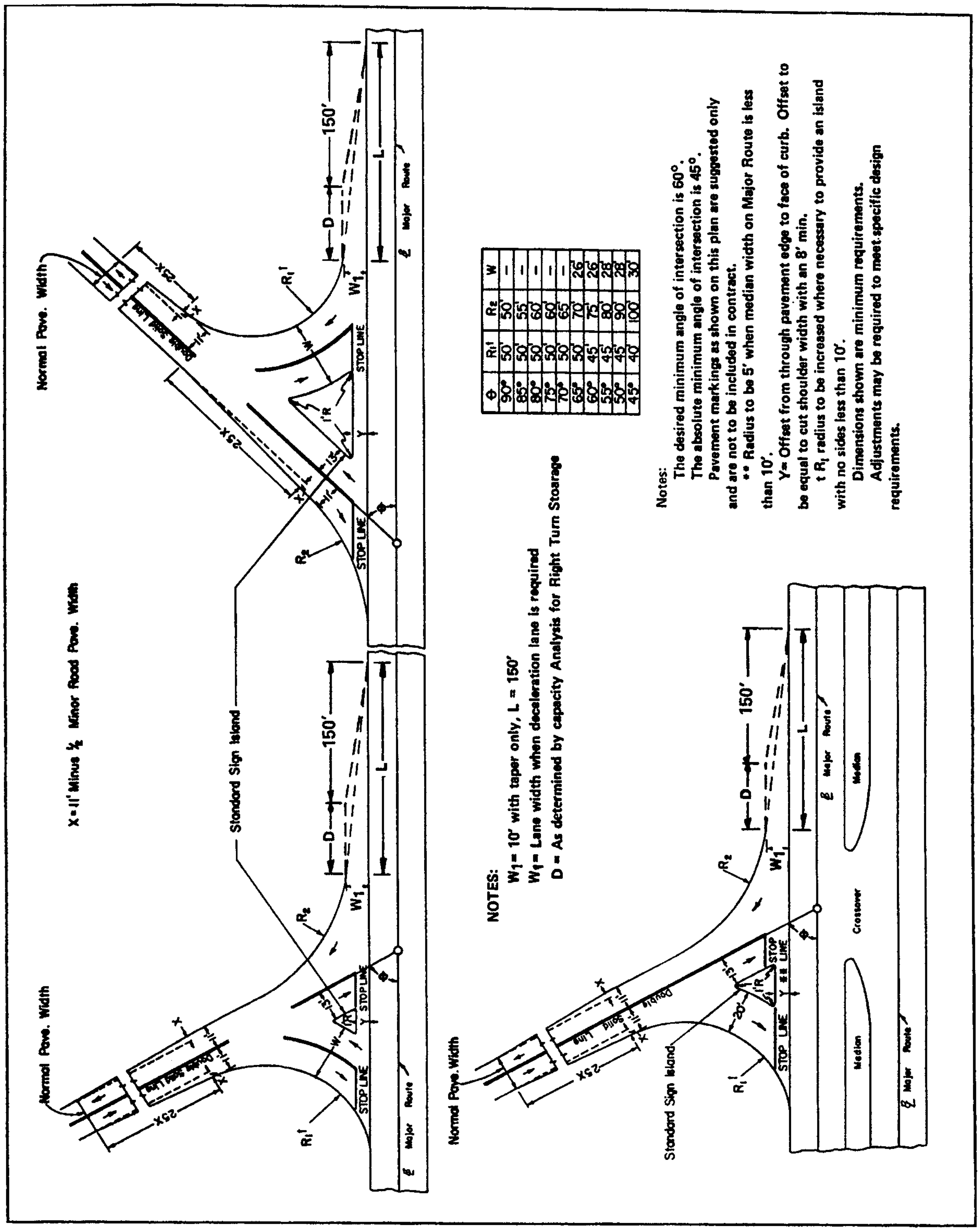



**FIGURE C-1-5  INTERSECTION DESIGN**

## SIGHT DISTANCE

Sight distances exceeding those shown in Table C-1-3 should be used as the basis for design wherever practical. When a highway is on a grade, the equation for braking distance should be modified in accordance with AASHTO's 2001 A Policy on Geometric Design of Highways and Streets, pages 109 through 130 (Exhibit 3-2, page 115).

The following tables are to be used in developing plans for all roadway systems:

| Height of Eye 3.5' Use "Desirable" values as minimum on the Interstate System. Use "Desirable" values as minimum on the Arterial System where feasible. | | | | | | | | | | Height of Object 2' |
|---|---|---|---|---|---|---|---|---|---|---|
| **Design Speed**** | **25** | **30** | **35** | **40** | **45** | **50** | **55** | **60** | **65** | **70** |
| MINIMUM SIGHT DISTANCE | 155 | 200 | 250 | 305 | 360 | 425 | 495 | 570 | 645 | 730 |
| MINIMUM K VALUE FOR: | | | | | | | | | | |
| CREST VERTICAL CURVES | 12 | 19 | 29 | 44 | 61 | 84 | 114 | 151 | 193 | 247 |
| SAG VERTICAL CURVES | 26 | 37 | 49 | 64 | 79 | 96 | 115 | 136 | 157 | 181 |
| DESIRABLE SIGHT DISTANCE | 155 | 200 | 250 | 325 | 400 | 475 | 550 | 650 | 725 | 850 |
| DESIRABLE K VALUE FOR: | | | | | | | | | | |
| CREST VERTICAL CURVES | 20 | 30 | 50 | 80 | 120 | 170 | 230 | 320 | 400 | 540 |
| SAG VERTICAL CURVES | 30 | 40 | 50 | 70 | 90 | 110 | 130 | 160 | 180 | 220 |

**TABLE C-1-3 STOPPING SIGHT DISTANCE**

K Value is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in feet of the vertical curve that will provide minimum sight distance.

| Height of Eye 3.5' | | | | | | Height of Object 3.5' |
|---|---|---|---|---|---|---|
| **Design Speed**** | **30** | **40** | **50** | **60** | **65** | **70** |
| MINIMUM SIGHT DISTANCE | 1100 | 1500 | 1850 | 2150 | 2300 | 2500 |

**TABLE C-1-4 PASSING SIGHT DISTANCE**

****** For all tables, if the Design Speed is unknown, it may be assumed to be the posted speed limit unless the operating speed is lower at that point.

Each designer is to review the plans to determine if passing zones have been provided in the design to the best practical extent. The generally accepted method of checking passing sight distance is graphically by the use of a straight edge along the profile while comparing same to the horizontal alignment. These minimum passing sight distances for design are not to be confused with other distances used as warrants for placing no-passing zone pavement stripes on completed highways. Such values as shown in the Manual on Uniform Traffic Control Devices are substantially less than design distances and are derived for traffic operating control needs which are based on assumptions different from the passing sight distance used for highway design.

| Height of Eye 3.5’ | | | | | | | | Height of Object 3.5’ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Speed (mph)** | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
| 2 Lane Major Road | 225 | 280 | 335 | 390 | 445 | 500 | 555 | 610 | 665 | 720 | 775 |
| 4 Lane Major Road (Undivided) | 240 | 295 | 355 | 415 | 475 | 530 | 590 | 650 | 710 | 765 | 825 |
| 4 Lane Major Road (Divided – 18’ median) | 260 | 325 | 390 | 455 | 520 | 580 | 645 | 710 | 775 | 840 | 905 |

**Sight Distances along Major Road at Intersection with Minor Roads,**

**TABLE C-1-5 CROSSOVERS AND COMMERCIAL ENTRANCES**

**For all tables, if the Design Speed is unknown, it may be assumed to be the posted speed limit unless the operating speed is lower at that point.

For major roadways of more than four lanes, large truck volumes on a minor road or crossover, or median widths over 60’, see AASHTO's A Policy on Geometric Design of Highways and Streets.

The designer must check each intersection to insure that these values are obtained. Any deficiency which cannot be corrected is to be brought to the attention of the State Location and Design Engineer.

On a typical two-lane road horizontal curve there are numerous objects that restrict sight distance such as, cut slopes, buildings, vegetation, vehicles, etc. It is very possible to have sight distance in the winter and not in the spring or summer due to the growth of vegetation.

These obstructions should be considered when reviewing commercial entrances. A divided highway can have similar problems. It is very important to obtain adequate commercial entrance sight distance from the entrance as well as the left turn position into the entrance. A design exception must be granted by the State Location and Design Engineer (or designee), and if applicable, the Federal Highway Administration for deviating from required sight distance standards.

The term "Major Road" refers to the major of the intersecting roads.

Sight Distance values in Table C-1-5 permit a vehicle stopped on minor road or crossover, to cross the major road safely or merge safely in the case of turns.

For additional information on sight distance and its application, the user should refer to AASHTO's A Policy on Geometric Design of Highways and Streets.

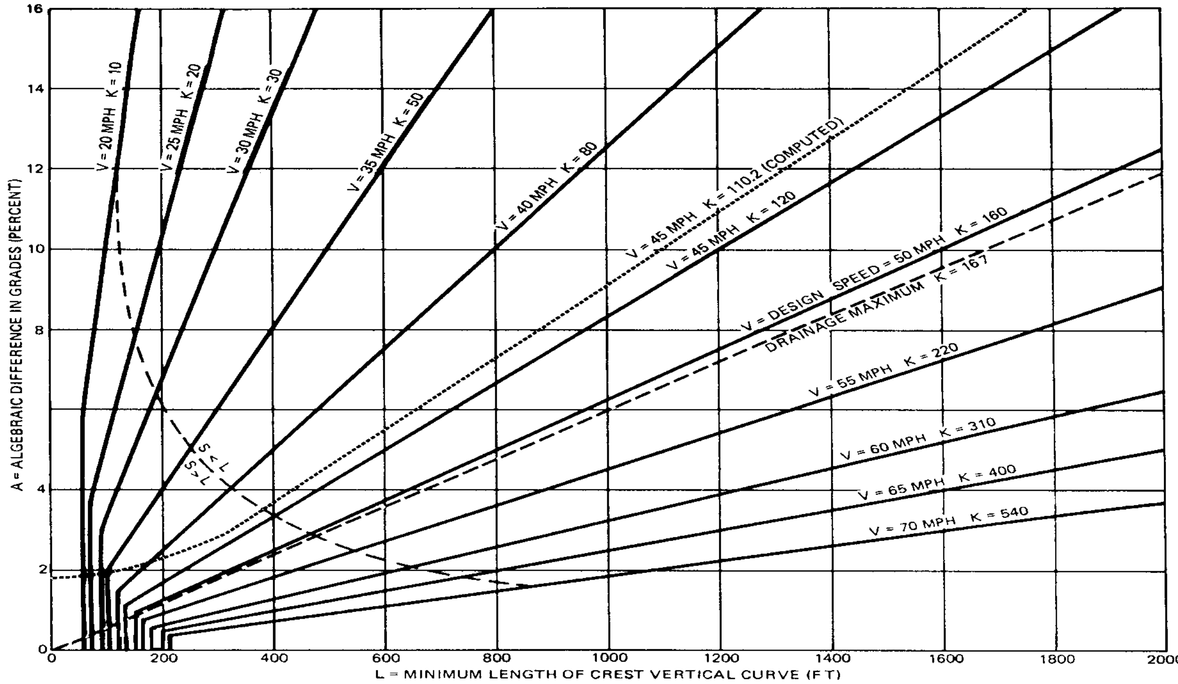



**FIGURE C-1-6 DESIGN CONTROLS FOR CREST VERTICAL CURVES, FOR STOPPING SIGHT DISTANCE AND OPEN ROAD CONDITIONS.**

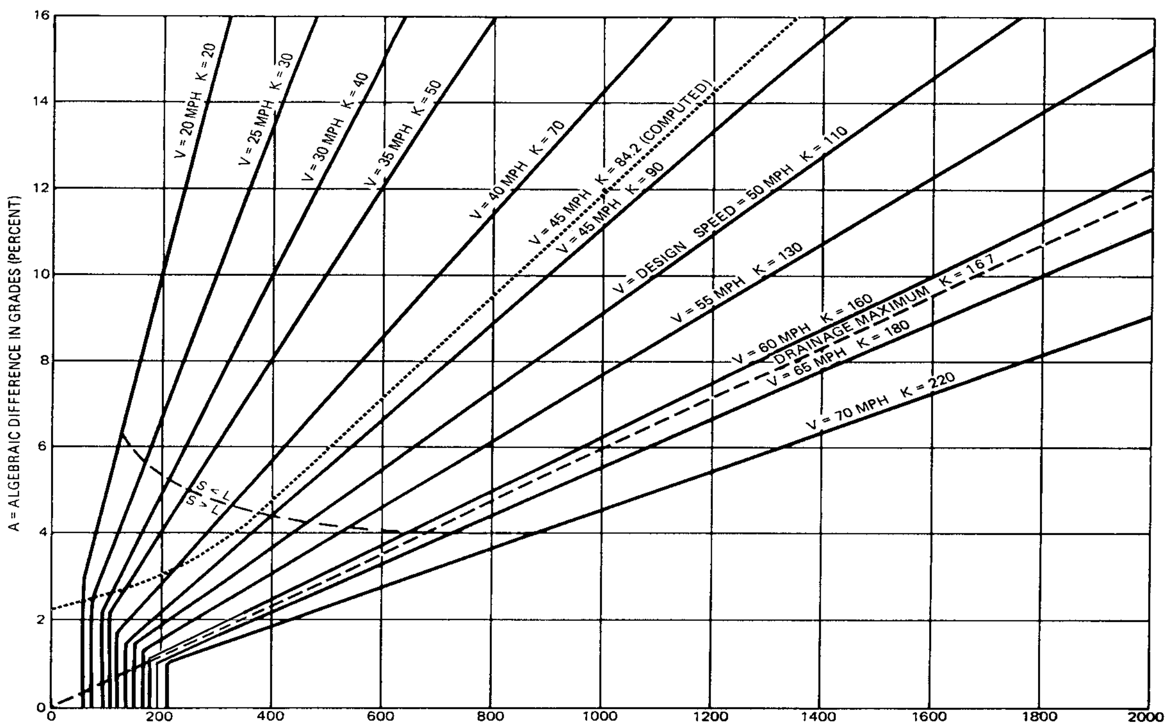
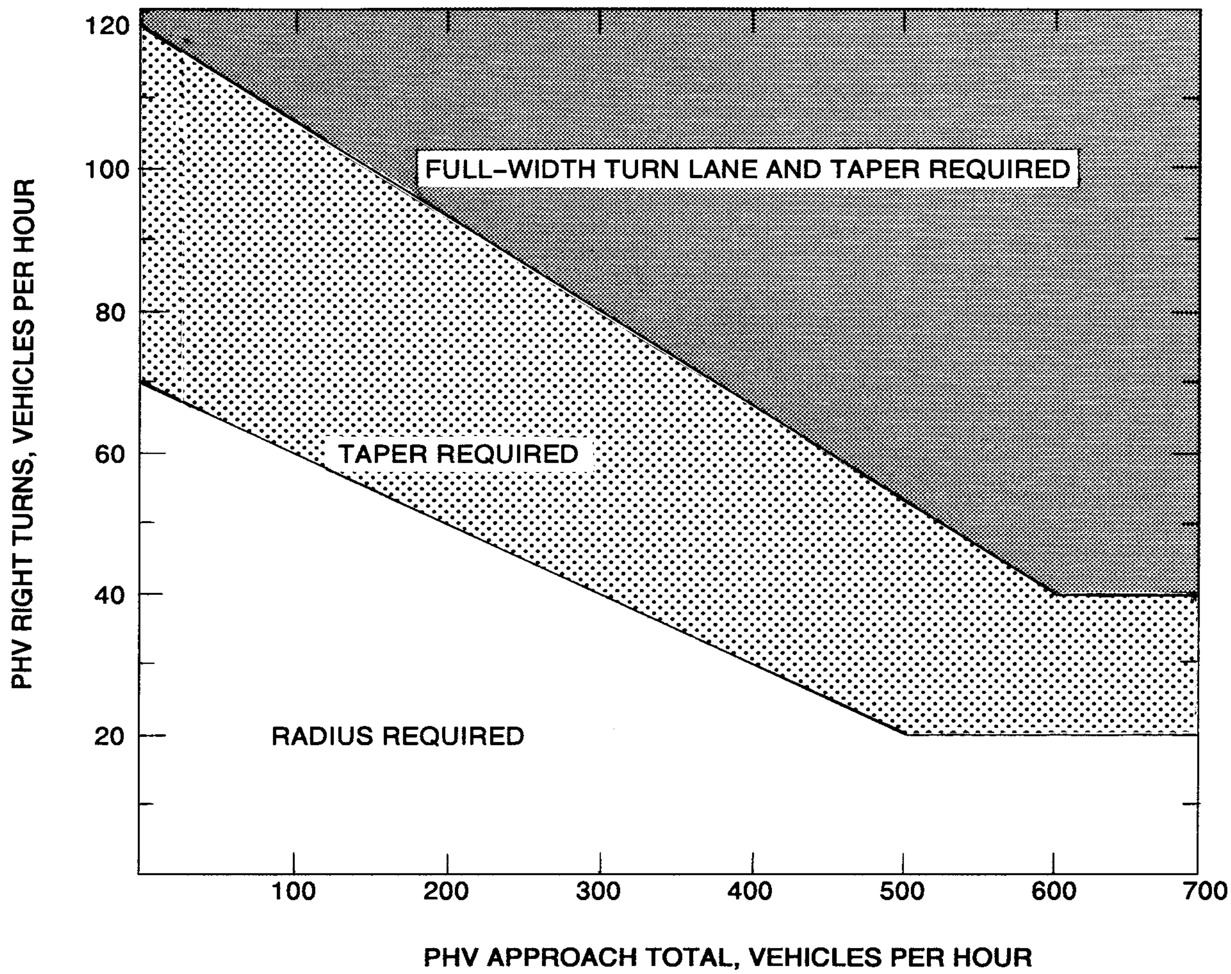



**FIGURE C-1-7 DESIGN CONTROLS FOR SAG VERTICAL CURVES, OPEN ROAD CONDITIONS.**




## LEGEND

**PHV** - Peak Hour Volume (also Design Hourly Volume equivalent)

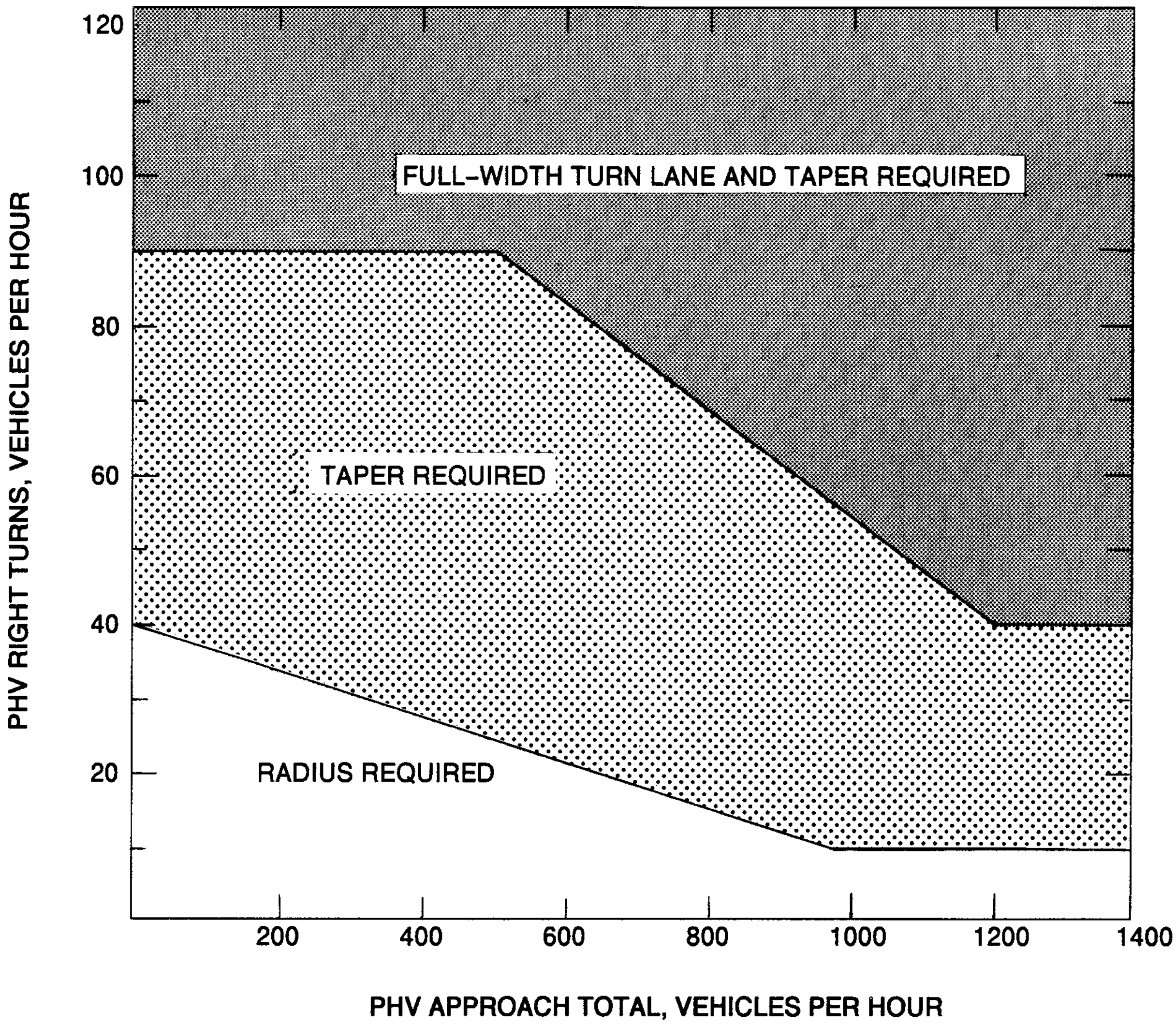
## Adjustment for Right Turns

For posted speeds at or under 70 km/h (45 mph), PHV right turns > 40, and PHV total < 300.
Adjusted right turns - PHV Right Turns - 20
If PHV is not known use formula: PHV = ADT x K x D

K = the percent of AADT occurring in the peak hour
D = the percent of traffic in the peak direction of flow

Note: An average of 11% for K x D will suffice.

**FIGURE C-1-8 GUIDELINES FOR RIGHT TURN TREATMENT (2-LANE HIGHWAY)**




**LEGEND**

**PHV-** - Peak Hour Volume (also Design Hourly Volume equivalent)

**Adjustment for Right Turns**

If PHV is not known use formula: PHV = ADT x K x D
K = the percent of AADT occurring in the peak hour
D = the percent of traffic in the peak direction of flow
Note: An average of 11% for K x D will suffice.

**FIGURE C-1-9 GUIDELINES FOR RIGHT TURN TREATMENT (4-LANE HIGHWAY)**

## RIGHT TURN LANES

These guidelines are to be used as an aid in selecting appropriate treatments for right turn movements. (Reference material attained from Virginia Highway and Transportation Research Council report "The Development of Criteria For the Treatment of Right Turn Movements on Rural Roads" dated March 1981.)

1. Number of Lanes - Guidelines are differentiated on the basis of the number of lanes on the major roadway. Refer to Figure C-1-8 for 2-lane roadways and Figure C-1-9 for 4-lane roadways. The minor roadway is a 2-lane road. Discussion on both figures is provided. All volumes refer to the volumes on the approach under consideration for right turn treatments.

2. Radius Treatment - Figure C-1-8 contains guidelines for right turn treatment on 2-lane roadways. The predominant treatment for 2-lane roadways is the radius. Arterial roadways tend to carry higher volumes of traffic traveling at higher speeds as compared to local roadways. The traffic on local roadways tends to include a higher number and percentage of right-turning vehicles than that on arterials. An adjustment is needed to permit local roadways to handle more right turns (at lower speeds) compared to arterial roads. The following adjustment is made for posted speeds at or under 70 km/h (45 mph):

   Adjusted Number of Right Turns = Number of Right Turns - 20 for number right turns > 40 and total volume < 300

   For example, let total volume = 200 vph, right turn volume = 70 vph and posted speed = 65 km/h (40 mph). Then adjusted number of right turns - r = 70 - 20 = 50. Therefore, entering Figure C-1-8 with a total volume 200 vph and r=50 vph, a radius is recommended as the right turn treatment.

   Taper treatment - A taper is recommended for a primary route with a right turn, unless the volume conditions require a full-width turn lane or the percentage of right-turning vehicles make up less than 10% of the total traffic, in which case a radius is suggested.

3. Figure C-1-9 contains guidelines for 4-lane roadways. Four-lane roadways tend to have a taper or full-width lane to facilitate right turn movements. Many of these roads are divided highways with a speed limit of 90 km/h (55 mph).

4. Other factors - The selection of a treatment for right turn movements may be influenced by sight distance, availability of right of way, grade, and angle of turn. Although these factors are not incorporated in the guidelines, they should be given consideration. The guidelines should be used unless the Engineer determines that special treatment is necessary due to other factors.

5. Data collection procedures - In order to employ these guidelines, peak hour volume data must be obtained from the Mobility Management Division or Transportation and Mobility Planning Division, as appropriate.

**ENTRANCES**

Title 33.1-89 of the Code of Virginia, as amended, requires that projects have the alignment, profile, and grade of private entrances shown on plans.

This information is to be shown as follows:

1. When the proposed entrance is to be placed in the same location as the existing entrance, no alignment will be shown. The proposed entrance will be shown graphically.

2. Where a proposed entrance is to be on a location different from the existing, the proposed location will be shown graphically on the field inspection plans. After the field inspection party has reviewed the proposed location, the Right of Way and Utilities Division will contract the property owner and determine that the proposed location is satisfactory or that the property owner desires some other location. The designer will then request the centerline and profile to be run by the survey party when this cannot be secured from existing notes. This alignment is to be shown on the plans.

3. A profile and proposed grade is to be shown for each entrance where it is necessary to regrade on existing or new location. The survey party runs a profile along every existing entrance using a data collector and converting the information for placement into a graphics file. The profile is generally run along the center of the existing entrance, although usually no alignment is taken. The proposed grade can be a spline grade with an approximate percent of grade shown. The proposed grade will begin at the edge of shoulder; back of curb; or back of sidewalk, sidewalk space, or bikeway whichever is the outermost permanent construction. If it is necessary to use some other beginning point, it should be identified on the profile. It is desirable that projects with a large number of entrances contain a separate profile sheet or sheets devoted to entrances.

4. A note is to be included on the general notes sheet as follows: "When no baseline alignment is shown for a proposed entrance, the entrance is to be constructed in the same location as the existing entrance."

5. The above information does not apply to Minimum Plan or No Plan Projects.

Title 33.1-199 of the Code of Virginia, as amended, provides that any entrance disturbed in the repair or construction of a highway be replaced. This entrance is to be left in the same condition as it was prior to such repair or improvement.

1. Whenever plans have been prepared for a proposed improvement and submitted to the district for field inspection, the plans will show the entrances in place as called for by the engineering information at the time the plans were prepared. The field inspection team shall make a close inspection of all entrances on the project and provisions are to be made to replace such entrances.

2. In reviewing the plans, there may be instances where a landowner now has access to his property by reason of the fact that he is able to drive from the highway surface to this adjoining property, particularly in farming operations, in order to obtain access to various fields within the farm. This must be carefully studied and, if the farm is so arranged that this is found to be true, the provisions are to be made to provide field entrances as conditions would require.

3. No additional entrances are to be called for or shown on the plans.

4. The right of way is to be appraised and acquired in accordance with the approved plans and the entrances that are shown thereon. (Should it be discovered at the appraising or negotiating stage that an existing entrance has been overlooked or added by the owner since the time of field inspection, then, of course, this entrance will be replaced.) There will, of course, be instances when the owner requests the construction of an entrance to a property where no access exists or for the construction of an additional entrance. When this occurs, the owner's request can be complied with if it is determined that construction of the entrance is economically justified and the District Administrator and District Traffic Engineer give their approval for the construction thereof.

5. The applicable details shown as CADD Cell “PCENTR” at http://www.extranet.vdot.state.va.us/locdes/caddman/html/frameset.htm are to be placed on the typical section sheet.

**SAFETY REST AREAS**

Design guides for safety rest areas are shown on Figure C-1-11 and Figure C-1-12. Rest areas along the roadways are functional and desirable elements on heavily traveled roads and on those carrying recreational traffic. They are a part of the complete highway development provided for the safety and convenience of the roadway users. The design and location of rest areas depends much on the character and volume of traffic, type of highway and adjacent land use and should consider the scenic quality of the area, accessibility and adaptability to development. Other essential considerations include an adequate source of water and a means to treat and/or properly dispose of sewage. Site plans should be developed by the use of a comprehensive site planning process that should include the location of ramps, parking areas, buildings, picnic areas, water supply, sewage treatment facilities and maintenance areas. The objective is to give maximum weight to the appropriateness of the site rather than adherence to constant distance or driving time between sites.

Principles of ramp terminal design apply generally at the points of access to or from these areas. The designer is to refer to IIM LD- 20 in the design of ramp terminal and speed change lane criteria. Figures C-1-13 and C-1-14 are to be used as guides for the selection of the parking space arrangement for cars and trucks. Parking spaces and access aisles shall be designed with surface slopes not to exceed 1:50 (2%) in all directions.

## PARKING SPACES

Where parking spaces are provided, accessible spaces for persons with mobility impairments should comply with the following table:

| **Total Parking in Lot** | **Required Minimum Number Accessible Spaces** |
|---|---|
| 1 to 25 | 1 |
| 26 to 50 | 2 |
| 51 to 75 | 3 |
| 76 to 100 | 4 |
| 101 to 150 | 5 |
| 51 to 200 | 6 |
| 201 to 300 | 7 |
| 301 to 400 | 8 |
| 401 to 500 | 9 |
| 501 to 1000 | 2 percent of total |
| 1001 and over | 20 plus 1 for each 100 over 1000 |

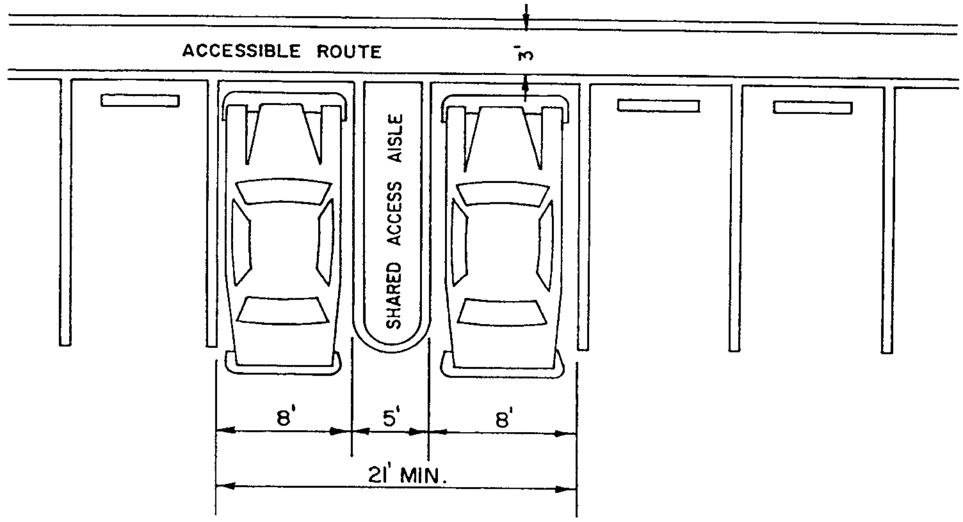
Accessible parking spaces shall be at least 2440 mm (96 in.) wide. Access aisles adjacent to accessible spaces shall be 1525 mm (60 in.) wide minimum. One in every eight accessible spaces, but not less than one, shall be served by an access aisle 2440 mm (96 in.) wide minimum and shall be designated "van accessible". Two accessible parking spaces may share a common access aisle (see Figure C-1-10.1).

The "Universal Parking Space Design" is an acceptable alternative to providing a percentage of spaces with a 2440 mm (96 in.) wide aisle. Under this design all accessible spaces are a minimum of 3350 mm (132 in.) wide with 1525 mm (60 in.) wide access aisles. Since all spaces using this design are van accessible, no additional signage is needed to denote which spaces will accommodate vans. This design allows vehicles to park to one side or the other within the 3350 mm (132 in.) space.

Accessible parking spaces for persons with mobility impairments are to be located and designed to provide the shortest possible route to rest area facilities. If there are curbs between the access aisle and parking perimeter, then curb cut ramps, Standard CG-12, are to be provided. The Mobility Management Division and Environmental Division should be contacted to coordinate the signing and placement of curb cuts. Figure C-1-10.1 is to be used to provide ample space for the accessible loading area.

Parked vehicle overhangs shall not reduce the clear width of an accessible route. Accessible parking spaces shall be designated as reserved by a sign showing the symbol of accessibility. Van accessible spaces shall have an additional sign "Van-Accessible" mounted below the symbol of accessibility. Such signs shall be located so they cannot be obscured by a vehicle parked in the space. Provide minimum vertical clearance of 2895 mm (114 in.) at accessible passenger loading zones and along at least one vehicle access route to such areas from site entrance(s) and exit(s).

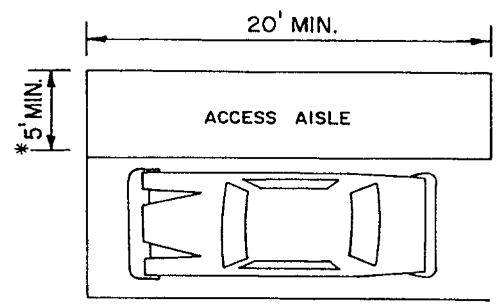
## ACCESSIBLE PARKING AND PASSENGER LOADING ZONES




MINIMUM DIMENSIONS FOR ACCESSIBLE PARKING

** Universal Parking Spaces 11' wide may be used. See instructions for "Parking Spaces" to determine number of accessible spaces required.

*8 min. adjacent to spaces for vans designed for handicapped persons.



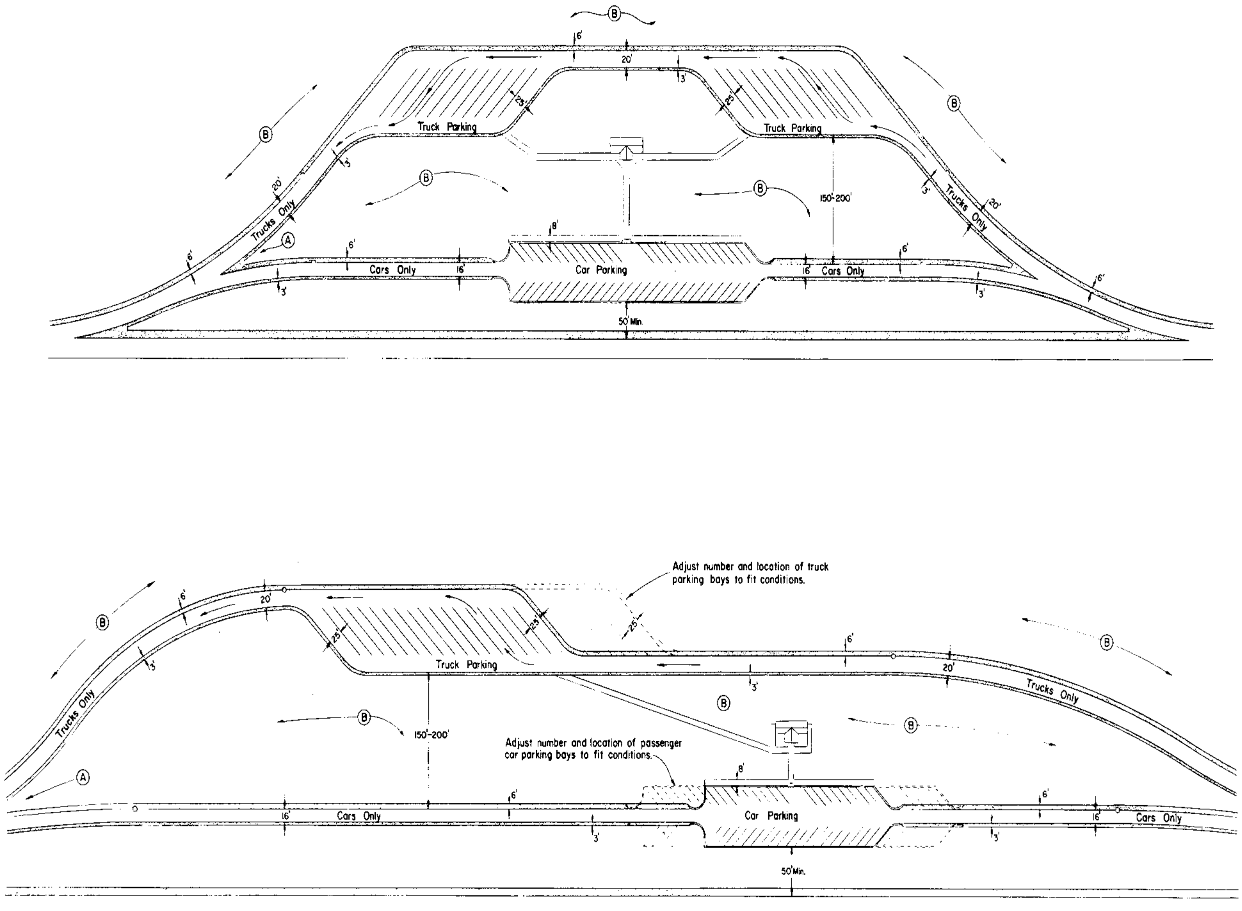

**ACCESS AISLE FOR ACCESSIBLE LOADING ZONES**

NOTES:

LOCATION: Parking spaces for persons with mobility impairments and accessible passenger loading zones 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, accessible parking spaces shall be located on the shortest possible circulation route to an accessible pedestrian entrance of the parking facility.

PASSENGER LOADING ZONES: If there are curbs between the access aisle and the vehicle pull-up space, then a Standard CG-12 Curb Ramp shall be provided.

**FIGURE C-1-10.1 DESIGNS FOR ACCESSIBLE PARKING SPACES**

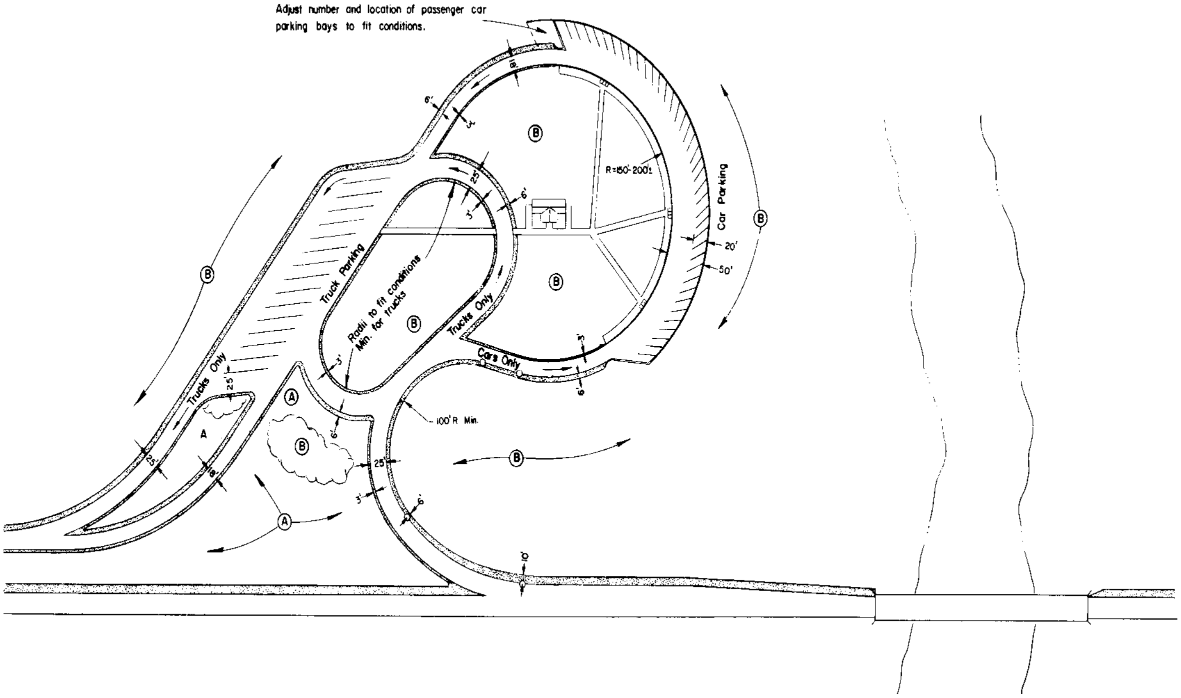



A  Denotes areas to be cleared, grubbed, graded, topsoiled, and seeded.

B  Denotes areas <u>NOT</u> to be cleared and grubbed except for areas within roadway and parking area construction limits

NOTE:  See Figure C-1-12 for additional areas.

**FIGURE C-1-11  DESIGN GUIDE FOR SAFETY REST AREAS**




A  Denotes areas to be cleared, grubbed, graded, topsoiled, and seeded.

B  Denotes areas <u>NOT</u> to be cleared and grubbed except for areas within roadway and parking area construction limits

## NOTES

Design types are to receive the approval of the Environmental Division.

Individual radii; length of ramps; individual ramp configuration, etc. are to be designed to fit the individual site conditions.

Design and dimensions shown hereon are approximate only.

Well and septic drainage field locations are to be recommended by the District Landscape representative. Testing and approval of soil conditions are to be obtained by the Environmental Division through the appropriate County and State agencies. Additional right of way for drain field should be acquired if necessary.

The proposed right of way limits should be discussed with the Environmental Division after preparation of the plan and grade lines in order that adequate area for required facilities will be obtained.

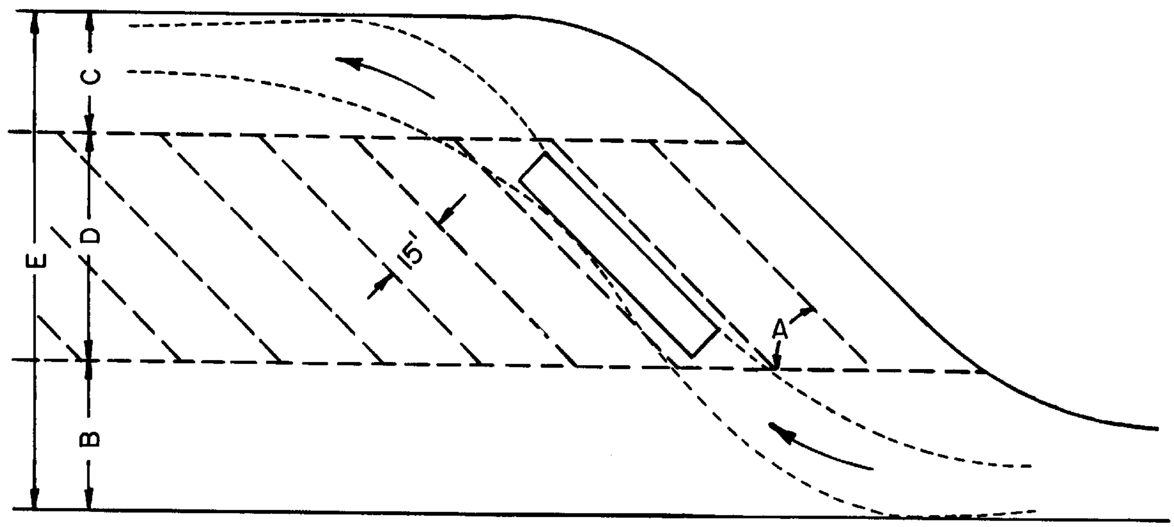
A single line of fence in median is to be specified if opposite rest areas are accessible, or if medians can be readily crossed by pedestrians. This fence should extend between points a minimum of 60 meters (200 feet) beyond ramp noses. Fencing in outer separator may be required because of site requirements.

Perimeter of rest area to be fenced unless otherwise recommended by the field party.

A note similar to the following is to be shown on the rest area detail sheet of all grading and drainage plans:

> "No trees or shrub outside the limits of the rest area roadway construction are to be cut without the approval of the Landscape Engineer."

**FIGURE C-1-12  DESIGN GUIDE FOR SAFETY REST AREAS**



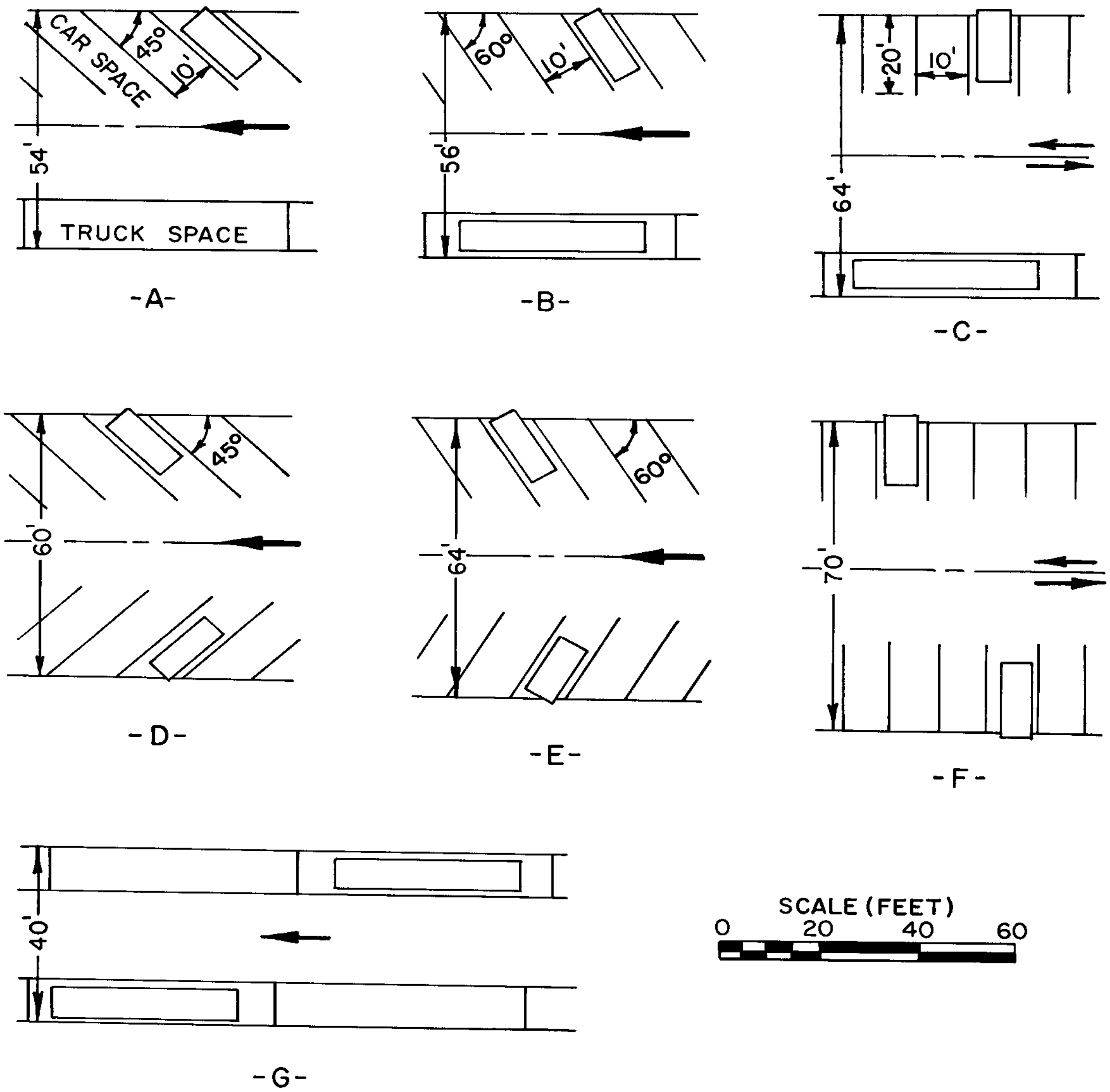

LEGEND

A - ANGLE OF PARKING
B - ENTRANCE ROADWAY WIDTH
C - EXIT ROADWAY WIDTH
D - PARKING WIDTH
E - TOTAL WIDTH

DIMENSIONS FOR PARKING SPACES

| ANGLE OF PARKING (DEGREES) A | ENTRANCE ROADWAY WIDTH (FEET) B | EXIT ROADWAY WIDTH (FEET) C | PARKING WIDTH (FEET) D | | TOTAL WIDTH PARKING AREA (FEET) E | | NUMBER OF TRUCKS PARKED (PER ACRE) | |
|---|---|---|---|---|---|---|---|---|
| | | | 55 ft. (WB-50) DESIGN VEHICLE | 82 ft. LENGTH DESIGN VEHICLE | 55 ft. (WB-50) DESIGN VEHICLE | 82 ft. LENGTH DESIGN VEHICLE | 55 ft. (WB-50) DESIGN VEHICLE | 82 ft. LENGTH DESIGN VEHICLE |
| 30 | 20 | 20 | 40 | 54 | 80 | 94 | 17 | 11 |
| 45 | 30 | 25 | 50 | 69 | 105 | 124 | 19 | 16 |
| 60 | 40 | 30 | 55 | 79 | 125 | 149 | 19 | 16 |

**FIGURE C-1-13 DESIGN FOR ANGLE PARKING OF TRUCKS**




**SUMMARY OF PARKING SPACE ARRANGEMENTS**

| Central Roadway | | Type of Vehicle and Angle of Parking | | Total Width Parking Area | Number Vehicles per 120 linear. feet | |
|---|---|---|---|---|---|---|
| | | Left | Right | (feet) | Left | Right |
| A | One-way | Trucks-parallel | Cars-45$^{0}$ | 54 | 2 | 8 |
| B | One-way | Trucks-parallel | Cars-60$^{0}$ | 56 | 2 | 9 |
| C | Two-way | Trucks-parallel | Cars-90$^{0}$ | 64 | 2 | 12 |
| D | One-way | Cars-45$^{0}$ | Cars-45$^{0}$ | 60 | 8 | 8 |
| E | One-way | Cars-60$^{0}$ | Cars-60$^{0}$ | 64 | 9 | 9 |
| F | Two-way | Cars-90$^{0}$ | Cars-90$^{0}$ | 70 | 12 | 12 |
| G | One-way | Trucks-parallel | Trucks-parallel | 40 | 2 | 2 |

**FIGURE C-1-14 DESIGN FOR PARKING SPACES**

# SECTION C-2-ENVIRONMENTAL

## NOISE ABATEMENT

In order that all factors are considered in reaching a decision on the installation of noise abatement, a joint committee comprised of members from the Federal Highway Administration and the Department will use the following flow chart in reaching decisions related to noise abatement features. During the development of the plans and the review of the noise abatement features by the Noise Committee, it will be the designer's responsibility to:

1. Provide cost for various walls as requested by the Committee.

2. Note on Right of Way plans that noise abatement is being considered affecting specific parcels and until final decision is reached, acquisition should be held in abeyance.

3. If the locations being considered for noise barriers are known prior to field inspection, they should be shown on the plans in the approximate location and be labeled possible noise barrier.

## NOISE ABATEMENT DECISION FLOW PROCESS

## PRELIMINARY PLAN REVIEW

The District environmental specialist participates in this preliminary plan review for the purpose of identifying noise sensitive activities in this early stage of project development where engineering solutions to potential noise problems may be possible.

## DRAFT EIS

The Draft Environmental Impact Statement presents existing and future noise levels and identifies the potential need for noise abatement. Potential location and approximate geometry of noise abatement features are shown. Preliminary cost data for abatement features are submitted to the engineering divisions for incorporation into the total project cost.

## LOCATION PUBLIC HEARINGS

The district environmental staff (with assistance from Environmental Division noise staff as necessary) would respond to noise related inquiries. Plans depicting the abatement features and a copy of the Draft EIS are made available for public review.

## FINAL ENVIRONMENTAL IMPACT STATEMENT (EIS)

Generally the noise section of the Final Environmental Impact Statement consists of a reorganization of the existing data for the selected alternative. Additional noise sensitive land use development in the project corridor or revisions to the highway alignment may require an update of the noise analysis and abatement considerations. Abatement features determined to be not prudent are deleted from the project proposal.

## FIELD INSPECTION AND FINAL DESIGN OF ABATEMENT FEATURES

The details of noise abatement features are reviewed on the site. Included in this review are such items as abatement material and design construction techniques and value engineering considerations. Abatement features and alternatives to noise mitigation such as vegetative screening and privacy fences and discussed. The participants in this field inspection should include representatives from FHWA, L & D, ED, the district and the city, if applicable. Following this field inspection, the final design of the abatement features is completed and cost data for specific abatement materials and designs are developed.

## DESIGN PUBLIC HEARING

Plans and pertinent data for probable abatement features are made available for review at the public hearing as an element of the overall project proposal.

## PUBLIC INTERACTION

Probable noise abatement features and non-noise mitigation measures are presented to involved citizens and their input is sought, unless such input has been otherwise obtained.

## DECISION

Noise abatement related decisions are reached on the basis of acoustical, engineering and socio-economic data acquired to this point. The team decision should include a recommendation on whether the abatement features should be included with the project contract or be advertised as a separate contract.

## APPROVAL OF THE NOISE STUDY

For projects which do not fall under Certification Acceptance, noise study, the abatement proposals and exception requests are submitted to FHWA for approval. For projects which fall under Certification Acceptance, the approval is rendered by the Director of Planning and Programming.

## RIGHT OF WAY

The Right of Way and Utilities Engineer is advised of the need for noise abatement related right of way by the State Location and Design Engineer.

## PLANS, SPECIFICATIONS AND ESTIMATES (PS & E)

If a significant time period has elapsed between the approval of the noise study and submission of the PS & E assembly, it may become necessary to update the abatement related data in the noise study, reevaluate abatement costs, and resubmit it to FHWA with the PS & E.

## CONSTRUCTION REVIEW

The Department and FHWA review the abatement features with the contractor during construction.

# SECTION C-3 RIGHT OF WAY

## CRITERIA FOR PLACEMENT OF RIGHT OF WAY MONUMENTS

Right of way monuments will be installed in accordance with the following criteria:

1. Interstate with Arterial, Primary, or Secondary Crossroad:
   - (a) On inside and outside of PC's and PT's
   - (b) Along minor road until existing right of way is tied in
   - (c) All right of way breaks
   - (d) At beginning and end of project unless monumented on previous project
   - (e) At 750 meter (2500') intervals between right of way breaks

2. Arterial or Primary with a Secondary Crossroads:
   - (a) Same as 1(a)
   - (b) To end of right of way flare of major road
   - (c) Same as 1(c)
   - (d) Same as 1(d)
   - (e) Same as 1(e)

3. Secondary Roads
   Show distance and plus to all right of way breaks with no monuments.

Where the right of way is variable around curves, use chords in lieu of arcs, limiting the number of chords to those actually needed to accurately delineate the right of way, but without obtaining excessive right of way. The foregoing is the general rule, but if it is necessary to use a curved non-concentric right of way line, then this line shall be described by arc length, radius and central angle. Where right of way around a curve is a constant distance from the baseline on which it is based, it is to be shown as a concentric curve.

When a right of way break is positioned in the vicinity of a property line, it is to be positioned so as not to be confused with the property line. The practice of showing the proposed right of way lines intersecting a property line at a break point is not acceptable unless it is necessary for some reason that the break be on the property line.

A necessary condition, for instance, would be for an entire taking where a part of the taking would be in fee right of way with the remaining residue being described along the proposed acquisition line. Another condition would be where the proposed right of way begins or ends on the existing right of way (see Figure C-3-1).

Survey parties have been, for some time, locating all existing property corners (monuments, stones, iron pins, trees, fence corners, etc.) referenced to the survey baseline by station and right angle offset or radial offset distance with both station and distance being accurately measured to the nearest one-hundredth of a foot. Property line bearings are furnished, calculated from the bearing of the survey and the direction of the bearing referred to this base line. Therefore, all pluses and distances can be calculated and shown to the nearest one-hundredth of a foot.

The practice of <u>scaled pluses and distances</u> for these right of way break points will not be acceptable.

The monuments along right of way lines, to meet inter-visibility requirements, shall be estimated by studying the grades or left up to the party setting the monuments to be placed at least every 750 meters 2500'. It is preferable to make an estimate from the plans to reduce the possible overrun on right of way monuments in the summaries.

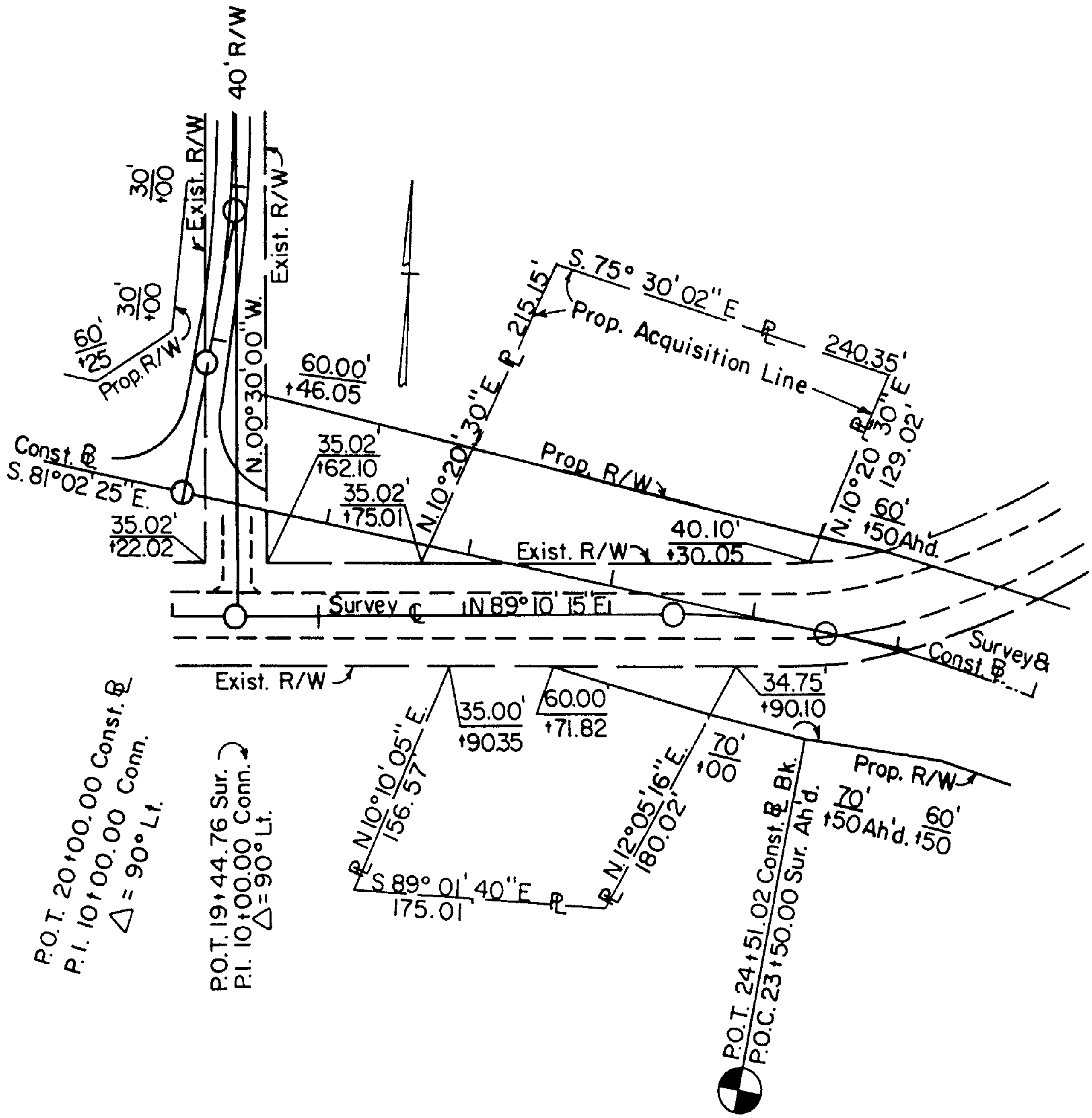



**FIGURE C-3-1 SKETCH SHOWING SURVEY PROPERTY LINE TIE AND PROPOSED R/W BREAK POINT**

# SECTION C-4-WATER RELATED PERMITS

## REVIEW OF PUBLIC NOTICES

The Department frequently receives copies of public notices from the Corps of Engineers and/or U.S. Coast Guard advising us of permit applications for various items crossing navigable waters such as overhead power lines, bridges, and underwater telephone cables. The Corps of Engineers and the U.S. Coast Guard have requested that all contacts in response to these public notices be from a single state agency. The Governor designated the Dept. of Environmental Quality as the contact agency. Any comments or objections are to be submitted to their office in writing. The Location and Design Engineer will review these public notices and act as the clearinghouse for all comments and/or objections from the Department. The Assistant Location and Design Engineer in charge of Location will consolidate and submit all comments to the Dept. of Environmental Quality. If there are no comments, then no response is necessary.

## INTRODUCTION (PERMIT APPLICATION)

The following material is intended to provide Location and Design personnel with an overview of the process by which the Department obtains permits from other agencies for its construction in or near waterways. It also provides detailed instructions for the compilation of that part of a permit assembly that is the responsibility of Location and Design personnel.

The information and procedures outlined herein are based on current practices and the Department's experience to date. Revisions and modifications will be issued in the future as necessary to reflect changes in the permit process.

| TYPES OF PERMITS | ISSUING AGENCIES |
|---|---|
| River and Harbor Act of 1899 | U.S. Army Corps of Engineers<br>U.S. Coast Guard |
| Public Law 92-500, Section 404 | U.S. Army Corps of Engineers |
| Public Law 92-500, Section 401<br>Virginia Water Protection Permit(VWPP) | Department of Environmental Quality |
| Public Law 92-500, Section 402 | Environmental Protection Agency |
| Subaqueous Bed Permit | Virginia Marine Resources Commission |
| Tennessee Valley Authority Permit | Tennessee Valley Authority |
| VDOT General Permit | U.S. Army Corps of Engineers<br>Virginia Marine Resources Commission |
| Navigable Water Permit | U.S. Coast Guard |

## PERMIT APPLICATIONS

### PERMIT APPLICATION PROCEDURE

The determination as to the need for permits is the responsibility of the District Environmental Managers. The normal procedure is for the District Environmental Manager to handle all permit matters for all projects in that District, regardless if plans are developed in the District or in the Central Office. The steps in the permit process are shown on the flow chart following this Section and are outlined as follows:

Step 1 After a project has been initiated, the project designer will determine if a permit determination has been done on the project. If not, the project designer will request a permit determination from the appropriate District Environmental Section. Stated more precisely, the District Design Engineer or the Central Office project designer will make his/her request to the District Environmental Manager. The request is accompanied by a topo map and preliminary plans, if available, indicating the limits of the project and Form LD-252 requesting supporting data.

Step 2 Upon receipt of this request, the District Environmental Section shall survey the project and determine what permits **MAY** be required. They shall notify the project designer initiating the request as to their determination.

Step 3 Upon receipt of the permit determination, the project designer is to notify all other disciplines who will be involved in the design of the project and, if a permit is required, requests that they furnish their respective components of the permit assembly at the earliest appropriate time. The District Design Engineer shall furnish the Central Office Coordinator a copy of the determination.

Typically, the project designer prepares the location map and basic sketches. If a bridge is involved, the bridge designer prepares the bridge sketch and obtain the hydraulic commentary from the Central Office Hydraulic Section. For facilities other than bridges, the project designer obtains the Hydraulic Commentary from the unit that designed the drainage items. The project designer obtains the construction commentary from the Scheduling and Construction Division in the case of a central office project or the Assistant District Engineer in charge of construction, if a district project, and if necessary, obtains the necessary property data from the respective Right of Way unit.

It is important to note that the initial permit determination is based on cursory data and is usually conservative, reflecting the most disruption that may be anticipated as a result of the proposed construction. If it becomes apparent during the development of a more detailed design that the proposed project will have little or no effect on the aquatic environment, the project designer shall request a review of the permit determination. To facilitate this, he shall submit a rough sketch showing the extent of the proposed activity (For details see Figure C-4-1).

Step 4 If a project requires a permit, as noted on the permit determination and after the project designer has received the required sketches and other information from the various disciplines involved, he will compile the permit assembly. The project designer will forward the entire assembly to the District Environmental Section making the permit determination. This step should occur after the public hearing requirements have been met and approximately one year prior to the project advertisement date.

The District Environmental Section will file the necessary permit applications on behalf of the Department.

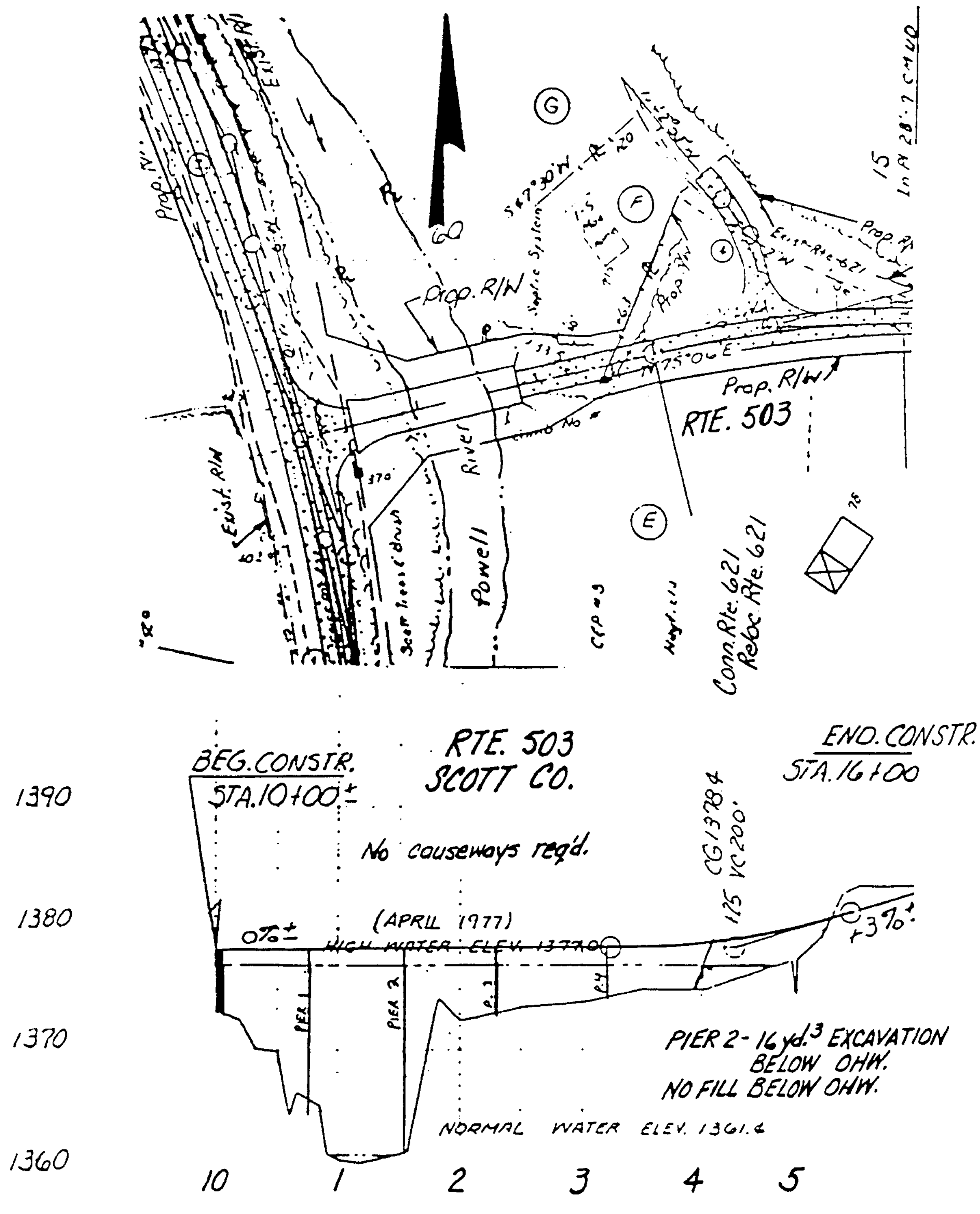



**FIGURE C-4-1 PLAN AND PROFILE - PERMIT (ROUGH SKETCH)**

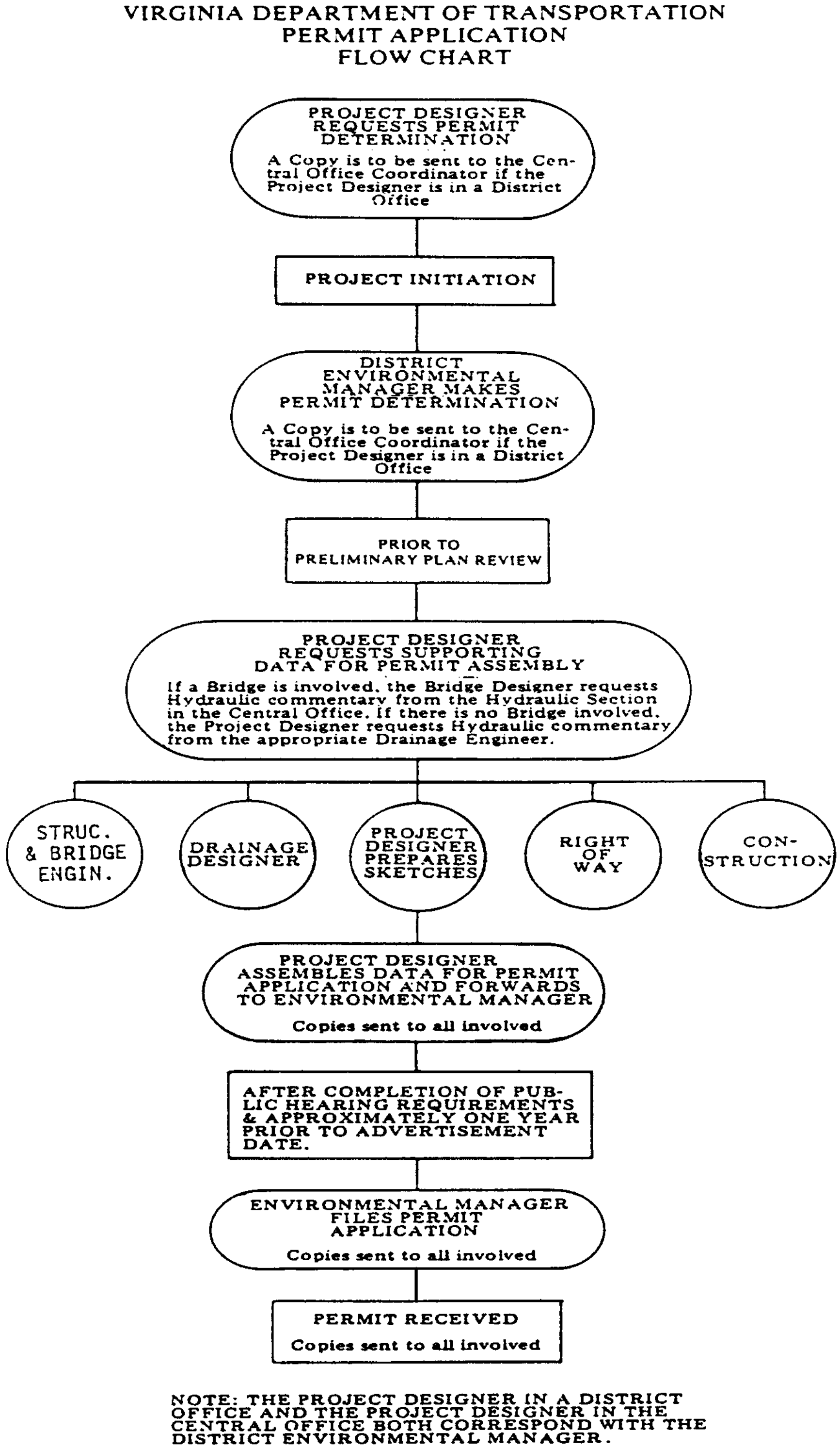



**FIGURE C-4-2 PERMIT APPLICATION FLOW CHART**

## DRAWING REQUIREMENTS

The permit sketch is to be drawn on paper sheets measuring 216 mm x 279 mm (8 1/2 x 11 inches) with a 25 mm (1") border at the top and 12 mm (half-inch) borders on the remaining three sides. The plan and profile views are to be drawn to the largest scale practical to clearly show the details of construction which the various permits address. In most cases, more than one sketch sheet will be needed to adequately show all of the details for each of the different views. For example, in a tidal area, the edge of existing stream mean low tide, mean high tide, limits of mud wave, limits of wetlands, and limits of oyster planting grounds may all have to be shown in addition to other pertinent information. When such is the case, a larger than normal scale must be used which would in turn lead to more than one sketch sheet. A maximum effort is to be directed toward clarity and the elimination of unnecessary details not pertaining to the subject of the permit (i.e., it is not necessary to show details of bridge parapets, guardrail, etc., but it is necessary to show cofferdam locations and channel cleanouts.

The applicable water elevations and corresponding quantities are outlined in the next three paragraphs. Note that the demarcation of ordinary high water and tide lines refers to their location prior to the proposed construction. For fresh water streams, the ordinary high water and wetlands limits (if applicable) need to be shown. Quantities will be figured channelward and below ordinary high water.

For fresh water lakes, the ordinary high water, ordinary low water and limits of wetlands (if applicable) need to be shown. Quantities will be figured channelward and below ordinary high water.

For tidal areas, the mean low tide, mean high tide and limits of wetlands (if applicable) need to be shown. Quantities are to be figured from where the tide lines touch the original banks (1) Channelward of and below mean low tide line and (2) Channelward of mean high tide line and below to the horizontal and vertical planes of mean low tide.

In addition, the total area to be filled below the applicable high water line is to be stated. The area of wetlands to be filled is to be stated separately. These areas are those within the limits of construction.

In addition to showing the wetland mitigation site(s) on the plan view, include, as appropriate, both a contour map with the proposed and adjacent contours and a typical cross-sectional view with the proposed grade of the site(s) in relation to the approximate adjacent ground/wetlands elevation. A primary concern of the VMRC involves slightly sloping mitigation sites to minimize trenching and excessive ponding. In addition, an enlarged plan view depicting species to be planted at the appropriate elevations if helpful.

In summary, it is suggested that a copy of the drawing checklist be utilized and made a part of the file when the sketches are prepared, since this will be the procedure followed when the sketches are reviewed before being submitted to the District Environmental Manager. When questions arise pertaining to the preparation of the permit sketch, the Hydraulics Section in the Central Office is to be consulted.

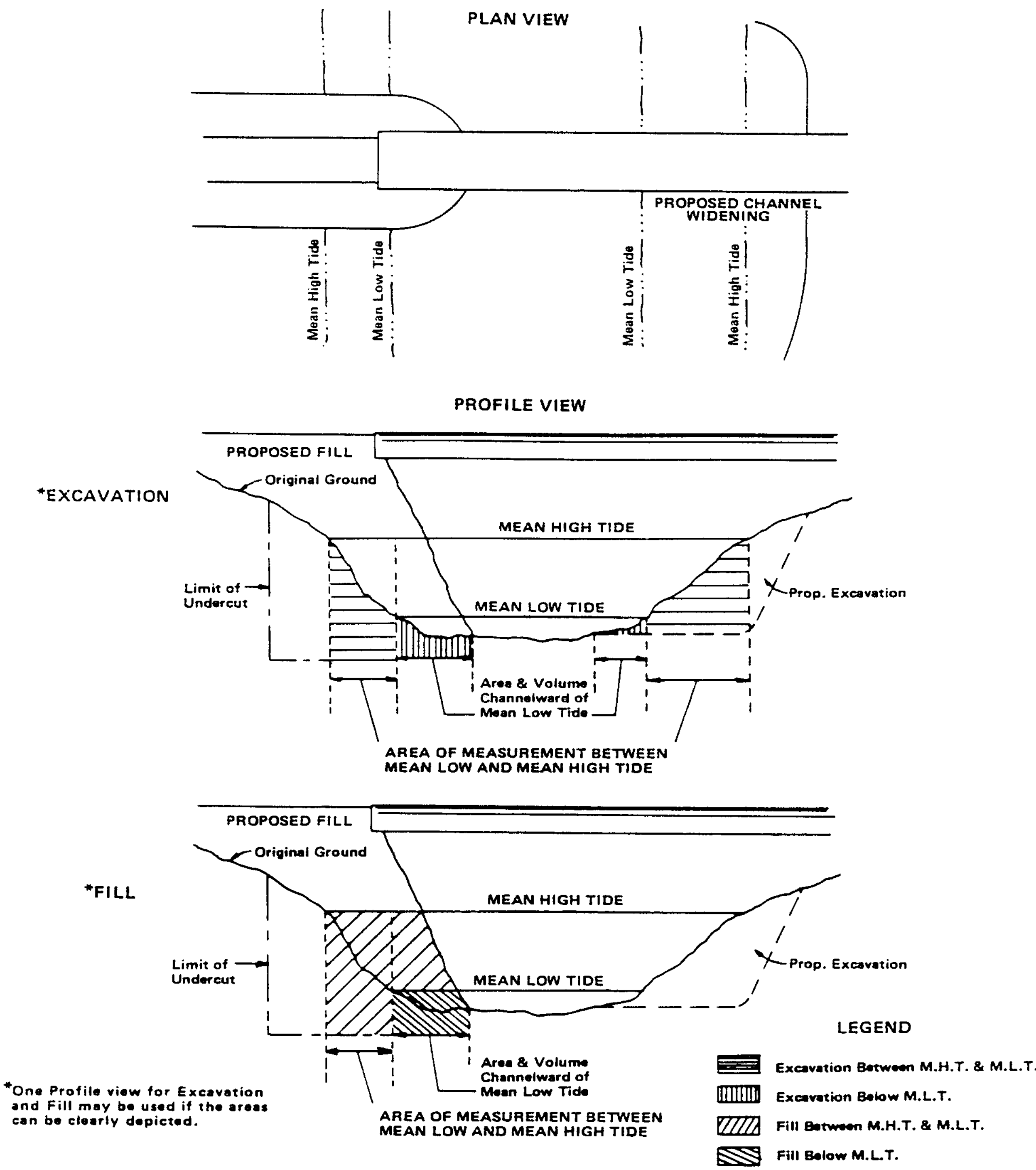



**FIGURE C-4-3 MEASUREMENT OF EXCAVATION AND FILL AREAS BETWEEN MEAN LOW AND MEAN HIGH TIDES**

**DRAWING CHECKLIST (TO BE STRICTLY ADHERED TO)**

1. General

( ) Submit one copy original of all drawings on paper sheets measuring 216 mm x 279 mm (8 1/2 x 11 inches). Submit the fewest number of sheets necessary to adequately and clearly show the proposed activity. Drawings should be in accordance with the general format of the enclosed sample drawings and must be of good reproducible quality. Block style lettering should be used. Do not use freehand sketches.

It is recommended that the drawings be in ink on plastic sheets. Prints may be made from these sheets and may, in turn, be used as the "copy original" for the permit application. The original drawing will be retained by the designer to facilitate revisions.

( ) A 25 mm (1") margin is to be left at the top edge of each sheet for binding purposes and a 12 mm (half-inch) margin on the other three sides.

( ) Drawings are not to reflect the approval, non-objection, or action of other agencies.

( ) Since drawings must be reproduced photographically, color shading cannot be used. Drawings may show proposed work using stippling, hatching, cross-hatching, or similar graphic symbols.

( ) Each drawing submitted should identify the project and contain the route and project number; the name of any applicable body of water and/or stream; river mile, if applicable; name of county; number of sheet and total number of sheets in a set; and date the drawing was prepared.

( ) State datum used as basis for elevations (mean sea level, mean low water or National Ocean Survey datum in tidal areas / ordinary high water in non-tidal areas).

( ) Subsequent revised drawings, as required, must be dated.

2. Vicinity Map

( ) Show location of each activity site (to scale) including latitude and longitude on a portion of an original USGS Topo map. Show name of the USGS map(s) used.

( ) *Show name of waterway and river mile (if applicable).

( ) *Show name of and distance to local town, community or other major landmark(s). Show city and/or county boundaries where applicable.

( ) Show graphic scale.

( ) Show North arrow (preferably oriented so North is pointing to top of sheet).

( ) *Show route numbers and names of roads in the vicinity of the activity site.

*Note: A cut out from a county map with the scale, north arrow and activity site identified may be used in lieu of showing distances and route numbers/road names on the topographic map.

3. Plan View (To be drawn to as large a scale as practical)

( ) Show name of waterway.

( ) Show distance between proposed activity and water channel or navigation channel where applicable.

( ) Show location and boundary of any wetlands. (Use COE's (Corps of Engineer's) multiparameter method for boundary delineation.)

( ) Show existing shorelines if different from ordinary high water or mean high tide.

( ) Show ebb and flood in tidal waters and direction of flow in non-tidal areas.

( ) Show North arrow (preferably oriented so North is pointing to top of sheet).

( ) Show graphic scale or "not to scale." (Adequate dimensions must be provided on "not to scale" views. Freehand sketches are unacceptable).

( ) Show existing and/or proposed VDOT right of way and easements, existing easements owned by others and existing and/or proposed utilities where applicable.

( ) Show proposed and/or existing roadway limits and existing structure to be replaced.

( ) Show proposed construction limits including channel changes and easements.

( ) Show relocated utilities if they are part of the project and located within our right of way easement.

( ) Show applicable erosion control devices. (Do not place in "live" streams.) Show stream bank stabilization.

( ) Show mean high and mean low tides if proposed activity is in tidal areas.

( ) Show delineation of ordinary high water line if activity is in a non-tidal area.

( ) Show normal pool elevation (level) if activity is on a lake.

( ) Show principal dimensions of structure or work and extent of encroachment channelward of the mean high water and mean low water lines (for tidal areas only), or ordinary high water line (for non-tidal areas only), or normal pool elevation (level) for lakes.

( ) Show the location for dredging, excavation, or fills below the applicable high water line, type of materials, and methods of handling. If applicable, indicate the number of cubic yards to be dredged, excavated and/or filled below and channelward of the ordinary high water line. In a tidal situation indicate the applicable dredged and/or fill quantities (1) below and channelward of the mean low water line, and (2) between the mean low water and mean high water lines.

( ) Indicate, if applicable, the total area in square feet to be dredged and/or filled below the ordinary high water line or in a tidal situation, the mean high water line.

( ) If known, show location of fill or spoil disposal area. If spoil material is to be placed in an approved spoil site, a separate map showing the location of the spoil site must be attached. The drawings must indicate proposed retention levees, weirs, and/or other devices for retaining hydraulically placed materials. If any de-watering or spoil material re-enters State waters, the site will need a permit.

( ) Show and identify structures, if any, in navigable waters immediately adjacent to the proposed activity including permit numbers, if known.

( ) Show water depths on either side of the project at mean low water (for tidal areas only) or ordinary high water (for non-tidal areas only) when a temporary causeway, dredge channel or channelization is part of the proposed project.

( ) If applicable, indicate the total area in square feet of wetlands to be filled and/or dredged based on the COE's (Corps of Engineers') multiparameter method for boundary delineation.

( ) Depict the wetland mitigation site(s).

( ) Show property lines and identify adjacent property owners and addresses. On narrow waterways the property owner on the opposite shore must also be identified. (Not required for general permit sketch.)

( ) Show limits of wetlands for fresh water and tidal areas, if applicable. Also show spot elevations adjacent to project when the foregoing criteria applies.

( ) Identify the limits of oyster planting grounds, if applicable.

( ) Show the limits of anticipated mud wave, if applicable.

( ) Show proposed causeways, cofferdams and detours, if applicable.

( ) Show composition of causeways and cofferdams.

4. Profile View* (To be drawn to as large a scale as practical to depict the proposed structure, cofferdams, piers, stream bank stabilization, etc., in relation to the stream.)

( ) Depict the proposed structure(s) perpendicular to the center line if not skewed. If skewed, depict the structure looking upstream along the angle (or line) of skew or perpendicular to the centerline if a simple profile view (looking upstream) is given.

( ) If extensive channel dredging or channel relocation is proposed, show the proposed dredging grade or channel profile as appropriate.

( ) Show same water elevation as for plan views, including wetlands elevation, if applicable.

( ) Show proposed and/or existing structures (with invert elevations in the case of culverts).

( ) Show proposed and/or existing road grade elevations over proposed structures.

( ) Show graphic scale or "not to scale". (Adequate dimensions must be provided on "not to scale" views.)

( ) Show elevation of spoil areas, if applicable.

( ) Show by cross hatching, area of fill below applicable high water.

*Note:

Small depictions of the profile view of temporary causeways/haul roads/detours with pipes, work bridges may be shown on the plan view if space permits and if such features are attendant/secondary. When projects are modified to include or reflect changes to these features, the features should be adequately depicted on a larger scale.

5. Cross-sectional View** (Adequate dimensions must be provided to describe activity - Does not have to be to scale).

( ) Show typical view of longitudinal roadway encroachments into streams and wetlands. The wetlands shown must be those based on the COE's (Corps of Engineer's) multiparameter method for boundary delineation.

( ) Show the typical view of channel relocations with low-flow provisions as appropriate.

( ) Show disposal sites with elevation of berms and any overflow pipes if any dewatering or spoil material will re-enter State waters.

( ) Show same water elevations as for plan view, including wetlands elevation, when applicable.

( ) Show cross section of excavation or fill and side slopes.

( ) Show elevation of spoil areas, if applicable.

( ) Show depth of waterward face of proposed work or if dredging is proposed, show dredging grade.

( ) If a fill, float, or pile supported platform is proposed, show dimensions above applicable high water line and identify any structures to be erected thereon.

( ) Show by cross hatching, area of fill below applicable high water.

** Note:

(1) Small depictions of typical cross-sections of temporary causeways /haul roads /detours, work bridges and detour bridges may be shown on the plan view if space permits when such features are attendant/secondary. When permits are revised to reflect changes to or include such features, larger depictions are preferable.

(2) Cross-sections are to be used to depict different type features and/or options of structural features. The detail/size of such cross-section is discretionary.

(3) Cross-sections referenced to the plan view are helpful.

6. Wetlands Mitigation Sketches

( ) In addition to showing the wetland mitigation site(s) on the plan view, include as appropriate, a contour map with the proposed and adjacent contours and a typical cross-sectional view with the proposed grade of the site(s) in relation to the approximate adjacent ground/wetlands elevation. In addition, an enlarged plan view depicting species to be planted at the appropriate elevations is required.

7. Notes on Drawings

( ) List names and addresses of adjacent property owners whose property also adjoins the water, if not shown in plan view. (Not required for general permit sketch).

( ) State purpose (private use, commercial, public, etc.) of proposed activity. (Identify Project).

( ) If petroleum products or other hazardous material will be stored or handled at the proposed facility, so indicate.

( ) State datum used in plan, profile, and section views. (Mean Low Water, National Ocean Survey Datum or USGS).

( ) List names and addresses, separate from the property owners, of known claimants of Water Rights and/of oyster planting Grounds, if applicable.

( ) State the method of dredging, if applicable.

( ) State the number of $m^3$ (cubic yards) to be dredged, excavated or filled channelward of and below the ordinary high water line (causeways and fill type cofferdams inclusive).

or

State the number of $m^3$ (cubic yards) to be dredged, excavated or filled (1) Channelward of and below Mean Low Tide and (2) between Mean Low Tide and Mean High Tide (causeways and fill type cofferdams inclusive). See Figures C-4-6 and C-4-7.

( ) State the total area in square meters (sq. ft.) to be filled and excavated channelward of and below applicable high water line. State separately the entire area of wetlands in $m^2$ (sq. ft.) filled (causeways and fill type cofferdams included.)

**HYDRAULIC COMMENTARY FOR PERMIT APPLICATIONS**

1. State source (or base) of hydrologic computations - i.e., "regional analysis of USGS gage data" or "empirical formulas such as Circular IV and USGS multiple regression formulas. State design frequency of projects, Q design, Q100.

2. State historical data - i.e., "high water marks for the 1969 flood obtained by VDOT field reconnaissance or from local resident." State discharge and frequency, if possible.

3. State type of hydraulic calculations - i.e., "FHWA Circular 5 -Culvert nomographs, FHWA Bridge Backwater Program, USACE HEC-2 W.S.P. Program, etc."

4. Display or describe by appropriate means the effect of the 100-year flood level under existing conditions and under proposed conditions.

It is recognized that the scope of this data will vary widely between different project types. Bridges and major streams will require adherence to the "1 on 100-year" rule or a detailed justification for deviating from the rule. Culverts and smaller streams are less restricted, although a statement of justification for our action is still required.

## DISTRIBUTION OF COPIES OF PERMIT APPLICATIONS

Permit Application Data ............................................................... to the Environmental Unit
District Environmental Section ......................................2 complete assemblies, 1 containing original sketches
Scheduling & Contract Division Engineer .....................................................cover letter only
Programming Division Director ....................................................................cover letter only
Bridge Designer.........................................................2 copies of bridge sketches and bridge construction commentary, if applicable
Assistant L&D Engineer - Rd. Des.........................................................1 complete assembly
Drainage Designer .........................................................................1 complete assembly
File.................................................................................................1 complete assembly

## GENERAL CONSTRUCTION NOTES AND EROSION AND SILTATION CONTROL NARRATIVE

The attached list of notes has been prepared for use as a guide in making permit application. It appears that one or more of the following conditions may exist on projects and the appropriate notes are to be used for the applicable condition:

---

Condition No. 1 - Proposed Channel Change Outside the limits of existing live streams - Use note numbers 1 and 2.

Condition No. 2 - Proposed Channel Change inside the limits of existing live stream - Use note number 1.

Condition No. 3 - Proposed Culvert (Pipe or Box) outside the limits of existing stream - Use note numbers 1 and 4.

Condition No. 4 - Proposed Culvert (Pipe or Box) inside the limits of existing stream where topography will permit temporary channel change - Use note numbers 1 and 3.

Condition No. 5 - Proposed Culvert (Pipe or Box) inside the limits of existing stream where topography will not permit temporary channel change - Use note numbers 1 and 5.

---

Note No. 1 - Construction of proposed and temporary channel changes and culverts will be performed in such a manner as to minimize siltation of streams. Coordinate the essential sequence of operations so that work in live streams (including tie-ins on existing streams to proposed or temporary channel changes and culverts) will be scheduled for the season occurring during the life of the contract at which stream flow is at or near its minimum.

Prior to beginning excavation in live streams (including tie-ins) for proposed and temporary channel changes and culverts, required erosion control devices downstream from the proposed location(s) will be in place. Such devices will be properly maintained during construction at the respective locations. Material excavated for construction of proposed and temporary channel changes and culverts will be deposited within the roadway prism or in designated waste areas in such a manner as to prevent its return to streams by high water or run off. Backfill and approach fills for culverts will consist of excavation material. Erosion control devices will be strategically located as shown on the plan view to prevent siltation of streams during placement of backfill and approach fills and until the slopes are stabilized in accordance with Virginia Department of Transportation's <u>Road and Bridge Specifications</u>.

Note No. 2 - Proposed Channel Change(s) No._________________ will be constructed in the dry, with the exception of tie-ins to existing live streams, and will be completed (including stabilization of the bottom and slopes) prior to diverting existing streams through proposed channel change(s). Once excavation for the tie-ins is begun, it shall be continuously prosecuted to completion, including stabilization of bottom and slopes.

Note No. 3 - Culvert(s) No._________________ will be constructed by diverting the stream through a temporary channel change during excavation for and installation of the culvert(s). The temporary channel change will be constructed in the dry, with the exception of tie-ins to existing stream, and will be completed (including necessary stabilization of bottom and slopes) prior to diverting stream through temporary channel change. Once excavation for the tie-ins for the temporary channel change is begun, it shall be continuously prosecuted to completion including necessary stabilization of the bottom and slopes. The stream will not be diverted through the proposed culvert(s) until installation is complete, including required stabilization of inlet and/or outlet channel(s).

Note No. 4 - Culvert(s) No.__________________ will be installed in the dry, with the exception of tie-ins to existing live stream. The minimum temporary channel change necessary to maintain the integrity of the channel will be constructed to provide the dry condition during installation of the culvert(s). Once excavation for the tie-ins is begun, it will be continuously prosecuted to completion, including any required stabilization of inlet and/or outlet channel(s).

Note No. 5 - Culvert(s) No._________________ will be constructed by diverting the stream through a temporary pipe culvert or temporary diversion channel during excavation for and installation of the proposed culvert(s).

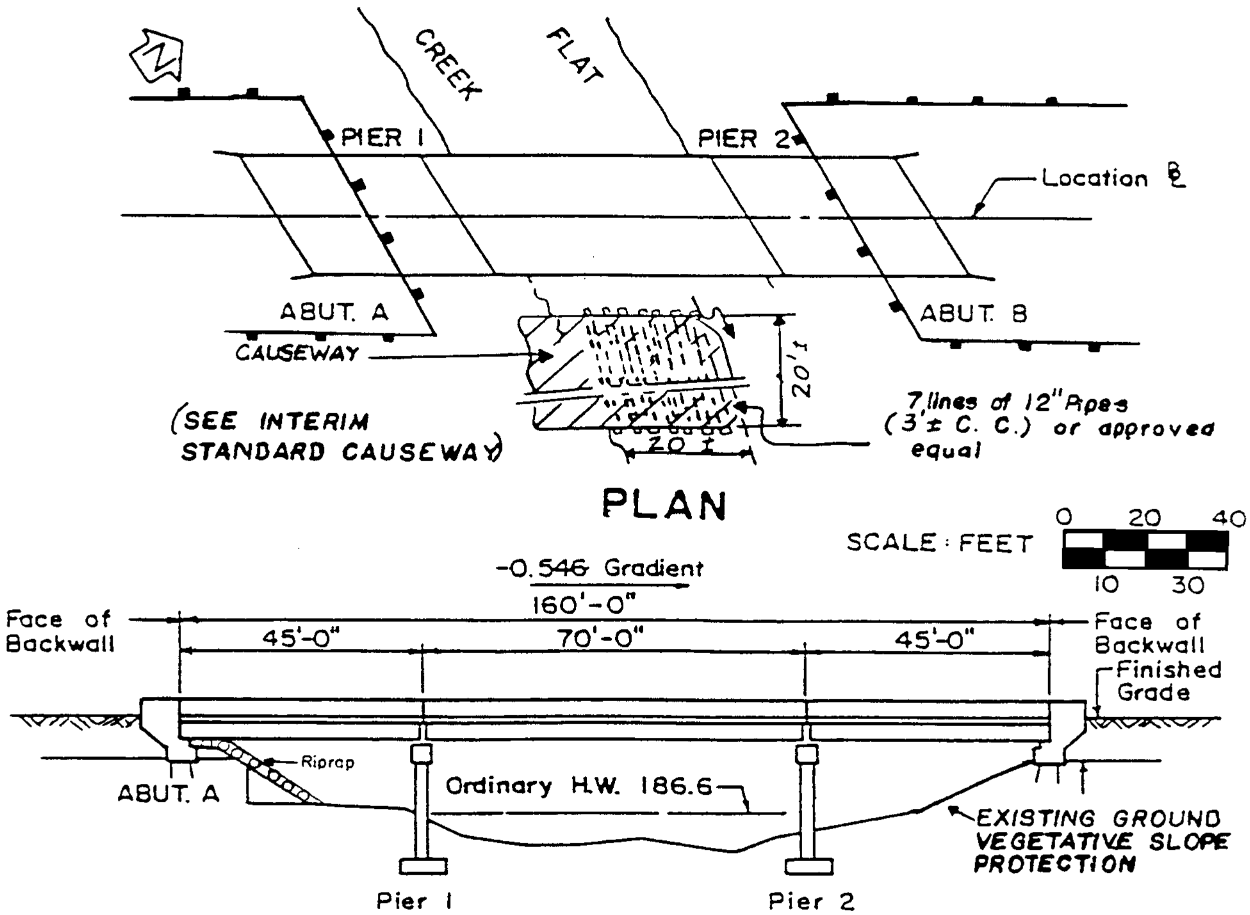
Note No. 6 - Measures shall be employed to prevent and/or control spills of fuels and/or lubricants from entering state waters. In the event that oil or other hazardous spill material has potential to or gets into state waters, the Contractor shall immediately notify the State Water Control Board land will take immediate actions for the containment and removal of such spill.

Note No. 7 - The Department will enforce the application of the following temporary and permanent erosion and siltation control measures for the work to be done on both shores of_________________.

a. Temporary filter barriers will be placed at the base of fill at the abutments and around the perimeter at the base of the causeway.

b. Temporary filter barriers will be installed in accordance with Section 303 of the Virginia Department of Transportation's Road and Bridge Specifications. The Contractor will regularly inspect the temporary barriers and correct any deficiencies in accordance with Section 107 of the Virginia Department of Transportation's Road and Bridge Specifications.

c. Cut and fill slopes will be promptly seeded in accordance with the Virginia Department of Transportation's Road and Bridge Specifications.




## ELEVATION

SCALE: FEET 0 10 20 30

| FILL BELOW ORDINARY HIGH WATER | | |
|---|---|---|
| | C.Y | S.F |
| RIPRAP | 23 | 280 |
| CAUSEWAY• | 30 | 400 |
| •CAUSEWAY IS OPTIONAL | | |

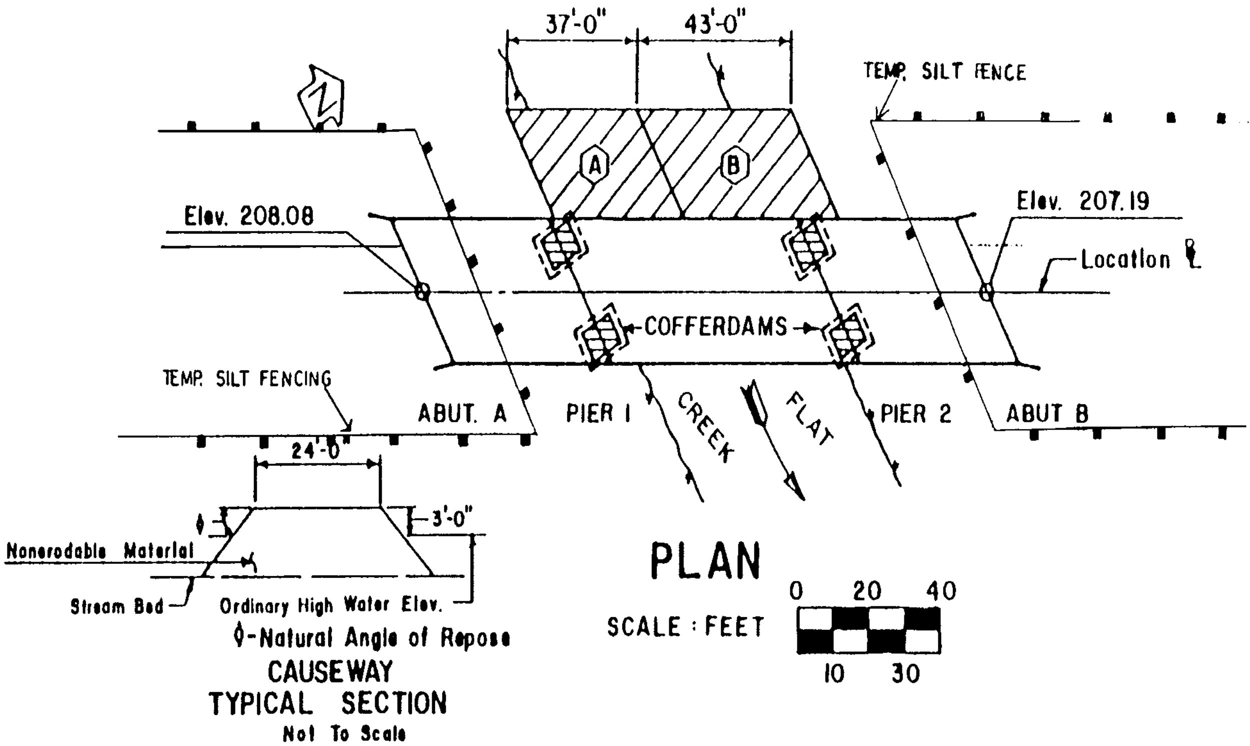
| EXCAVATION BELOW ORDINARY HIGH WATER | | |
|---|---|---|
| | C.Y | S.F |
| RIPRAP | 23 | 280 |
| CAUSEWAY• | 30 | 400 |
| EXISTING STRUCTURE | 37 | 1000 |

DATUM: U.S.C. & G.S.

PROPOSED BRIDGE ON RTE. 604
OVER FLAT CREEK
0.4 MI. N. INT. RTE. 632
COUNTY OF AMELIA
STATE OF VIRGINIA
APPLICATION BY: VA. DEPT. OF TRANS.

SHEET OF

**FIGURE C-4-4 PROPOSED BRIDGE PLAN-PROFILE SKETCH**




STRUCTURE EXCAVATION

PIER 1 - 80 C.Y.

PIER 2 - 73 C.Y.

CAUSEWAY QUANTITIES

| | FILL | AREA |
|---|---|---|
| (A) - | 99 C.Y. | 1200 S.F. |
| (B) - | 68 C.Y. | 1400 S.F. |

DENOTES AREA OF EXCAVATION

DENOTES CAUSEWAY

PROPOSED BRIDGE ON RTE. 604
OVER FLAT CREEK
0.4 MI. N. INT. RTE. 632
COUNTY OF AMELIA
STATE OF VIRGINIA
APPLICATION BY: VA. DEPT. OF TRANS.

SHEET OF

**FIGURE C-4-5 PROPOSED BRIDGE EXCAVATION AND CAUSEWAY SKETCH**

**PROJECT 0604-004-140,B-615**

**ROUTE 604 OVER FLAT CREEK**

I . Causeway A is to be constructed of non-erodable material as shown on the attached drawing. Causeway to be used for construction of Pier I and superstructure.

2. Excavation for Pier I to be performed within cofferdam placed from Causeway A. Cofferdam to be constructed so as to permit no siltation of the stream as a result of the excavation and backfill operations. Materials excavated from within cofferdam to be hauled from the site and used within the roadway prism.

3. After completion of Pier I and superstructure, the cofferdam and Causeway A are to be completely removed in such a manner as to cause minimal disturbance of the stream and hauled from the site to be used within the roadway prism or salvaged.

4. After removal of Causeway A, Causeway B is to be constructed of non-erodable material as shown on attached drawing. Causeway B to be used for construction of Pier .

5. Excavation for Pier 2 is to be performed within cofferdam placed from Causeway B. Cofferdam to be constructed as to permit no siltation of the stream as a result of the excavation and backfill operations. Material excavated from within cofferdam is to be hauled from the site and used within the roadway prism.

6. After completion of Pier 2 and superstructure, the material in cofferdam and Causeway B is to be completely removed in such a manner as to cause minimal disturbance of the stream and hauled from the site to be used within the roadway prism or salvaged.

7. All material disposed of within the roadway prism will be prevented from re-entry into the stream and its flood plains in accordance with Virginia Department of Transportation's Roadway and Bridge Specifications. Special Provisions and Supplemental Specifications.

8. The order of construction may be reversed in order to build Causeway B first thence following the above outlined procedures.

9. The existing bridge will be removed in accordance with our Road and Bridge Specifications.

10. The fill at the existing abutments will be removed and graded to the elevation of natural ground.

11. All fill material removed from the existing abutments shall be disposed of and prevented from re-entry into the stream and its flood plains in accordance with Virginia Department of Transportation's Roadway and Bridge Specifications, Special Provisions and Supplemental Specifications.

12. Measures shall be employed to prevent and/or control spills of fuels and/or lubricants from entering state waters. In the event that oil or other hazardous spill material has potential to or gets into state waters, the Contractor shall immediately notify the State Water Control Board and will take immediate actions for the containment and removal of such spill.

13. The Department will enforce the application of the following temporary and permanent erosion and siltation control measures for the work to be done on both shores of Four Mile Creek:

    a. Temporary filter barriers will be placed at the base of fill at the abutments and around the perimeter at base of the causeway.

    b. Temporary filter barriers will be installed in accordance with Section 303.02(e) of the "Virginia Department of Transportation Road and Bridge Specifications." The Contractor will regularly inspect the temporary barriers and correct any deficiencies in accordance with Section 107.14(a) of the "Virginia Department of Transportation Road and Bridge Specifications."

    c. Cut and fill slopes will be promptly seeded in accordance with the "Virginia Department of Transportation Road and Bridge Specifications."

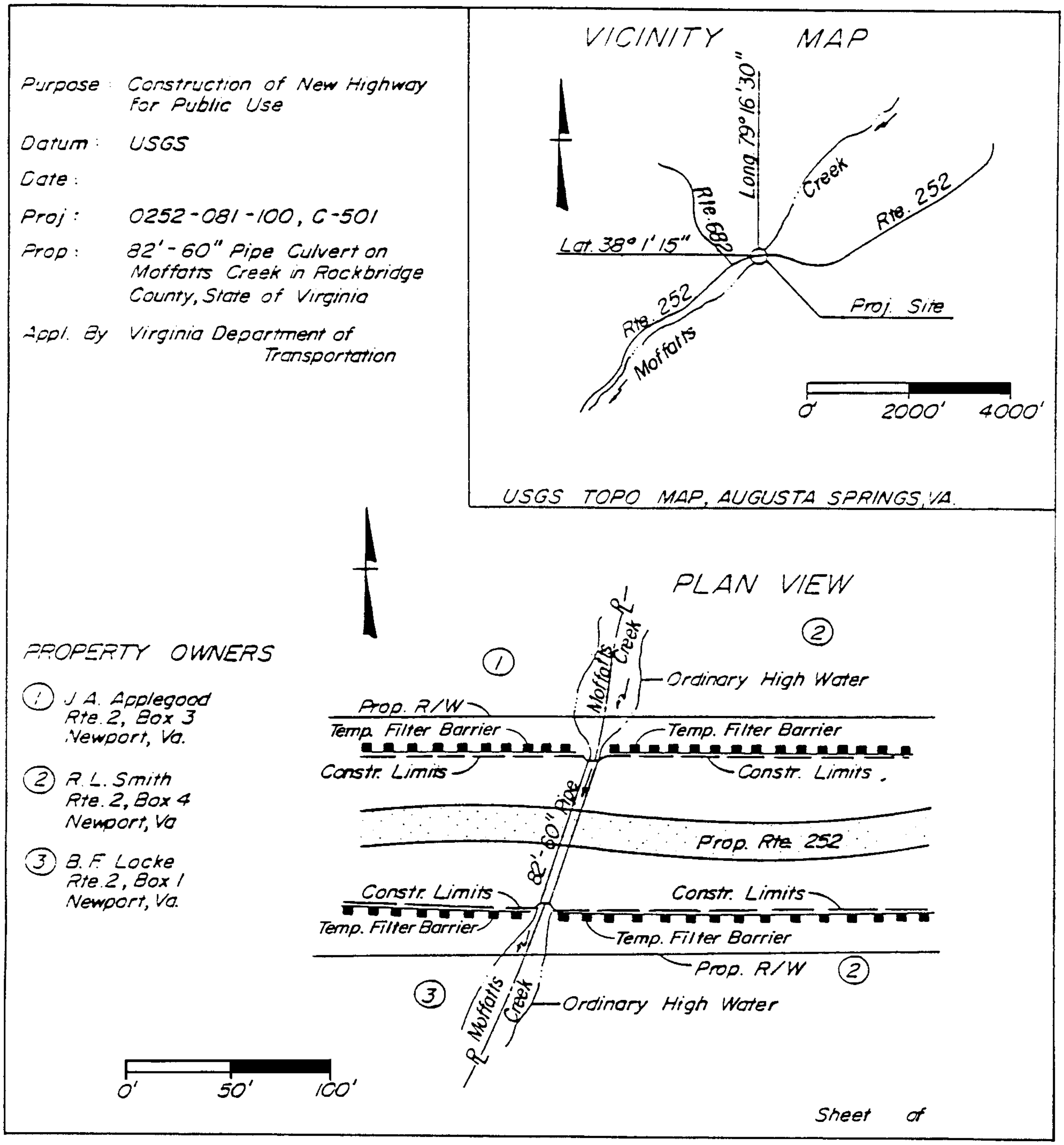



**FIGURE C-4-6 CULVERT (NON-TIDAL) PLAN VIEW**

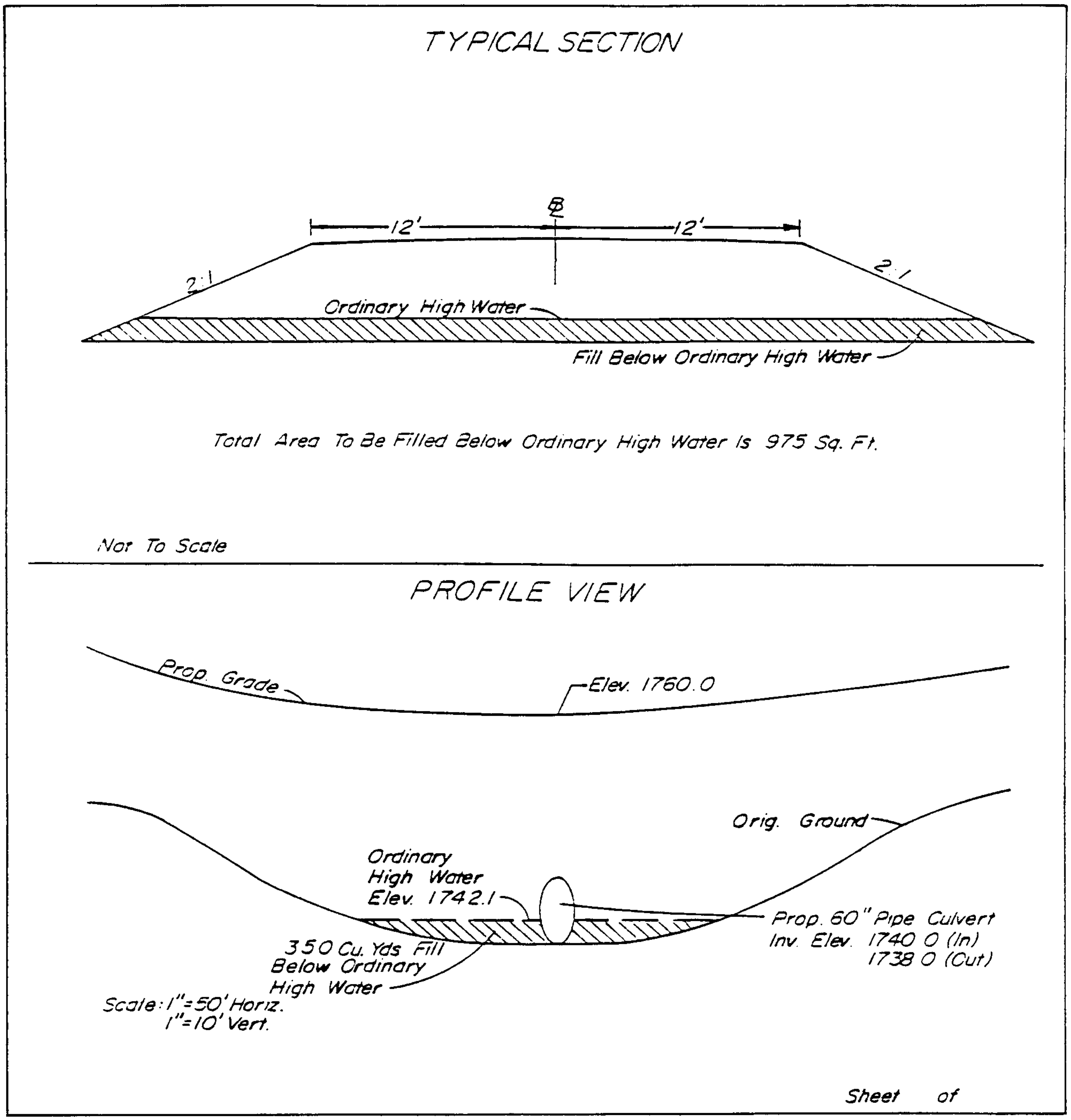



**FIGURE C-4-7 CULVERT (NON-TIDAL) -TYPICAL SECTION AND PROFILE VIEW**

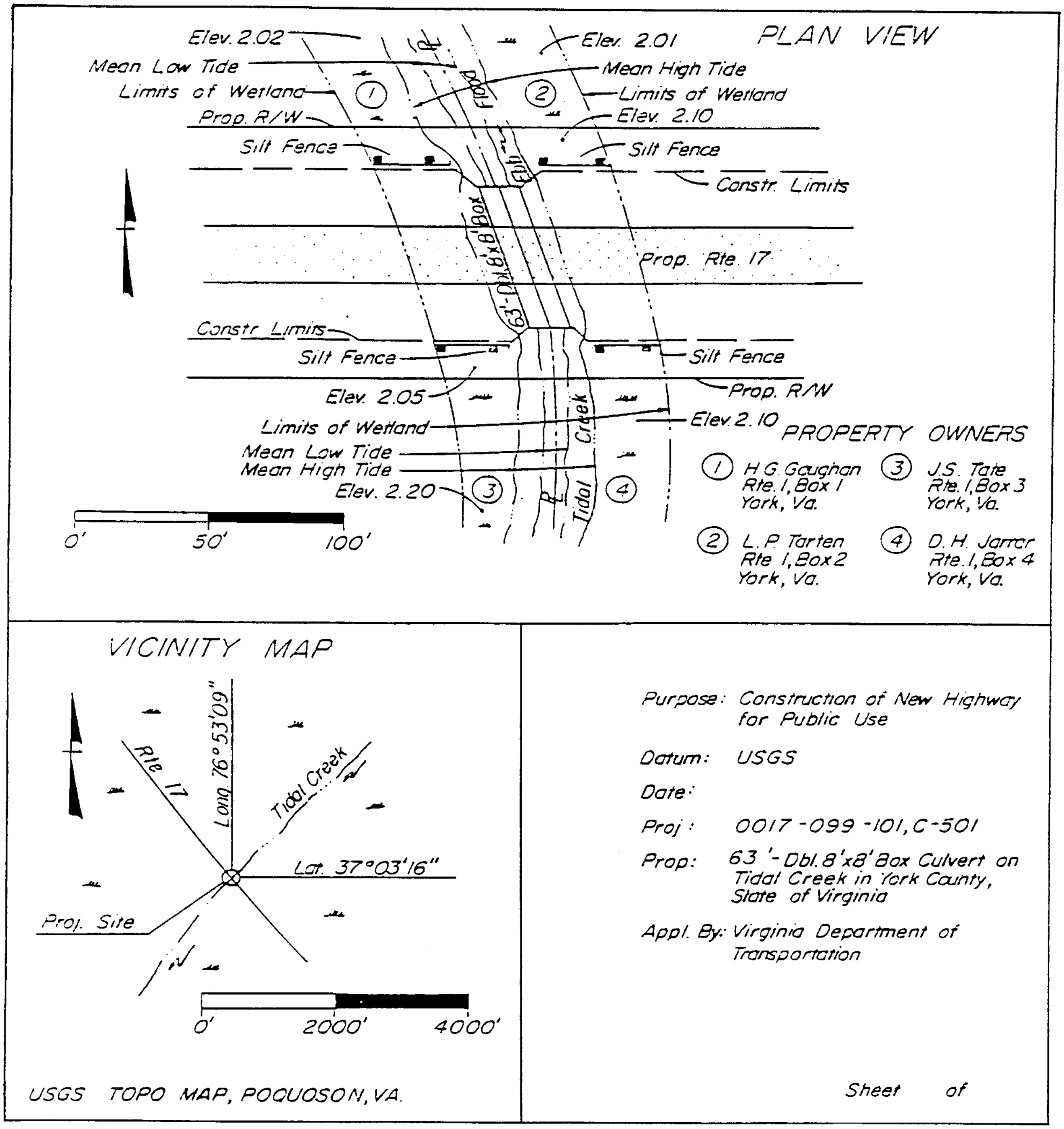



**FIGURE C-4-8 CULVERT (TIDAL)-PLAN VIEW**

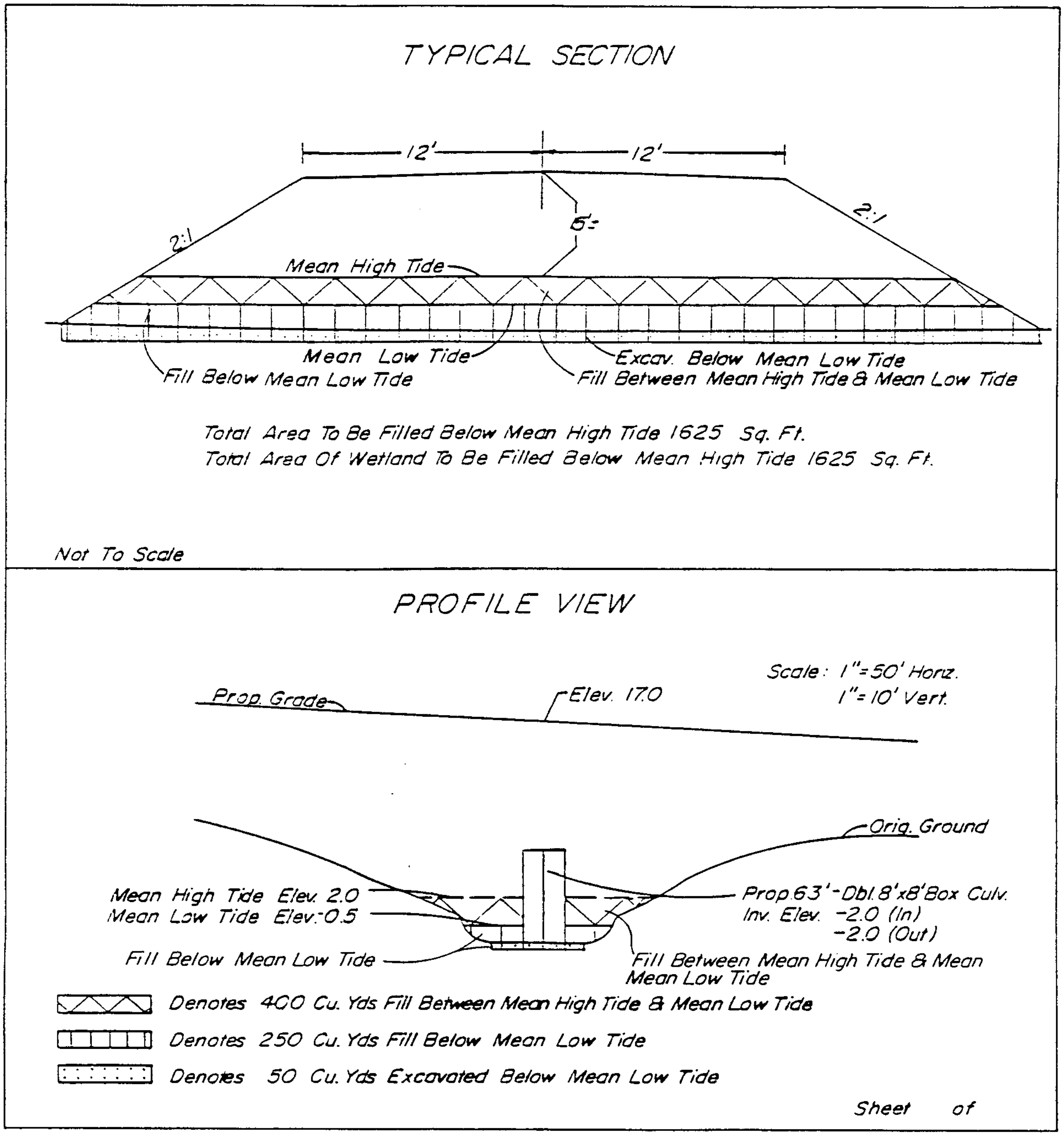



**FIGURE C-4-9 CULVERT (TIDAL) -PLAN VIEW**

# SECTION C-5 SAFETY PROJECTS

## PROCEDURES

The preliminary steps utilized to implement Federal-Aid Primary Safety Projects requiring surveys and plans need to realistically correlate planning with funding commitments. Many projects are delayed either due to a nonsystematic approach or to the total project cost being estimated low in the early stages, and are delayed in the final stages when more current estimates have been obtained. Much of this disparity is caused by changes in the scope of projects from that originally envisioned. The objective of the following procedures is to promote a joint and cooperative effort of all units involved in the planning process to arrive at a more realistic project concept and financial understanding which should result in a realistic scheduling process.

1. The selection process for the project will proceed as in the past, with the Mobility Management Division in cooperation with the District Administrator and appropriate division(s) in selecting projects for inclusion into the safety program. Information pertaining to the scope and nature of the proposed projects is to be provided to the MMD for their use in the justification process and obtaining priority approval from the FHWA.

2. After priority approval of the project, the Mobility Management Engineer is to request the Location and Design Division to assign a project number. After the project number is assigned, the Mobility Management Division will notify the appropriate divisions and each division will be requested at this time to commence the necessary work to implement the project.

3. The State Location and Design Engineer, upon receipt of the approval of the project, will request preliminary engineering authorization. As soon as authorization has been received, the State Location and Design Engineer will instruct the District Design Transportation Engineering Program Supervisor to proceed with preliminary plans.

3. The District Design Transportation Engineering Program Supervisor will consult with the District Traffic Engineer and Resident Engineer so that the proposed improvement may be outlined utilizing aerial photography, topographic maps, or other material suitable for a preliminary field study if deemed necessary. The actual survey is to be held in abeyance until after the preliminary scheme has been approved.

The State Location and Design Engineer will be available to assist in supplying any mapping or photography which may be required to complete the above.

4. Upon defining the scope and intent of the project, the District Design Transportation Engineering Program Supervisor will request historical and archeological survey and permit determination using Form LD-252. A brief description of the work should be noted in the remarks.

5. The District Design Transportation Engineering Program Supervisor, upon completion of Step 4, will notify the Mobility Management Division, The Location And Design Division, and the Resident Engineer that the project is now ready for a preliminary plan review and make arrangement, if necessary, for scheduling the review. Due to the limited Preliminary Engineering Funds, only those representatives form the Environmental, Right-of Way, Mobility Management, Materials, or any interested Division the District Administrator deems necessary may be requested to attend.

   Items pertaining to the need for a field inspection, anticipation of donated right of way, or type of public hearing, etc., should be fully resolved at the plan review. The scheduling should be discussed and dates set for the different stages in the development of the project. After the dates have been fixed, all affected divisions should be advised.

6. The result of the plan review along with construction estimates, right of way, and utility estimates as required, should be forwarded to the State Location and Design Engineer with copies to MMD.

   The Mobility Management Engineer will complete his review and, should be concur with the proposed scheme of development, advise the State Location and Design Engineer in order that the necessary field survey can be initiated.

7. Upon completion of the survey, the District Design Transportation Engineering Program Supervisor will plot the necessary plans and show the scheme of development along with the grades, proposed right of way line, and obtain a realistic construction cost. At this point a scoping review will be made to ascertain if the project is still within the scope and nature of intended work and within the funding limitations.

A set of prints with scoping Form LD-403 should be provided the District Administrator. If he/she approves, the prints with Form LD-403 should be forwarded to the Programming Division for scoping and then to the State Location and Design Engineer. A set of prints and an estimate should also be forwarded to MMD.

Approval to proceed will be documented by the receipt of scoping Form LD-403 indicating final scoping is complete. The State Location and Design Engineer will advise of the scope approval by scoping Form LD-404 and request the District Location and Design Engineer to proceed with the development of the project. From this point the project development will proceed in accordance with the normal design procedures including public hearing, Utility Field Inspection, and right of way requirements.

At this time, the District Design Transportation Engineering Program Supervisor should request the District Environmental Section, by Form LD-252, to prepare the appropriate environmental document. Copies of Form LD-252, should note a brief description of the work in the remarks with copies of the form forwarded to Environmental Engineer and the State Location and Design Engineer.

8. Any major deviation from the agreements reached at the preliminary plan review as indicated in Item No. 5 must be evaluated as to the difference in cost and this information transmitted along with the prints and Form LD-403, as indicated in Item 7, so that any change from the original concept can be included in the decision making process. It is imperative to ascertain that the revised project still satisfies the original objective within a reasonable funding scope. This will reduce the disparity in cost previously mentioned in the opening remarks of this section.

The above instructions apply to all Federal Safety projects, except secondaries, which are handled by the Local Assistance Division, other than justification which will be handled by the Mobility Management Division. Railroad Crossing projects are handled in a manner similar to these guidelines with the main exception being the fact that the plans, sketches, estimates, and work are done by the railroad company involved. In view of the mandatory allocation of manpower time and funding resources to priority projects, every step must be taken that will reduce or eliminate efforts expended throughout all Divisions within the Department. The project is to be viable from a funding and functional standpoint and every consideration shall be given to fulfilling all highway needs; however, the major thrust of manpower availability must be given to those projects for which funding is most readily available.

# SECTION C-6- SITE PLAN REVIEW

## I. CHECKLISTS FOR SITE PLAN COMPLETENESS

### A. HOW TO USE THE CHECKLISTS

A Preliminary Site Plan/Rezoning Application Checklist and a Site Plan Checklist are provided.

The site plan should be checked for completeness by the appropriate county staff, then by the VDOT residency staff (except in Northern Virginia where the district staff should check it). To be most effective, complete site plans based on the checklist should be mandated by a county site plan ordinance. The checker should review the site plan to determine if every applicable item on the checklist is contained in the plan.

After the check for completeness, the checker will determine whether or not all the information necessary for a site plan review is available in the plan. If complete, the site plan is ready for review. If incomplete, the site plan should be returned for resubmittal.

### B. CHECKLIST FOR PRELIMINARY SITE PLAN/REZONING APPLICATION COMPLETENESS

Check each item that is included in the site plan.

### I. PROJECT IDENTIFICATION

a. ______ Date.
b. ______ Project name.
c. ______ Name/address of applicant and land owner.
d. ______ Magisterial district, county, state.
e. ______ Map and parcel number.
f. ______ Type of use.
g. ______ Total hectares (acreage).
h. ______ Current zoning.
i. ______ Name of engineer/surveyor.

## II. GENERAL SITE INFORMATION

b. ______ Site plan ( 1 : 500 or larger).
c. ______ North point on maps.
d. ______ One reproducible plus ____ copies of plan.
e. ______ Adjacent property identification
______ Name of owner ______ Current zoning
______ Location ______ Current use
f. ______ Location and total hectares (acreage) of land uses.
g. ______ Topographic map (2 m (5-ft.) interval or less).
h. ______ Boundary survey with source and title.
i. ______ Locations, names, and dimensions of proposed streets, entrances to existing highways, alleyways, building lines, easements, rights-of-way, interior travel ways, parking lots, and pedestrian system.
j. ______ Flood plain limits, if applicable.
k. ______ Locations, names, and dimensions of existing roads ____, easements ____, utility lines ____, rights-of-way ____, streams ____, and drainage ways ____.
l. ______ Preliminary sketch plans indicating provision for all utilities including but not limited to
______ Drainage (including stormwater management)
______ Water supply ______ Sewage disposal
m. ______ Typical street sections.

## III. STATEMENTS

n. ______ Proposed development conforms to the provisions of all applicable ordinances, regulations, and adopted standards (or note specific waivers sought).
o. ______ Public improvements both on- and off-site that are proposed for dedication and/or construction and an estimate of timing of providing such improvement.
p. ______ Proposed development schedule.

**Checklist for Site Completeness**

Circle the number or letter of items included.

## I. GENERAL INFORMATION (IDENTIFICATION)

A. Title of project and name of applicant.
B. Names of engineer, architect, landscape architect, and/or surveyor and plan certification.
C. Vicinity map with scale (no less than 1 : 25 000).
D. Direction of north.
E. Plan scale.
F. Type and size of development.
G. Right Of Way line, centerline, departing lot lines, lot numbers, subdivision limits, and limits of construction.

## II. GEOMETRICS

### A. GENERAL

1. Typical section designation. Where special typical section is approved, provide detail on plan.
2. The edge of proposed street surface or the face of curb (as the case may be) and the full length of all streets.
3. The width of right of way, width of surface, or distance between curb faces and relation to center line.
4. All temporary turnaround construction, with easement as indicated on the preliminary plat.
5. Centerline curve data, including delta, radius, arc, chord, tangent, and profile data.
6. Radius of all curb returns to face of curb and on streets where curb and gutter are not required; radius to edge of bituminous treatment.
7. Stations at every 100 meters (feet) at even stations on centerline; stations at points of curve and tangent at the beginning and end of all returns, at centerline intersection, and at subdivision or section limits, and turnaround radius.
8. State route number and or city or town street name on all existing streets to which connection is to be made. Indicate proposed street name where appropriate.
9. Any notes necessary to explain the intent and purpose of plans or profile.

**B. ROADS**

1. Existing entrances, entrances of planned developments that are committed, street connections, crossovers, etc. that are located along existing roadway that may be affected by the proposed development.
2. Where proposed streets or entrances connect with existing roads or streets, indicate both edges of existing pavement, surface, or curb and gutter for a minimum of 30 m (100 ft.) or the length of connection, whichever is the greater distance.
3. Symmetrical transition of pavement at intersection with existing street.
4. Lengths of acceleration lanes and left and right turn lanes and tapers.
5. Crossover spacing and sight distance.
6. Sight distance profiles at all proposed street intersections and entrances, and landscaping, sign placement, and all obstructions that may obstruct or affect sight distance. Dedication of easements for improving sight distance.

7. Functional classification and design speeds for proposed public roadway improvements.
8. Existing roadway geometrics and pavement markings.

**C. OTHER**

1. Guard rail where required.
2. Location of curb ramps where appropriate.
3. Dedication of easements for future improvements in the comprehensive plan, state projects, or road bond programs.
4. Sidewalks and trails.

**III. DRAINAGE**

**A. Systems**

1. Contour map showing complete coverage of the total contributing drainage area.
2. Locations and dimensions of all existing or proposed drainage easements.
3. Direction of drainage flow for all proposed streets, storm sewers, valley gutters, subdrains, and the like, and all existing streams.

4. All storm sewers and appurtenances. Identify storm sewer appurtenances by type and a number. Station on plan must conform to stations shown on profile. Indicate the top and invert elevation of each structure. Tabulation in the plan view may be permitted.
5. Complete drainage calculations for all proposed facilities and all affected existing facilities, as required in VDOT's Drainage Manual.
6. Profiles on outfall ditches, pipe, etc.; indicate natural drainage and label if applicable.
7. Protection for erosion control
8. A design for adequate storm water management with calculations and appropriate data where necessary.
9. Any notes necessary to explain the intent and purpose of the proposed drainage plan.

**B. DRAINAGE STRUCTURES**

1. The size of all driveway entrance culvert, i.e.,380 mm (15") or 450 mm (18"), according to computed size, for each lot.
2. The contributing area in hectares (acres) at all culvert pipe, curb inlets, and other entrances, exclusive of driveway pipes.
3. Type or class of pipe to be installed both in right of way and outside right of way.

**C. DITCHES**

1. Proposed drainage ditches for full length in all easements. Furnish detailed typical section and type of stabilization to be provided.
2. Paved ditches and easements at toe of fills.
3. Paved roadside ditches.

**D. STREAMS**

1. The location of all streams or drainageways related to the street construction.
2. Proposed stream relocations. Show existing and proposed locations. Furnish detailed typical section and type of stabilization.

## IV. UTILITIES

**A. GENERAL**

1. All proposed water mains, their sizes, valves, and fire hydrants.
2. All proposed sewer lines.

3. All existing utilities; if within limits of proposed right of way, provide details as to location and typical sections.
4. Where security lighting is proposed, indicate the following:
   a. Distance of pole from edge of pavement.
   b. Distance of pole from proposed right of way.
   c. Distance from pole to center of luminaire.
   d. Height of luminaire above centerline of roadway.
   e. Level of illumination.
5. Any notes necessary to explain the intent and purpose of proposed utilities or adjustment of existing utilities.

## V. TRAFFIC ANALYSIS

Developer will be responsible for supplying sufficient information for VDOT to determine entrance and road design features to serve the existing roadway and the proposed development adequately. The information may include:

1. Traffic analysis for site development on existing and proposed facility used to determine design of entrances, including trip generation and traffic assignment.
2. On-site circulation patterns for potential impact on existing roadway.
3. Intersection analysis including need for signalization, channelization, turn lanes, and modification of existing signals.
4. Existing and proposed traffic control devices such as signs and pavement markings.
5. Recommendations for roadway improvements to accommodate traffic generated by proposed development, including proposed signal phasing plans.
6. Any notes necessary to explain the intent and purpose of the proposed traffic analysis.

## VI. COMMENTS

### A. DESIGN

1. Site plans and subdivision plans shall be designed in accordance with the appropriate manuals of the Virginia Department of Transportation:
   a. <u>Minimum Standards of Entrances to State Highways</u>, Mobility
   b. <u>Subdivision Street Requirements</u>, Local Assistance Division.
   c. <u>Road and Bridge Standards</u>, Location and Design Division.
   d. <u>Drainage Manual</u>, Location and Design Division.
   e. <u>Land Use Permit Manual</u>, Asset Management Division.
   f. <u>Guidelines for Lighting by Permit on State Right of Way</u>, Asset Management Division.

These design standards are considered minimal. In keeping with its mission to provide a safe, efficient, and effective ground transportation system, VDOT is obligated to make recommendations that exceed these standards where it is deemed necessary and in VDOT's best interest.

2. Where a county has adopted standards higher than VDOT standards, the higher standards of the county should prevail.

**B. RESUBMITTAL**

A written description of all plan revisions must accompany all revised plans submitted for reevaluation and approval. The description should state each problem and its resolution. If the resolution does not concur with state and county recommendations, an explanation must be given. The changes should be clearly illustrated on the plans.

## II. SITE PLAN REVIEW CHECKLIST

VDOT reviews site plans for a wide range of types and sizes of land development. There are specific elements that are a part of all reviews. However, each review should be tailored to meet the site-specific conditions for the area and the proposed project. To the extent practical, short-, medium-, and long-range implications should be considered. A substantial amount of engineering judgment may be used.

Circle the number or letter of items that are acceptable.

### I. ACCURACY AND COMPATIBILITY

A. Verify the location and dimensions of existing roadway elements of the plan.

B. Examine the compatibility of the site plan with the six-year road improvement plan, the county master plan, and VDOT's statewide highway plan. Examine all available sources to eliminate discrepancies.

### II. INTERNAL CIRCULATION PATTERN

A. Review proposed internal circulation patterns to determine if their traffic flow patterns allow for vehicular circulation to take place on-site and not on the street system.

B. Review driveway location(s) relative to intersections and other driveways and adjacent property lines.
1. Check spacing from other drives for potential interference.
2. Check spacing from signalized drives or intersections to determine if traffic queue will block proposed drive.
3. Check access spacing to determine if the spacing from other signals will be conducive to a signal system if the proposed driveway(s) are signalized.
4. Check projected queues for interference with traffic operations.

## III. INTERSECTION GEOMETRICS

(Proposed Entrances and Affected Intersections)

Verify that geometrics satisfy the appropriate design standards. Check the entrance of intersection designs, especially the radii and angle of intersection with the existing roadway.

## IV. INTERSECTION SIGHT DISTANCES

A. Check for intersection sight distances and compliance with the design requirements.

B. Check for consideration of the numbers of buses and type and frequency of trucks entering and exiting the facility in determining sight distance needs.

## V. AUXILIARY LANES

A. Left-turn Lanes
1. Check the need for and dimensions of a left-turn lane based on volume and traffic operations.
2. Note that left-turn lanes are generally provided at median openings.
3. Consider severe horizontal and/or vertical geometry, driver expectancy, accident experience, the effect of turning vehicles on through traffic, and observations.

B. Right-turn Lanes
1. Check the need for and dimensions of a right-turn lane.

2. Consider severe horizontal and/or vertical geometry, driver expectancy, accident experience, the effect of turning vehicles on through traffic, and observations.

C. Additional through lanes: Check the need for and dimensions of additional through lanes.

## IV. PEDESTRIANS

A. Estimate the volume of pedestrians and their needs.

B. Review existing and proposed sidewalks and paths in the area and the need for sidewalks.

## VII. SIGNALIZATION

A. Verify that signalized intersections are studied as shown in the current Highway Capacity Manual.

B. Determine if signals are required as warranted by the MUTCD.

C. Review signal phasing and the need for certain phases such as protected and/or permissive phasing.

D. Review adjacent signals and determine if signal coordination is needed.

E. Consider preferred locations of signals for efficient signal systems.

## VIII. SIGNING AND PAVEMENT MARKINGS

A. Verify that signing and pavements markings are compatible with proposed traffic operations.

B. Verify that signs and pavement markings located in both the driveway and internal areas are installed and maintained by the developer.

C. Review existing and proposed signing and pavement marking.

D. Verify that all signing is in accordance with the MUTCD and the Virginia Supplement to the MUTCD.

## IX. FENCING

Check VDOT policy (when property abuts a limited access roadway). Consider fencing when an unusual need is present, e.g., railroad line.

## X. ROADSIDE OBSTACLES

Review proposal to determine if traffic is being moved closer to fixed objects or roadside hazards and what, if anything, should be considered in accordance with VDOT's Road and Bridge Standards.

## XI. ROADWAY LIGHTING

Review roadway lighting to be installed by the developer pursuant to Guidelines for Lighting by Permit on State Right of Way, Maintenance Division.

## XII. RIGHT OF WAY

Determine if right of way denotation or easements are needed.

## XIII. DRAINAGE

A. Perform a spot check of drainage calculations for:
   1. Proper/applicable design methods and procedures.
   2. Completeness and accuracy.
   3. Change in flow patterns and diversions.

B. Review drainage that would have a direct effect on the roadway.
   1. Check for adequate pavement drainage and proper placement of drainage structures.

2. Check the location and method by which pavement drainage is conveyed away from the travelway.

C. Review drainage structures.
   1. Check existing structures (storm sewers, ditches, etc.) for adequacy to convey the runoff that will come to them in conformance with applicable criteria/requirements.
   2. Check hydraulic design of proposed drainage facilities for conformance with applicable criteria/requirements.
   3. Check for proper treatment at ends of drainage facilities (riprap, paved ditches, etc.).
   4. Check detention facilities for required hydraulic performance, proper outfall, and adequate roadway protection.

D. Review erosion control.
   1. Check for current and potential erosion and siltation problems.
   2. Check for impact of the development.
   3. Check for the adequate placement of erosion control devices.

E. Check involvements with regulatory flood plains and/or the 100-year flood zone.

F. Check to ensure that all necessary drainage easements have been designated.

## XIV. REVIEW COMMENTS

A. Prepare written review comments. The comments should be well organized, clear, direct, and specific. Problems should be clearly defined and, when desired, actions to be taken to resolve each problem should be stated.

B. Recommendations and requirements.
   1. For compliance when minimum standards are involved, state that the design feature is required. Design features that exceed minimum standards but are required to resolve capacity or safety problems should be stated as required with an explanation.
   2. For design features that exceed the minimum standards state that the design is recommended or, if appropriate, highly recommended.

## III. GUIDELINES FOR A TRAFFIC IMPACT STUDY

### A. PURPOSE

A traffic impact study assesses the impact of a proposed development, zoning change, or special use approval on the transportation system. Its purposes are (1) to ensure that proposed developments or zoning changes do not adversely affect the transportation network, (2) to identify any traffic problems associated with access from the site to the existing transportation network, (3) to delineate solutions to potential problems, and (4) to present improvements to be incorporated into the proposed development.

The traffic impact study guidelines contained herein are subject to modification by VDOT and the county as necessary. They will be reviewed periodically and updated with state-of-the-art technical information. These guidelines have been developed in order to provide for consistent preparation of traffic impact studies. The guidelines will greatly enhance the efficiency of staff review and, at the same time, will provide the applicant with "accepted" technical procedures and methodologies. VDOT and the county will review each development application on a case-by-case basis and may make recommendations that differ from the guidelines.

### B. RESPONSIBILITIES FOR TRAFFIC IMPACT STUDIES

The primary responsibility for assessing the traffic impacts associated with a proposed development rests with the applicant, with the county and VDOT serving in a review capacity. This is consistent with the approach followed for other civil engineering aspects of zoning and subdivision applications. The county and VDOT should specify whether a traffic impact study is required, the extent of the study area, and any specific issues that should be addressed (i.e., safety, accidents, truck traffic). This determination should be made in the rezoning application or preliminary site plan stage.

If a traffic impact study is required, the applicant will be responsible for submitting a formal traffic impact report. The applicant will also be responsible for all date collection efforts required in preparing a traffic impact study, including current peak period turning movement counts. Current peak period turning movement counts is defined as those counts that have been collected within one year of the zoning or subdivision application.

The county or VDOT, at its discretion, may request the applicant to adjust the peak hour turning movement counts in order to account for seasonal variations in traffic or other localized factors.

In addition, the applicant will be responsible for ensuring that any submitted site plans meet the minimum state and local standards for geometric design. The study should be conducted only by an individual or firm that could be qualified as an expert in traffic engineering.

Upon submission of a draft traffic impact analysis report, the county and VDOT will review the study data sources, methods, and findings and provide comments. The applicant will then have the opportunity to incorporate necessary revisions prior to submitting a final report to public officials. Accompanying the applicant's submission will be written comments of local and state staff. This information will then be used to reach a decision regarding the proposed development.

## C. DETERMINING THE NEED FOR A TRAFFIC IMPACT STUDY

The reviewing agencies should have the discretion to determine when a traffic impact study is needed. The need for a traffic impact study should be evaluated based on conditions surrounding the individual development. The site specific conditions that should be considered include:

1. The potential impact upon the local and regional read networks.
2. The capacity and level of service of the existing roadways to be entered.
3. Roadway geometrics.
4. The type and size of the proposed development.
5. Traffic operations of one or more intersections.
6. Issues of safety and/or traffic operation within the public right of way.

VDOT and the county should consider requesting that a group of developers jointly sponsor a traffic impact study on a section of highway where many independent developments are planned.

## D. TRAFFIC IMPACT STUDY CONTENTS AND SPECIFICATIONS

The contents were primarily adopted from VDOT "Guidelines for Traffic Impact Study--Final Report," prepared by Simpson and Curtin, April 1979, and "Guidelines for Traffic Impact Studies in James City County."

1. Format

A traffic impact study prepared for a specific site proposal should follow the chapter format shown in Table C-7-1. Wherever additions or modifications are appropriate for a specific site, they should be made.

2. Capacity and Level of Service Analyses

a. Use of the Highway Capacity Manual

All capacity analyses shall be conducted utilizing the procedures in the current Highway Capacity Manual (Special Report 209), Transportation Research Board.

1. INTRODUCTION

   A. Site and Study Area Boundaries
   B. Existing and Proposed Site Uses
   C. Existing and Proposed Nearby Uses
   D. Existing and Proposed Roadways and Intersections

2. ANALYSIS OF EXISTING CONDITIONS

   A. Daily and Peak Hour(s) Traffic Volumes
   B. Capacity Analyses at Critical Points
   C. Levels of Service at Critical Points

3. ANALYSIS OF FUTURE CONDITIONS WITHOUT DEVELOPMENT

   A. Daily and Peak Hour(s) Traffic Volumes
   B. Capacity Analyses at Critical Points
   C. Levels of Service at Critical Points

4. TRIP GENERATION

5. TRIP DISTRIBUTION

6. TRAFFIC ASSIGNMENT

7. ANALYSIS OF FUTURE CONDITIONS WITH DEVELOPMENT
   A. Future Daily and Peak Hour(s) Traffic Volumes
   B. Capacity Analyses at Critical Points
   C. Levels of Service at Critical Points

8. RECOMMENDED IMPROVEMENTS
   A. Proposed Recommended Improvements
   B. Capacity Analyses at Critical Points
   C. Levels of Service at Critical Points

9. CONCLUSION

For capacity analysis and level of service determinations, the most recent Federal Highway Administration software package should be used for the different types of analysis required (e.g., signalized intersections, freeways, ramps). CAPCALC 85 may also be used for analyzing intersections. Regardless of which software package is used, the results should be reviewed for reasonableness. Other software, if approved by the county and VDOT in advance, may be used.

Consultants may use any of a number of software packages available for capacity analysis. They should provide the input data as well as the results of the capacity analysis so that VDOT may check the results with its own analysis. Where a great number of intersections or road sections are analyzed, a sample of those should be checked by performing the analysis and comparing results. Where differences occur, the consultant should be required to explain the differences, and all road sections and intersections should be reviewed closely.

b. Level of Service

Level of Service C will be the design objective, and under no circumstances will less than Level of Service D for all approaches of an intersection be accepted for on-site and off-site traffic. This criterion, however, may be modified by the county and VDOT on a case-by-case basis, depending on traffic conditions in the proposed site vicinity.

c. Use of Results of Level of Service Studies

1. The primary function of a level of service study is the determination of the geometrics required to provide a desired level of service in a design year.

2. The number of lanes required on either a through road or at an intersection can be determined, and the need for auxiliary lanes, as well as their length, can be established.

3. The need for signalization can be determined from the projected traffic volumes and the signal warrants in the Manual on Uniform Traffic Control Devices for Street and Highways (MUTCD).

4. The level of service study can indicate where on-street parking will have to be eliminated or restricted in order to achieve a desired level of service.

5. When a development in a given area is projected to be phased over a long period of time, stage construction should be considered and a level of service study used to determine when the various stages must be completed.

3. Narrative

A brief narrative for each chapter of the traffic impact study follows.

**CHAPTER 1. INTRODUCTION**

A. Site and Study Area Boundaries
Include a brief description of and a map displaying the size of the land parcel, the general terrain features, and the location within the jurisdiction and region. In addition, identify the roadways that afford access to the site and are included in the study area. The exact limits of the study area should be based on engineering judgment and an understanding of the existing traffic conditions in the site vicinity. In all instances, however, the study area limits will be discussed with the applicant and his traffic engineer and will be determined by the county and VDOT staff. The definition of the study area should result, subsequent to the initial staff review of a developer's rezoning application or preliminary site plan, at which time a traffic impact study will be required. If the project is being completed in phases, describe the total project and the phases. The study should address the appropriate phase.

B. Existing and Proposed Site Uses
Identify the existing and proposed uses of the site in terms of the various zoning categories. In addition, identify the number and the type of residential units, and type and amount of commercial, industrial, or office uses in accordance with ITE trip generation categories.

C. Existing and Proposed Nearby Uses
Include a complete description of the existing land uses in the vicinity of the site, as well as their current zoning. Also state the proposed developments of adjacent land using the county's comprehensive land use plan. This is especially important where large tracts of underdeveloped land are in the vicinity of the site and are within a prescribed study area.

D. Existing and Proposed Roadways and Intersections

Describe and provide diagrams of the existing roadways and intersections (including road geometrics, lane usage, traffic control, and intersection condition diagrams) within the study area as well as improvements contemplated by the county and state. This includes the nature of the improvement project, its extent, the implementation schedule, and the agency or funding source responsible.

## CHAPTER 2. ANALYSIS OF EXISTING CONDITIONS

A. Daily and Peak Hour(s) Traffic Volumes

Present diagrams depicting daily and peak hour traffic volumes for roadways within the study area. Present turning movement and mainline volumes for the three peak hour conditions (a.m., p.m., and site-generated). Present only mainline volumes to reflect daily traffic volumes. Also present the source and/or the method of computation for all traffic volumes.

B. Capacity Analyses at Critical Points

Utilizing techniques as described in the current Highway Capacity Manual, assess the relative balance between roadway volumes and capacity. Analyze existing conditions (roadway geometrics and traffic signal control) for all peak hours.

C. Level of Service at Critical Points

Based on the results obtained in the previous section, determine and present levels of service (A through F). Include a description of typical operating conditions at each level of service.

## CHAPTER 3. ANALYSIS OF FUTURE CONDITIONS WITHOUT DEVELOPMENT

Describe the anticipated traffic volumes in the future and the ability of the roadway network to accommodate this traffic without the proposed zoning or subdivision request. The future year(s) for which projections are made will be specified by the county or VDOT staff and will depend on the timing of the proposed development.

A. Future Daily and Peak Hour(s) Traffic Volumes

Indicate clearly the method and assumptions used to forecast future traffic volumes so that the county and VDOT staff can replicate these calculations.

B. Capacity Analyses at Critical Locations
Describe the ability of the existing roadway system to accommodate future traffic (without site development) for all peak hours using the current Highway Capacity Manual. If roadway improvements or modifications are committed for implementation, present the capacity analysis for these conditions.

C. Levels of Service at Critical Points
Based on the results obtained in the previous section, determine the levels of service (A through F).

## CHAPTER 4. TRIP GENERATION

Present and diagram the amount of traffic generated by the site for daily and three peak hour conditions. Trip generation rates to be used should be those presented in Trip Generation, 4th ed, Institute of Transportation Engineers. Deviation from these rates must be justified and documented to the satisfaction of the county and VDOT.

## CHAPTER 5. TRIP DISTRIBUTION

Present and diagram the direction of approach for site-generated traffic for the appropriate time periods. The basic method and assumptions used must be clearly stated so that the county and VDOT can replicate these results.

## CHAPTER 6. TRAFFIC ASSIGNMENT

Describe the utilization of study area roadways by site-generated traffic. Combine the proposed traffic volumes with the anticipated traffic volumes from Chapter 3 to describe and diagram mainline and turning movement volumes for future conditions with the site developed as proposed. Clearly state the basic method and assumptions used.

## CHAPTER 7. ANALYSIS OF FUTURE CONDITIONS WITH DEVELOPMENT

A. Future Daily and Peak Hour(s) Traffic Volumes
Present and diagram mainline and turning movement volumes for the highway network in the study area, as well as driveways and internal circulation roadways for all time periods.

B. Capacity Analysis at Critical Points
Perform a capacity analysis for all peak hours for future conditions with the site developed as proposed using the current Highway Capacity Manual.

C. Levels of Service at Critical Points
As a result of the capacity analysis, compute and describe the level of service on the study area roadway system.

## CHAPTER 8. RECOMMENDED IMPROVEMENT

In the event the analysis indicates that unsatisfactory levels of service will occur on study area roadways, describe the improvement proposed to remedy deficiencies. The proposals would identify committed projects by the county and state that were described in Chapter 1 and reflected in the analysis contained in Chapters 2 and 3.

A. Proposed Recommended Improvements
Clearly describe and diagram the location, nature, and extent of proposed improvements to ensure sufficient roadway capacity. Accompanying this list of improvements should be preliminary cost estimates, source of funding, timing, and likelihood of implementation.

B. Capacity Analysis at Critical Points
Describe the anticipated results of making these improvements.

C. Levels of Service at Critical Points
As a Result of the revised capacity analyses presented in the previous section, present the levels of service for the roadway system with improvements.

## CHAPTER 9. CONCLUSION

The last chapter of the report should be a clear, concise description of the study findings. This concluding chapter should serve as an executive summary.

## IV. ROLES OF VDOT OFFICES IN SITE PLAN REVIEW

## A. RESIDENCY OFFICES

(This description is not applicable for residencies in Northern Virginia where the district office is the primary entry point for site plans.)

1. Log in all preliminary site plans and rezoning applications and site plans from the county. In counties without an engineering or planning staff, the residency may receive plans from the developer or his representative. The residency office is a clearinghouse for site plans and traffic impact studies. Any site plans sent directly to the district or central office should be returned to the appropriate residency.

2. Check the site plan for completeness using the appropriate checklist, either the checklist for the preliminary site plan or for site plan completeness.

3. Return incomplete site plans to or contact the sender noting the deficiencies to be corrected.

4. For completed site plans, determine if the plan should be forwarded to the appropriate district office section for either drainage or traffic review or both. The factors considered in this determination include:

    a. The capabilities of the residency staff.
    b. The size of the development.
    c. The level of service on the existing highways that will provide access.
    d. The complexity of the drainage system design.
    e. The residency staff has questions on the site plan.

5. Perform the site plan review using the site plan review checklist and prepare written review comments, or forward the site plan to the appropriate district office section(s) for review with issues of particular concern noted. If both areas are reviewed, jointly address both review persons in the cover letter. Wait to receive their comments.

6. Forward all traffic impact studies to the district traffic engineering section.

7. Forward the review comments to the county staff or developer or his representative.

8. Coordinate site plan review activities with the county and, if appropriate, with the district.

## B. DISTRICT OFFICES

1. Log in the rezoning applications and site plans received from the residency.

2. If appropriate, coordinate activities between the district sections reviewing the plan, primarily the hydraulics and traffic engineering section.

3. Determine if the application or site plan should be forwarded to the central office for a partial or complete review, or not at all. The factors considered in this determination include:

    a. The size of the development.
    b. The level of service on the existing highways that will provide access.
    c. Impact on an interstate road.
    d. The complexity of the road and drainage designs.
    e. The development impacts on roads with major improvements planned.
    f. A policy change is needed.
    g. The district staff has questions on the plan.

4. For plans to be reviewed in the central office:

    a. For a complete review, forward the plan to the head of the Location and Design Division, indicate the divisions that should review the plan, and flag issues of special concern.
    b. For a partial review, forward the plan to the head of the division that should review the plan and flag issues of particular concern. Send a copy of the letter to the head of the Location and Design Division. Wait to receive their comments.

5. Perform the site plan review using the Site Plan Review Checklist and prepare written review comments.

6. For a traffic impact study:

    a. Check for adherence to the guidelines for a traffic impact study.

    b. If the study does not satisfy the guidelines, return it to the initial sender, either the county or the preparer of the study.

c. If the study is acceptable, determine if the study should be reviewed by the Transportation and Mobility Planning Division. The factors to be considered are outlined in item 3 above for the district office.

d. Perform the review and prepare written comments or forward the review to the Transportation and Mobility Planning Division, flagging issues of concern, and wait for their comments.

7. When comments on a plan or traffic impact study are received, review the comments, then forward the review comments to the residency, including any comments from the district and a note stating which office should review the revised site plan when it is submitted.

**C. CENTRAL OFFICE**

1. Log in rezoning applications and site plans from the district offices.

2. For complete plan reviews by the central office, the Location and Design Division will coordinate the review with the related divisions as requested by the district office. The Location and Design Division is responsible for forwarding the plans to the appropriate divisions, compiling the review comments from the divisions, and forwarding the comments to the district offices.

3. For partial reviews by the central office, the reviewing division receives the plan from the district office and reviews the plan using the Site Plan Review Checklist, and other references deemed appropriate by the division, and prepares a written response that is forwarded to the district. The areas of site plan review responsibility for the divisions are:

Location and Design: (a) reviews road geometrics and entrance designs, (b) reviews drainage designs, and (c) examines how the proposed site may impact planned road projects.

Transportation and Mobility Planning Division: (a) reviews plans for traffic impact on existing roads and planned road improvements, especially the capacity analysis, and (b) reviews traffic impact studies.

Mobility Management Division: evaluates unusual proposals or extenuating circumstances for compliance with the subdivision street requirements.

Local Assistance Division: evaluates unusual proposals or extenuating circumstances for compliance with the subdivision street requirements.

Asset Management Division: serves as a clearinghouse for complaints of betterment when a developer who views VDOT's requirements as excessive submits a request to the Commission to review his complaint.

Materials Division: (a) occasionally reviews pavement structures, and (b) reviews the geotechnical plans of roadway dams.

On rare occasions, other divisions may be requested to review a particular aspect of the site plan that involves their areas of responsibility.

## D. SITE PLAN REVIEW PROCESS THROUGH VDOT

Figures C-7-1 and C-7-2 illustrate the flow of site development plans and subdivision plans, respectively, through the VDOT. In both cases, all plans should be submitted to the residency to initiate VDOT review (except for Northern Virginia where the district is the entry point).

Figure C-7-1 shows the plan flow through VDOT for partial site plan reviews. Figure C-7-2 shows the flow for complete reviews by the next level.

Figure C-7-3 is from the draft of "Subdivision Street Requirements."

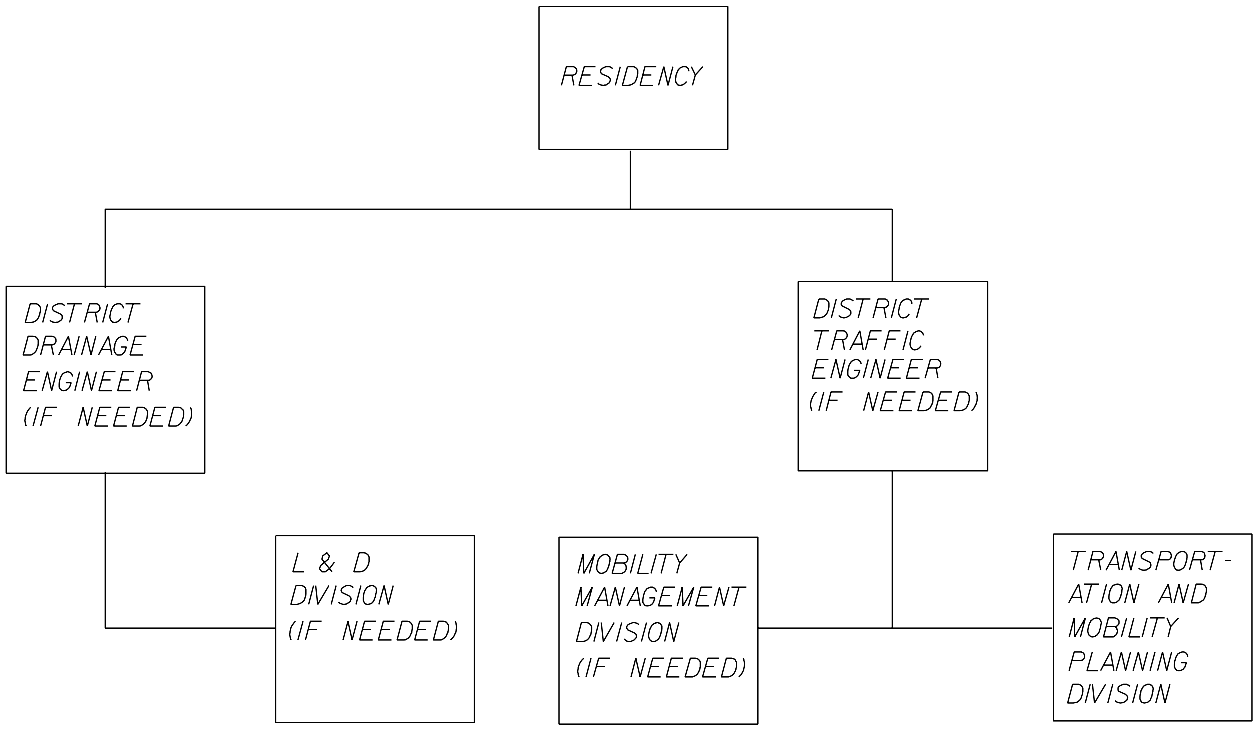



**FIGURE C-7-1 PARTIAL SITE PLAN PREVIEW PROCESS**

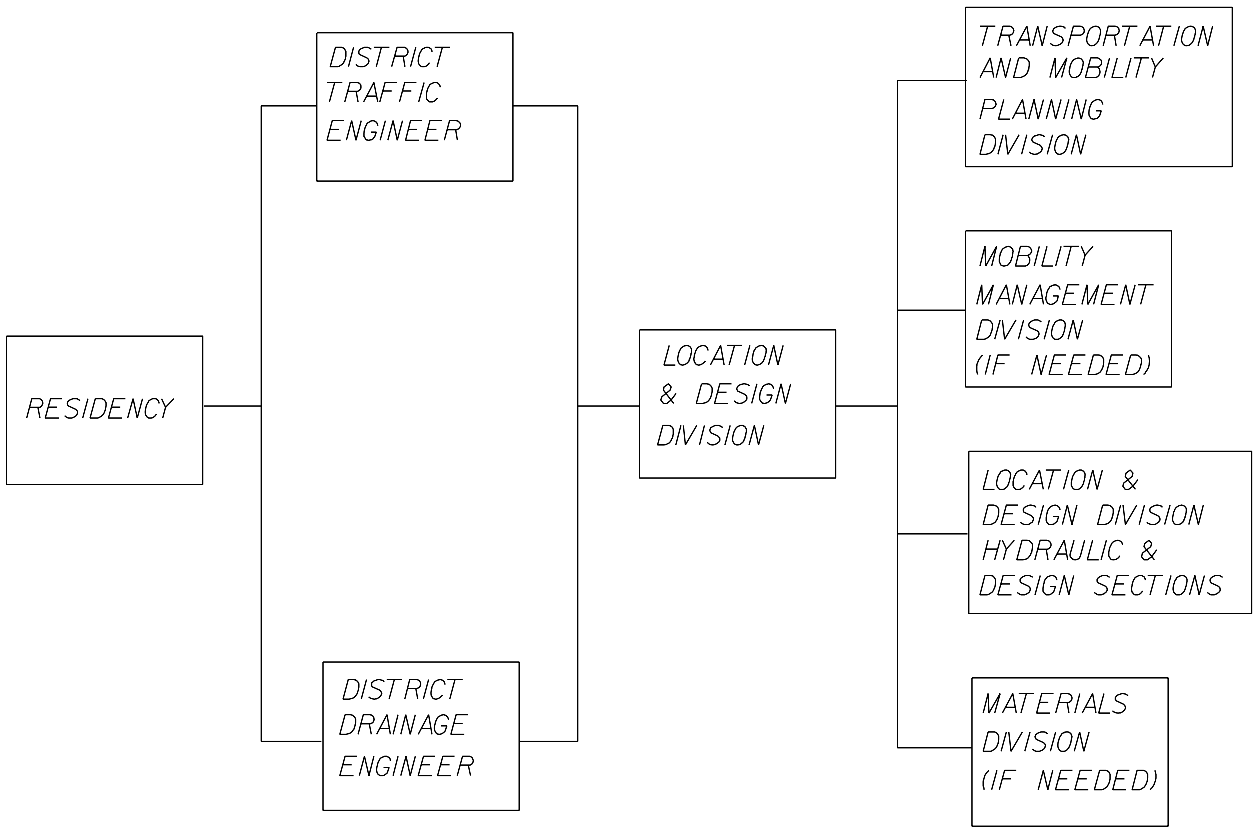
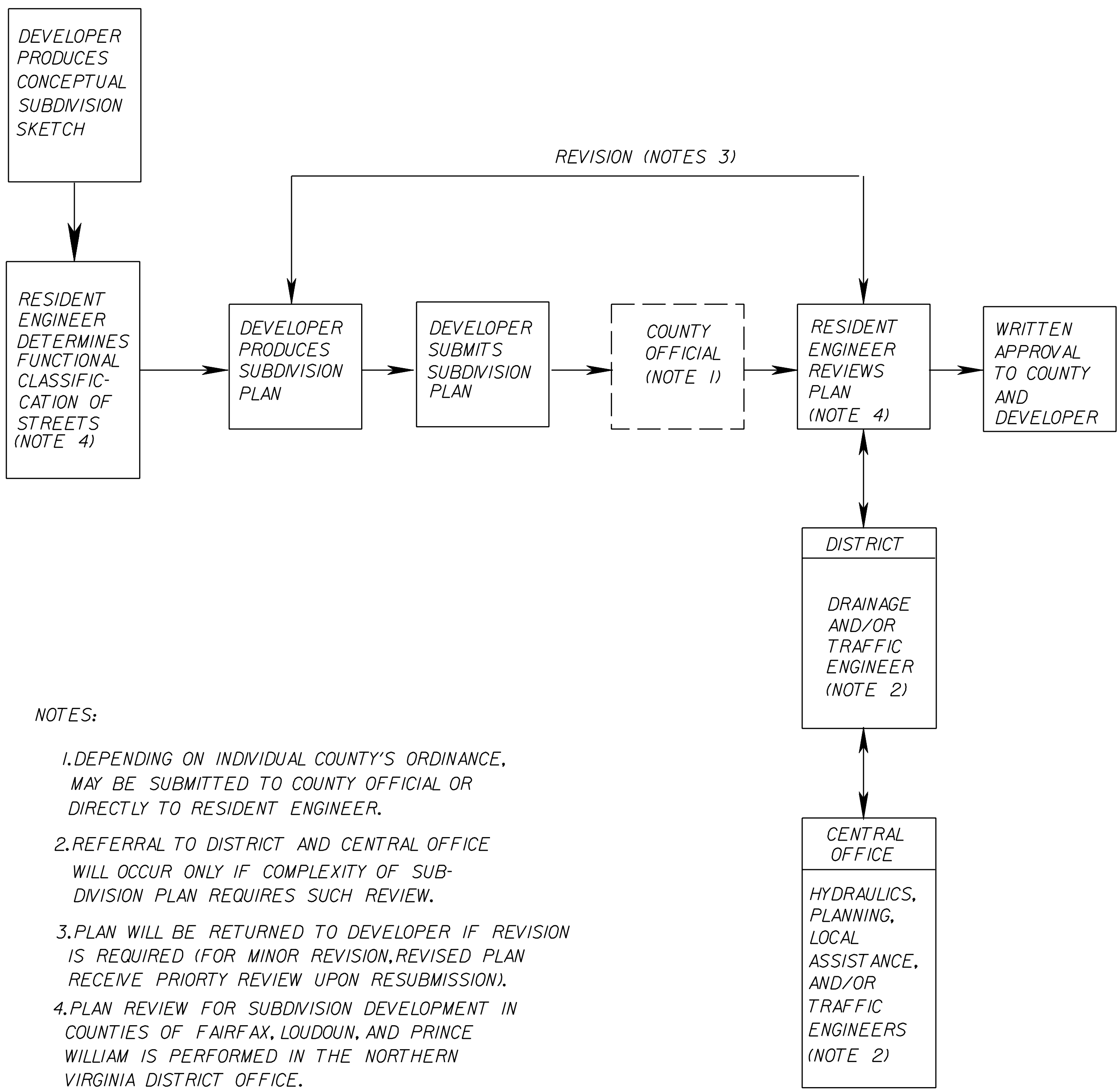



**FIGURE C-7-2  COMPLETE SITE PLAN REVIEW PROCESS**




NOTES:

1. DEPENDING ON INDIVIDUAL COUNTY'S ORDINANCE, MAY BE SUBMITTED TO COUNTY OFFICIAL OR DIRECTLY TO RESIDENT ENGINEER.
2. REFERRAL TO DISTRICT AND CENTRAL OFFICE WILL OCCUR ONLY IF COMPLEXITY OF SUB-DIVISION PLAN REQUIRES SUCH REVIEW.
3. PLAN WILL BE RETURNED TO DEVELOPER IF REVISION IS REQUIRED (FOR MINOR REVISION, REVISED PLAN RECEIVE PRIORTY REVIEW UPON RESUBMISSION).
4. PLAN REVIEW FOR SUBDIVISION DEVELOPMENT IN COUNTIES OF FAIRFAX, LOUDOUN, AND PRINCE WILLIAM IS PERFORMED IN THE NORTHERN VIRGINIA DISTRICT OFFICE.

**FIGURE C-7-3 SUBDIVISION STREET PLAN REVIEW PROCEDURE**

## V. COORDINATION WITH COUNTY GOVERNMENTS IN SITE PLAN REVIEW

The previous sections of the guide emphasized site plan review activities within VDOT. Coordination and communication with the county governments are strongly encouraged and should be responsive to the needs of the county and the respective residency and/or district offices. Communication between VDOT and the counties is important in facilitating site plan review activities and in resolving problems and misunderstandings. Agreement on county and VDOT interaction with the developer should be obtained. With the exception of Northern Virginia, a VDOT residency staff person should be designated to serve as a liaison with the county.

The field offices and counties are strongly encouraged to document their site plan review process. In this way, the process will be clearly outlined on paper to facilitate mutual understanding and expectations of the site plan review process. The process of developing the document will provide opportunities to resolve problems and misunderstandings. Updates or revisions of the process should be made as needed.

The field offices and counties should each have updated copies of all of the other's documents pertinent to site plan review.

## LIST OF TABLES

| CULVERT SIZE DIAMETER (in.) | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | |
| 12 | 1.06 | 0.53 | 1.00 | 0.50 |
| 15 | 1.66 | 0.83 | 1.56 | 0.78 |
| 18 | 2.41 | 1.20 | 2.26 | 1.13 |
| 24 | 4.26 | 2.13 | 4.00 | 2.00 |
| 30 | 6.65 | 3.33 | 6.25 | 3.13 |
| 36 | 9.59 | 4.79 | 9.01 | 4.51 |
| 42 | 12.86 | 6.43 | 12.07 | 6.04 |
| 48 | 16.55 | 8.27 | 15.53 | 7.76 |
| 54 | 20.81 | 10.40 | 19.51 | 9.76 |
| 60 | 25.56 | 12.78 | 23.95 | 11.98 |
| | | | | |

**TABLE D-1 STONE FOR EROSION CONTROL WITH ST'D. ES-1 END SECTIONS**

| CULVERT SIZE DIAMETER (in.) | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | |
| 12 | 1.19 | 0.60 | 1.13 | 0.56 |
| 15 | 1.85 | 0.93 | 1.75 | 0.87 |
| 18 | 2.66 | 1.33 | 2.51 | 1.25 |
| 24 | 4.70 | 2.35 | 4.43 | 2.21 |
| 30 | 7.31 | 3.66 | 6.90 | 3.45 |
| 36 | 10.51 | 5.26 | 9.91 | 4.96 |
| 42 | 14.29 | 7.15 | 13.47 | 6.74 |
| 48 | 18.38 | 9.19 | 17.31 | 8.66 |
| 54 | 23.11 | 11.56 | 21.77 | 10.88 |
| 60 | 28.43 | 14.22 | 26.76 | 13.38 |
| | | | | |

**TABLE D-2 STONE FOR EROSION CONTROL WITH ST'D. ES-2 END SECTIONS**

| PIPE ARCH | | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|---|
| SPAN | RISE | Normal Depth (2 Feet) | Increments For Each Add’l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add’l. Foot Above Normal |
| (in.) | | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| 17 | 13 | 1.82 | 0.91 | 1.73 | 0.85 |
| 21 | 15 | 2.62 | 1.31 | 2.45 | 1.22 |
| 24 | 18 | 3.56 | 1.78 | 3.33 | 1.67 |
| 28 | 20 | 4.65 | 2.33 | 4.34 | 2.17 |
| 35 | 24 | 7.06 | 3.53 | 6.59 | 3.29 |
| 42 | 29 | 10.32 | 5.16 | 9.64 | 4.82 |
| 49 | 33 | 13.69 | 6.85 | 12.77 | 6.39 |
| 57 | 38 | 18.24 | 9.12 | 17.01 | 8.51 |
| 64 | 43 | 23.35 | 11.68 | 21.79 | 10.89 |
| 71 | 47 | 28.63 | 14.31 | 26.70 | 13.35 |

**TABLE D-3 STONE FOR EROSION CONTROL WITH ST’D. ES-3 END SECTIONS**

| CULVERT SIZE DIAMETER (in.) | 1 ½ : 1 Slope | | 2:1 Slope | | Increments For Each Add’l. Pipe (St’d. EW-6) . | |
|---|---|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add’l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add’l. Foot Above Normal | Conc. | C.M. |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu Yds | Cu Yds. |
| 12 | 0.73 | 0.36 | 0.69 | 0.34 | 0.35 | 0.30 |
| 15 | 1.14 | 0.57 | 1.08 | 0.54 | 0.54 | 0.47 |
| 18 | 1.65 | 0.82 | 1.56 | 0.78 | 0.79 | 0.69 |
| 24 | 2.93 | 1.46 | 2.78 | 1.39 | 1.38 | 1.22 |
| 30 | 4.59 | 2.29 | 4.36 | 2.18 | 2.17 | 1.92 |
| 36 | 6.64 | 3.32 | 6.31 | 3.15 | 3.16 | 2.80 |

**TABLE D-4 STONE FOR EROSION CONTROL WITH ST’D. EW-1 AND EW-6 ENDWALLS**

| ELLIPTICAL PIPE<br><br>SPAN RISE (in.) | | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|---|
| | | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | | |
| 23 | 14 | 1.62 | 0.81 | 1.54 | 0.77 |
| 30 | 19 | 2.90 | 1.45 | 2.75 | 1.38 |
| 34 | 22 | 3.81 | 1.90 | 3.61 | 1.81 |
| 38 | 24 | 4.63 | 2.32 | 4.40 | 2.20 |
| 42 | 27 | 5.78 | 2.89 | 5.49 | 2.75 |
| 45 | 29 | 6.65 | 3.32 | 6.31 | 3.15 |
| 49 | 32 | 8.01 | 4.00 | 7.60 | 3.80 |
| 53 | 34 | 9.19 | 4.60 | 8.73 | 4.36 |
| | | | | | |
| | | | | | |

**TABLE D-5 STONE FOR EROSION CONTROL WITH ST'D. EW-1A ENDWALLS**

| CULVERT SIZE DIAMETER (in.) | 1 ½ : 1 Slope | | 2:1 Slope | | ST'D. EW-7 |
|---|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Increments For Each Add'l. Pipe (Conc.) |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | | |
| 42 | 10.80 | 5.40 | 10.07 | 5.03 | 4.67 |
| 48 | 14.12 | 7.06 | 13.16 | 6.58 | 6.07 |
| 54 | 17.89 | 8.95 | 16.67 | 8.33 | 7.67 |
| 60 | 22.10 | 11.05 | 20.59 | 10.30 | 9.44 |
| 66 | 26.94 | 13.47 | 24.93 | 12.46 | 11.41 |
| 72 | 31.87 | 15.93 | 29.68 | 14.84 | 13.56 |
| 78 | 37.42 | 18.71 | 34.85 | 17.42 | 15.89 |
| 84 | 43.41 | 21.71 | 40.43 | 20.21 | 18.41 |
| | | | | | |
| | | | | | |

**TABLE D-6 STONE FOR EROSION CONTROL WITH ST'D. EW-2 AND EW-7 ENDWALLS**

| CULVERT SIZE DIAMETER (in.) | 1 ½ : 1 Slope | | 2:1 Slope | | ST'D. EW-7S |
|---|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Increments For Each Add'l. Pipe (Conc.) |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | | |
| 42 | 11.22 | 5.61 | 10.49 | 5.24 | 5.39 |
| 48 | 14.67 | 7.33 | 13.71 | 6.85 | 7.00 |
| 54 | 18.59 | 9.29 | 17.37 | 8.68 | 8.86 |
| 60 | 22.97 | 11.49 | 21.46 | 10.73 | 10.90 |
| 66 | 27.98 | 13.99 | 25.97 | 12.99 | 13.18 |
| 72 | 33.11 | 16.55 | 30.92 | 15.46 | 15.66 |
| 78 | 38.88 | 19.44 | 36.31 | 18.15 | 18.34 |
| 84 | 45.10 | 22.55 | 42.11 | 21.06 | 21.26 |
| | | | | | |
| | | | | | |

**TABLE D-7 STONE FOR EROSION CONTROL WITH ST'D. EW-2S AND EW-7S ENDWALLS (30º SKEW)**

| CULVERT SIZE DIAMETER (in.) | 1 ½ : 1 Slope | | 2:1 Slope | | ST'D. EW-7S |
|---|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Increments For Each Add'l. Pipe (Conc.) |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | | |
| 42 | 13.03 | 6.51 | 12.56 | 6.28 | 6.61 |
| 48 | 17.02 | 8.51 | 16.41 | 8.21 | 8.59 |
| 54 | 21.55 | 10.77 | 20.77 | 10.39 | 10.85 |
| 60 | 26.61 | 13.30 | 25.64 | 12.82 | 13.35 |
| 66 | 32.16 | 16.08 | 31.03 | 15.51 | 16.13 |
| 72 | 38.32 | 19.16 | 36.93 | 18.46 | 19.17 |
| 78 | 44.97 | 22.48 | 43.33 | 21.66 | 22.47 |
| 84 | 52.16 | 26.08 | 50.25 | 25.13 | 26.04 |
| | | | | | |
| | | | | | |

**TABLE D-7A STONE FOR EROSION CONTROL WITH ST'D. EW-2S AND EW-7S ENDWALLS (45º SKEW)**

| ELLIPTICAL PIPE<br><br>SPAN RISE<br>(in.) | | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|---|
| | | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | | |
| 60 | 38 | 14.36 | 7.18 | 12.79 | 6.39 |
| 68 | 43 | 18.84 | 9.42 | 16.87 | 8.44 |
| 76 | 48 | 23.47 | 11.74 | 20.99 | 10.50 |
| 83 | 53 | 28.20 | 14.10 | 25.22 | 12.61 |
| 91 | 58 | 33.81 | 16.90 | 30.20 | 15.10 |
| 98 | 63 | 39.98 | 19.99 | 35.23 | 17.62 |
| 106 | 68 | 46.03 | 23.01 | 41.09 | 20.54 |
| | | | | | |
| | | | | | |

**TABLE D-8 STONE FOR EROSION CONTROL WITH ST'D. EW-2A ENDWALLS**

| PIPE ARCH<br><br>Span Riser<br>(in.) | | 1 ½ : 1 Slope | | 2:1 Slope | | ST'D. EW-10 |
|---|---|---|---|---|---|---|
| | | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Increments For Each Add'l. Pipe |
| | | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| | | | | | | |
| 17 | 13 | 1.12 | 0.56 | 1.06 | 0.53 | 0.52 |
| 21 | 15 | 1.60 | 0.80 | 1.52 | 0.76 | 0.70 |
| 24 | 18 | 2.20 | 1.10 | 2.09 | 1.04 | 0.92 |
| 28 | 20 | 2.86 | 1.43 | 2.71 | 1.36 | 1.14 |
| 35 | 24 | 4.27 | 2.13 | 4.05 | 2.03 | 1.58 |
| 42 | 29 | 6.20 | 3.10 | 5.89 | 2.94 | 2.33 |
| 49 | 33 | 8.27 | 4.13 | 7.85 | 3.92 | 3.10 |
| 57 | 38 | 11.11 | 5.56 | 10.55 | 5.28 | 4.21 |
| | | | | | | |
| | | | | | | |

**TABLE D-9 STONE FOR EROSION CONTROL WITH ST'D. EW-9 AND EW-10 PIPE ARCHES**

| CULVERT SIZE (FEET)<br><br>SPAN X RISE | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| 3 x 3 | 9.55 | 4.77 | 9.28 | 4.64 |
| 3 x 4 | 13.10 | 6.55 | 13.09 | 6.54 |
| 4 x 3 | 12.95 | 6.48 | 12.14 | 6.07 |
| 4 x 4 | 17.01 | 8.51 | 16.60 | 8.30 |
| 4 x 5 | 21.70 | 10.85 | 21.66 | 10.84 |
| 4 x 6 | 26.58 | 13.29 | 27.39 | 13.69 |
| 5 x 3 | 16.86 | 8.43 | 15.44 | 7.72 |
| 5 x 4 | 21.43 | 10.71 | 20.27 | 10.13 |
| 5 x 5 | 26.62 | 13.31 | 25.83 | 12.92 |
| 5 x 6 | 32.13 | 16.06 | 32.03 | 16.01 |
| 5 x 7 | 38.42 | 19.21 | 38.85 | 19.43 |
| 6 x 4 | 26.34 | 13.17 | 24.44 | 12.22 |
| 6 x 5 | 32.04 | 16.02 | 30.42 | 15.21 |
| 6 x 6 | 38.18 | 19.09 | 37.10 | 18.55 |
| 6 x 7 | 44.98 | 22.49 | 44.41 | 22.21 |
| 6 x 8 | 51.91 | 25.95 | 52.35 | 26.17 |
| 7 x 4 | 31.77 | 15.88 | 29.10 | 14.55 |
| 7 x 6 | 44.80 | 22.40 | 42.61 | 21.31 |
| 7 x 8 | 59.98 | 29.99 | 58.83 | 29.42 |
| 7 x 10 | 76.35 | 38.17 | 76.81 | 38.40 |
| 8 x 4 | 37.69 | 18.85 | 34.20 | 17.10 |
| 8 x 6 | 51.87 | 25.93 | 48.57 | 24.28 |
| 8 x 8 | 68.05 | 34.02 | 66.07 | 33.03 |
| 8 x 10 | 85.68 | 42.84 | 85.45 | 42.72 |
| 9 x 4 | 44.12 | 22.06 | 39.73 | 19.86 |
| 9 x 6 | 59.56 | 29.78 | 55.06 | 27.53 |
| 9 x 8 | 76.62 | 38.31 | 73.30 | 36.65 |
| 9 x 10 | 95.51 | 47.76 | 93.77 | 46.89 |
| 9 x 12 | 116.42 | 58.21 | 116.95 | 58.48 |
| 10 x 4 | 51.06 | 25.53 | 45.70 | 22.85 |
| 10 x 6 | 67.76 | 33.88 | 61.99 | 31.00 |
| 10 x 8 | 85.70 | 42.85 | 80.98 | 40.49 |
| 10 x 10 | 106.17 | 53.08 | 102.93 | 51.47 |
| 10 x 12 | 128.52 | 64.26 | 127.40 | 63.70 |
| 12 x 6 | 85.09 | 42.55 | 76.71 | 38.36 |
| 12 x 8 | 105.63 | 52.81 | 97.78 | 48.89 |
| 12 x 10 | 128.17 | 64.09 | 121.69 | 60.84 |
| 12 x 12 | 153.11 | 76.55 | 148.41 | 74.21 |

**TABLE D-10 STONE FOR EROSION CONTROL FOR BOX CULVERT ST'D. BCS-02 THRU BCS-50 (NO SKEW)**

| CULVERT SIZE (FEET) SPAN X RISE | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| 3 x 3 | 9.62 | 4.81 | 9.35 | 4.67 |
| 3 x 4 | 13.20 | 6.60 | 13.18 | 6.59 |
| 4 x 3 | 13.04 | 6.52 | 12.24 | 6.12 |
| 4 x 4 | 17.14 | 8.57 | 16.72 | 8.36 |
| 4 x 5 | 21.86 | 10.93 | 21.84 | 10.92 |
| 4 x 6 | 26.77 | 13.38 | 27.58 | 13.79 |
| 5 x 3 | 16.98 | 8.49 | 15.56 | 7.78 |
| 5 x 4 | 21.58 | 10.79 | 20.42 | 10.21 |
| 5 x 5 | 26.82 | 13.41 | 26.03 | 13.01 |
| 5 x 6 | 32.36 | 16.18 | 32.26 | 16.13 |
| 5 x 7 | 38.70 | 19.35 | 39.13 | 19.56 |
| 6 x 4 | 26.53 | 13.27 | 24.63 | 12.32 |
| 6 x 5 | 32.28 | 16.14 | 30.66 | 15.33 |
| 6 x 6 | 38.47 | 19.23 | 37.39 | 18.69 |
| 6 x 7 | 45.31 | 22.66 | 44.74 | 22.37 |
| 6 x 8 | 52.28 | 26.14 | 52.73 | 26.36 |
| 7 x 4 | 31.99 | 15.99 | 29.32 | 14.66 |
| 7 x 6 | 45.13 | 22.57 | 42.94 | 21.47 |
| 7 x 8 | 60.42 | 30.21 | 59.27 | 29.63 |
| 7 x 10 | 76.89 | 38.45 | 77.36 | 38.68 |
| 8 x 4 | 37.94 | 18.97 | 34.45 | 17.22 |
| 8 x 6 | 52.24 | 26.12 | 48.94 | 24.47 |
| 8 x 8 | 68.55 | 34.27 | 66.57 | 33.28 |
| 8 x 10 | 86.31 | 46.15 | 86.07 | 43.04 |
| 9 x 4 | 44.41 | 22.20 | 40.01 | 20.01 |
| 9 x 6 | 59.98 | 29.99 | 55.48 | 27.74 |
| 9 x 8 | 77.19 | 38.59 | 73.87 | 36.93 |
| 9 x 10 | 96.22 | 48.11 | 94.48 | 47.24 |
| 9 x 12 | 117.26 | 58.63 | 117.80 | 58.90 |
| 10 x 4 | 51.37 | 25.69 | 46.01 | 23.00 |
| 10 x 6 | 68.23 | 34.11 | 62.46 | 31.23 |
| 10 x 8 | 86.33 | 43.17 | 81.60 | 40.80 |
| 10 x 10 | 106.95 | 53.48 | 103.71 | 51.86 |
| 10 x 12 | 129.46 | 64.73 | 128.34 | 64.17 |
| 12 x 6 | 85.66 | 42.83 | 77.28 | 38.64 |
| 12 x 8 | 106.38 | 53.19 | 98.53 | 49.27 |
| 12 x 10 | 129.11 | 64.56 | 122.63 | 61.32 |
| 12 x 12 | 154.24 | 77.12 | 149.54 | 74.77 |

**TABLE D-11 STONE FOR EROSION CONTROL FOR BOX CULVERT ST'D. BCS-02 THRU BCS-50 (15º SKEW)**

| CULVERT SIZE (FEET) SPAN X RISE | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| 3 x 3 | 9.93 | 4.96 | 9.71 | 4.85 |
| 3 x 4 | 13.70 | 6.65 | 13.85 | 6.92 |
| 4 x 3 | 13.34 | 6.67 | 12.56 | 6.28 |
| 4 x 4 | 17.72 | 8.86 | 17.39 | 8.69 |
| 4 x 5 | 22.74 | 11.37 | 23.00 | 11.50 |
| 4 x 6 | 28.28 | 14.14 | 29.40 | 14.70 |
| 5 x 3 | 17.26 | 8.63 | 15.84 | 7.92 |
| 5 x 4 | 22.11 | 11.06 | 21.02 | 10.51 |
| 5 x 5 | 27.67 | 13.84 | 27.09 | 13.55 |
| 5 x 6 | 33.79 | 16.89 | 33.95 | 16.98 |
| 5 x 7 | 40.57 | 20.28 | 41.47 | 20.74 |
| 6 x 4 | 27.07 | 13.54 | 25.18 | 12.59 |
| 6 x 5 | 33.11 | 16.56 | 31.62 | 15.81 |
| 6 x 6 | 39.80 | 19.90 | 38.94 | 19.47 |
| 6 x 7 | 46.94 | 23.47 | 46.95 | 23.47 |
| 6 x 8 | 54.81 | 27.41 | 55.80 | 27.90 |
| 7 x 4 | 32.54 | 16.27 | 29.83 | 14.91 |
| 7 x 6 | 46.34 | 23.17 | 44.37 | 22.18 |
| 7 x 8 | 62.65 | 31.33 | 62.18 | 31.08 |
| 7 x 10 | 80.99 | 40.50 | 82.60 | 41.30 |
| 8 x 4 | 38.51 | 19.25 | 34.91 | 17.46 |
| 8 x 6 | 53.40 | 26.70 | 50.23 | 25.12 |
| 8 x 8 | 70.62 | 35.31 | 69.39 | 34.69 |
| 8 x 10 | 90.52 | 45.27 | 91.21 | 45.61 |
| 9 x 4 | 44.98 | 22.49 | 40.43 | 20.22 |
| 9 x 6 | 61.08 | 30.54 | 56.66 | 28.33 |
| 9 x 8 | 79.41 | 39.70 | 76.49 | 38.24 |
| 9 x 10 | 100.25 | 50.13 | 99.32 | 49.66 |
| 9 x 12 | 123.33 | 61.66 | 125.24 | 62.62 |
| 10 x 4 | 51.96 | 25.98 | 46.39 | 23.20 |
| 10 x 6 | 69.27 | 34.63 | 63.54 | 31.77 |
| 10 x 8 | 88.45 | 44.22 | 84.09 | 42.05 |
| 10 x 10 | 110.78 | 55.39 | 108.37 | 54.18 |
| 10 x 12 | 135.31 | 67.65 | 135.63 | 67.82 |
| 12 x 6 | 86.43 | 43.22 | 78.03 | 39.02 |
| 12 x 8 | 108.29 | 54.15 | 100.60 | 50.30 |
| 12 x 10 | 132.52 | 66.26 | 126.69 | 63.34 |
| 12 x 12 | 159.65 | 79.82 | 156.24 | 78.12 |

**TABLE D-12 STONE FOR EROSION CONTROL FOR BOX CULVERT ST'D. BCS-02 THRU BCS-50 (30º SKEW)**

| CULVERT SIZE (FEET) SPAN X RISE | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal | Normal Depth (2 Feet) | Increments For Each Add'l. Foot Above Normal |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| 3 x 3 | 10.44 | 5.22 | 10.22 | 5.11 |
| 3 x 4 | 14.39 | 7.20 | 14.54 | 7.27 |
| 4 x 3 | 14.03 | 7.02 | 13.25 | 6.62 |
| 4 x 4 | 18.64 | 9.32 | 18.31 | 9.15 |
| 4 x 5 | 23.90 | 11.95 | 24.15 | 12.09 |
| 4 x 6 | 29.67 | 14.83 | 30.78 | 15.39 |
| 5 x 3 | 18.12 | 9.06 | 16.71 | 8.35 |
| 5 x 4 | 23.27 | 11.63 | 22.17 | 11.09 |
| 5 x 5 | 29.12 | 14.56 | 28.53 | 14.27 |
| 5 x 6 | 35.52 | 17.76 | 35.68 | 17.84 |
| 5 x 7 | 42.59 | 21.29 | 43.49 | 21.74 |
| 6 x 4 | 28.46 | 14.23 | 26.56 | 13.28 |
| 6 x 5 | 34.84 | 17.42 | 33.35 | 16.67 |
| 6 x 6 | 41.87 | 20.94 | 41.02 | 20.51 |
| 6 x 7 | 49.54 | 24.77 | 49.37 | 24.69 |
| 6 x 8 | 57.58 | 28.79 | 58.57 | 29.28 |
| 7 x 4 | 34.15 | 17.08 | 31.44 | 15.72 |
| 7 x 6 | 48.76 | 24.38 | 46.79 | 23.39 |
| 7 x 8 | 65.88 | 32.94 | 65.41 | 32.70 |
| 7 x 10 | 85.03 | 42.52 | 86.63 | 43.32 |
| 8 x 4 | 40.35 | 20.18 | 36.76 | 18.38 |
| 8 x 6 | 56.17 | 28.09 | 53.00 | 26.50 |
| 8 x 8 | 74.56 | 37.28 | 73.08 | 36.54 |
| 8 x 10 | 95.16 | 47.58 | 95.82 | 47.91 |
| 9 x 4 | 47.06 | 23.53 | 42.51 | 21.26 |
| 9 x 6 | 64.20 | 32.10 | 59.78 | 29.89 |
| 9 x 8 | 83.56 | 41.78 | 80.64 | 40.32 |
| 9 x 10 | 105.44 | 52.72 | 104.51 | 52.26 |
| 9 x 12 | 129.55 | 64.78 | 131.47 | 65.73 |
| 10 x 4 | 54.27 | 27.13 | 48.70 | 24.35 |
| 10 x 6 | 72.73 | 36.36 | 67.00 | 33.50 |
| 10 x 8 | 93.06 | 46.53 | 88.71 | 44.35 |
| 10 x 10 | 116.54 | 58.27 | 114.14 | 57.07 |
| 10 x 12 | 142.23 | 71.11 | 142.55 | 71.28 |
| 12 x 6 | 90.58 | 45.29 | 82.18 | 41.09 |
| 12 x 8 | 113.83 | 56.92 | 106.13 | 53.07 |
| 12 x 10 | 139.44 | 69.72 | 133.61 | 66.80 |
| 12 x 12 | 167.95 | 83.98 | 164.55 | 82.27 |

**TABLE D-13 STONE FOR EROSION CONTROL FOR BOX CULVERT ST'D. BCS-02 THRU BCS-50 (45º SKEW)**

| CULVERT SIZE (FEET) SPAN X RISE | 1 ½ : 1 Slope | | 2:1 Slope | |
|---|---|---|---|---|
| | No Skew | 15 Skew | 30 Skew | 45 Skew |
| | Cu. Yds. | Cu. Yds. | Cu. Yds. | Cu. Yds. |
| 3 x 3 | 2.56 | 2.65 | 2.97 | 3.61 |
| 3 x 4 | 3.53 | 3.65 | 3.89 | 4.95 |
| 4 x 3 | 3.11 | 3.23 | 3.59 | 4.40 |
| 4 x 4 | 4.15 | 4.30 | 4.79 | 5.87 |
| 4 x 5 | 5.19 | 5.37 | 5.99 | 7.34 |
| 4 x 6 | 6.22 | 6.44 | 7.19 | 8.80 |
| 5 x 3 | 3.78 | 3.91 | 4.36 | 5.34 |
| 5 x 4 | 5.03 | 5.22 | 5.82 | 7.12 |
| 5 x 5 | 6.30 | 6.52 | 7.27 | 8.91 |
| 5 x 6 | 7.56 | 7.83 | 8.73 | 10.69 |
| 5 x 7 | 8.82 | 9.12 | 10.18 | 12.46 |
| 6 x 4 | 5.93 | 6.14 | 6.85 | 8.38 |
| 6 x 5 | 7.49 | 7.75 | 8.66 | 10.58 |
| 6 x 6 | 9.13 | 9.44 | 10.50 | 12.81 |
| 6 x 7 | 10.77 | 11.13 | 12.49 | 15.16 |
| 6 x 8 | 11.85 | 12.27 | 13.69 | 16.76 |
| 7 x 4 | 6.82 | 7.06 | 7.87 | 9.64 |
| 7 x 6 | 10.35 | 10.71 | 11.92 | 14.58 |
| 7 x 8 | 14.07 | 14.55 | 16.28 | 19.82 |
| 7 x 10 | 17.79 | 18.39 | 20.61 | 25.04 |
| 8 x 4 | 7.70 | 7.98 | 8.90 | 10.90 |
| 8 x 6 | 11.55 | 11.97 | 13.35 | 16.34 |
| 8 x 8 | 15.40 | 15.95 | 17.79 | 21.79 |
| 8 x 10 | 19.26 | 19.94 | 22.24 | 27.24 |
| 9 x 4 | 8.60 | 8.90 | 9.93 | 12.15 |
| 9 x 6 | 12.89 | 13.35 | 14.89 | 18.22 |
| 9 x 8 | 17.19 | 17.79 | 20.00 | 24.46 |
| 9 x 10 | 22.00 | 22.75 | 25.45 | 31.03 |
| 9 x 12 | 26.61 | 27.52 | 30.81 | 37.49 |
| 10 x 4 | 9.48 | 9.82 | 10.95 | 13.41 |
| 10 x 6 | 14.23 | 14.73 | 16.42 | 20.12 |
| 10 x 8 | 18.97 | 19.64 | 21.90 | 26.82 |
| 10 x 10 | 23.70 | 24.54 | 27.37 | 33.53 |
| 10 x 12 | 28.44 | 29.45 | 32.85 | 40.23 |
| 12 x 6 | 16.89 | 17.48 | 19.50 | 23.89 |
| 12 x 8 | 22.52 | 23.31 | 26.01 | 31.85 |
| 12 x 10 | 28.15 | 29.14 | 32.51 | 39.81 |
| 12 x 12 | 33.78 | 34.97 | 39.01 | 47.77 |

**TABLE D-14 STONE FOR EROSION CONTROL FOR MULTIPLE BOX CULVERTS (INCREMENTS FOR EACH ADDITIONAL BARREL)**

PROJECT ____________ STATION ____________

1. Grade Elevation ______
2. Minus Inv. Elev. ______
3. Vertical Difference ______
4. Minus Pipe Size ______
5. Difference ______

If Line 5 is over 5' 4", use Type A Tower
If Line 5 is 3' 2" to 5' 4", use Type B Tower
If Line 5 is 2' 4" to 3' 2", use Type C Tower

Increase above dimensions by 1' for use with 72" pipe.

## CHAMBER

| | CONCRETE CU. YDS. | REINFORCING STEEL LBS. |
|---|---|---|
| 6. Type ______ Pipe Size ______ Turn Angle ______ | | |
| Less: Pipe Openings | | |
| 7. Size ______ Class ______ Defl. Angle ______ | | |
| 8. Size ______ Class ______ Defl. Angle ______ | | |
| 9. Size ______ Class ______ Defl. Angle ______ | | |
| 10. Size ______ Class ______ Defl. Angle ______ | | |
| 11. Total Deductions (Lines 7-10) | | |
| 12 Quantities for Chamber (Subtract Line 11 from Line 6 and Transfer to Line 17) | | |

See Standard JB-1

See Table D-27

## TOWER

13. Type ______ ✱Height ______

✱48" Pipe = Line 3 minus 6.33'
✱54" Pipe = Line 3 minus 6.83'
✱60" Pipe = Line 3 minus 7.33'
✱66" Pipe = Line 3 minus 7.83'
✱72" Pipe = Line 3 minus 9.33'

Min. Height
Type A = 3.00'
Type B = 0.83'
Type C = 0.00'

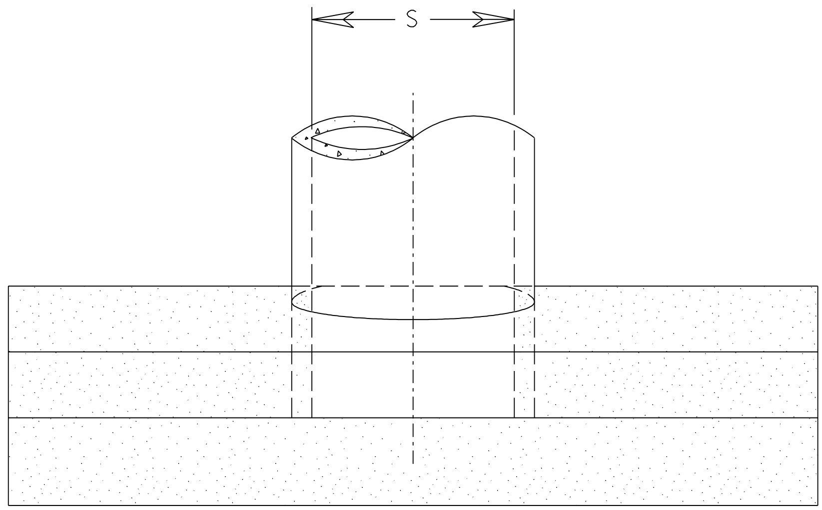
| | CONCRETE CU. YDS. | REINFORCING STEEL LBS. |
|---|---|---|
| 14. Minimum Height Quantities | | |
| 15. (Line 13 less Min. Height) x increment per foot | | None |
| 16. Quantities for tower (Add Lines 14 & 15) | | |
| 17. Quantities for Chamber (Line 12) | | |
| 18. Total Concrete and Reinforcing Steel (Add Lines 16 & 17) | | |

STRUCTURAL STEEL QUANTITY (Lbs.) ______

DISPLACEMENT QUANTITIES FOR PIPE OPENINGS
(To be used with Standard JB-1 Junction Box)

| PIPE SIZE | PIPE CLASS | CONCRETE 0° CU. YDS. | CONCRETE 15° CU. YDS. | CONCRETE 30° CU. YDS. | CONCRETE 45° CU. YDS. | REINFORCING STEEL LBS. |
|---|---|---|---|---|---|---|
| 12" | III, IV, V | 0.035 | 0.036 | 0.040 | 0.050 | 17.67 |
| | C. M. | 0.019 | 0.020 | 0.022 | 0.027 | 11.06 |
| 15" | III, IV, V | 0.050 | 0.052 | 0.058 | 0.071 | 24.88 |
| | C. M. | 0.030 | 0.031 | 0.034 | 0.042 | 15.93 |
| 18" | III, IV, V | 0.069 | 0.072 | 0.080 | 0.099 | 33.23 |
| | C. M. | 0.043 | 0.044 | 0.049 | 0.061 | 21.68 |
| 24" | III, IV, V | 0.118 | 0.122 | 0.137 | 0.168 | 53.53 |
| | C. M. | 0.076 | 0.078 | 0.087 | 0.108 | 35.83 |
| 30" | III, IV, V | 0.179 | 0.186 | 0.208 | 0.256 | 78.64 |
| | C. M. | 0.118 | 0.122 | 0.137 | 0.168 | 53.53 |
| 36" | III, IV, V | 0.254 | 0.263 | 0.294 | 0.362 | 108.76 |
| | C. M. | 0.170 | 0.176 | 0.197 | 0.242 | 74.76 |
| 42" | III, IV, V | 0.341 | 0.353 | 0.395 | 0.486 | 143.33 |
| | C. M. | 0.231 | 0.240 | 0.268 | 0.330 | 99.53 |
| 48" | III, IV, V | 0.441 | 0.457 | 0.511 | 0.629 | 182.90 |
| | C. M. | 0.302 | 0.313 | 0.350 | 0.431 | 127.85 |
| 54" | III & IV | 0.554 | 0.574 | 0.642 | 0.789 | 227.29 |
| | V | 0.580 | 0.600 | 0.672 | 0.826 | 237.42 |
| | C. M. | 0.382 | 0.396 | 0.443 | 0.545 | 159.70 |
| 60" | III & IV | 0.679 | 0.704 | 0.787 | 0.965 | 276.49 |
| | V | 0.708 | 0.734 | 0.821 | 1.009 | 287.65 |
| | C. M. | 0.472 | 0.481 | 0.551 | 0.673 | 195.09 |
| 66" | III & IV | 0.818 | 0.847 | 0.948 | 1.166 | 330.50 |
| | V | 0.849 | 0.880 | 0.985 | 1.211 | 342.70 |
| | C. M. | 0.571 | 0.591 | 0.662 | 0.814 | 234.02 |
| 72" | III & IV | 0.969 | 1.004 | 1.123 | 1.382 | 389.34 |
| | V | 1.003 | 1.040 | 1.163 | 1.431 | 402.58 |
| | C. M. | 0.679 | 0.704 | 0.787 | 0.969 | 276.49 |

**FIGURE D-1 COMPUTATIONS FOR STANDARD JB-1 JUNCTION BOX**
**TABLE D-15 ADJUSTMENT QUANTITIES FOR JUNCTION BOX**




**PLAN VIEW**

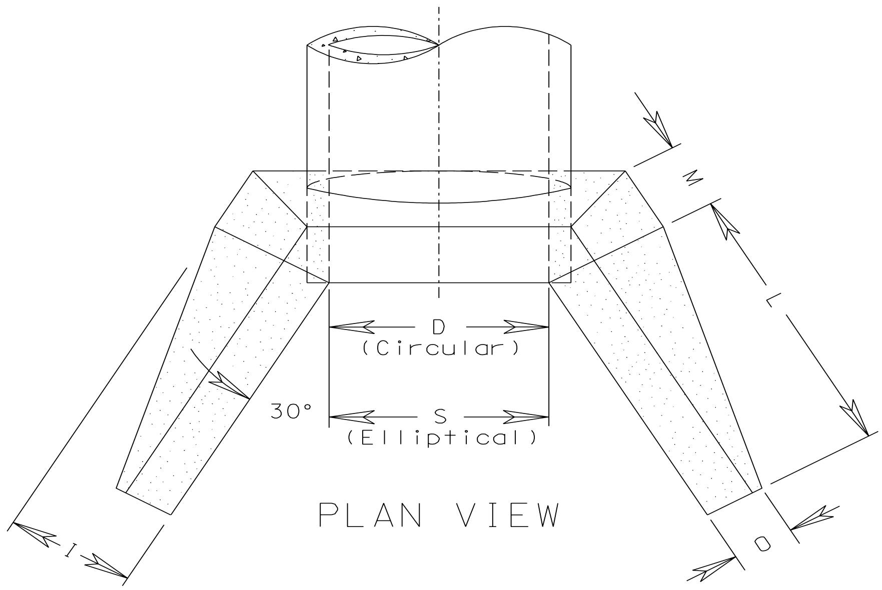
Area for computing ratio

| STANDARD | (S) Span of Culvert (inches) | Area (A) Conc or C. M. Sq. Ft. |
|---|---|---|
| EW-1A | 49 | 24.40 |
| | 53 | 27.06 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| TO DETERMINE RATIO | $\dfrac{A}{\text{S (in feet)} \times \text{Length of Culvert}}$ |
|---|---|

**TABLE D-16 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-1A**




Area for computing ratio

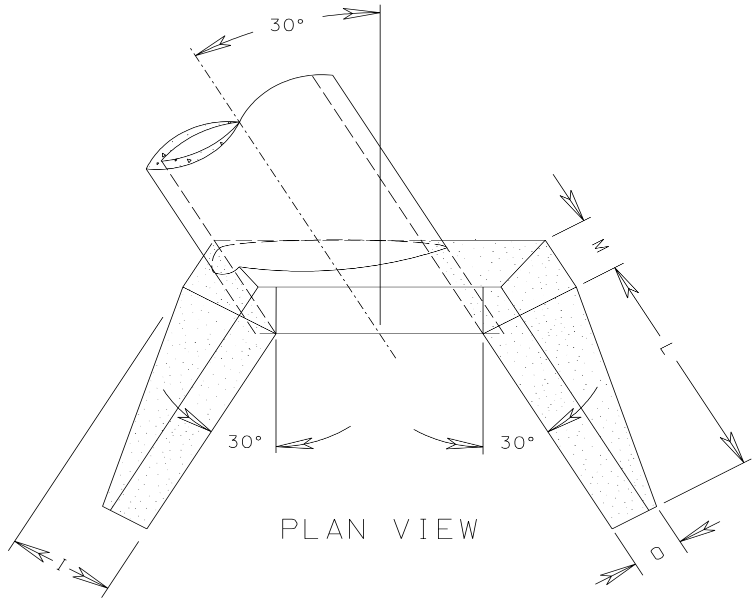
| (D) Diameter of Culvert (inches) | Area (A) | |
|---|---|---|
| | 1 ½ : 1 Slope | 2 : 1 Slope |
| | Sq. Ft. | Sq. Ft. |
| 48 | 27.31 | 33.95 |
| 54 | 33.43 | 41.64 |
| 60 | 40.07 | 50.05 |
| 66 | 47.38 | 59.29 |
| 72 | 55.29 | 69.25 |
| 78 | 63.74 | 80.00 |
| 84 | 72.80 | 91.55 |

| (S) Span of Culvert (inches) | Area (A) | |
|---|---|---|
| | 1 ½ : 1 Slope | 2 : 1 Slope |
| | Sq. Ft | Sq. Ft |
| 60 | 23.31 | 28.88 |
| 68 | 23.31 | 28.88 |
| 76 | 27.31 | 33.95 |
| 83 | 33.43 | 41.64 |
| 91 | 40.07 | 50.05 |
| 98 | 47.38 | 59.29 |
| 106 | 55.29 | 69.25 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| TO DETERMINE RATIO | $\dfrac{A}{\text{D or S (in feet)} \times \text{Length of Culvert}}$ |
|---|---|

**TABLE D-17 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARDS EW-2, EW-2A**



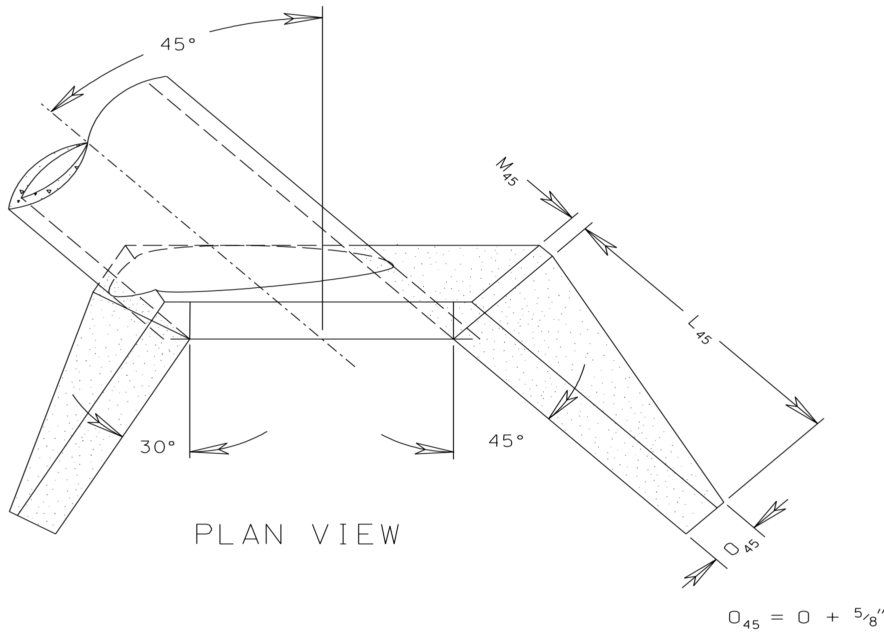

Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) | |
|---|---|---|
| | 1 ½ : 1 Slope Sq. Ft. | 2 : 1 Slope Sq. Ft. |
| 48 | 27.31 | 33.95 |
| 54 | 33.43 | 41.64 |
| 60 | 40.07 | 50.05 |
| 66 | 47.38 | 59.29 |
| 72 | 55.29 | 69.25 |
| 78 | 63.74 | 80.00 |
| 84 | 72.80 | 91.55 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{D \text{ (in feet)} \times \text{Length of Culvert}}$ |

**TABLE D-18 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-2S (30º )**



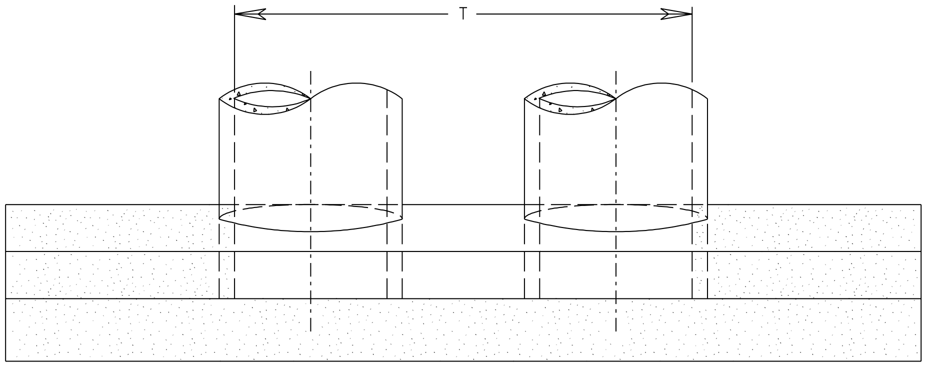

Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) | |
|---|---|---|
| | 1 ½ : 1 Slope | 2 : 1 Slope |
| | Sq. Ft. | Sq. Ft. |
| 48 | 32.23 | 40.50 |
| 54 | 39.37 | 49.45 |
| 60 | 47.31 | 59.51 |
| 66 | 55.90 | 70.43 |
| 72 | 65.20 | 82.30 |
| 78 | 75.25 | 95.11 |
| 84 | 85.96 | 108.84 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{D \text{ (in feet) } \times \text{ Length of Culvert}}$ |

**TABLE D-19 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-2S (45º )**




**PLAN VIEW**

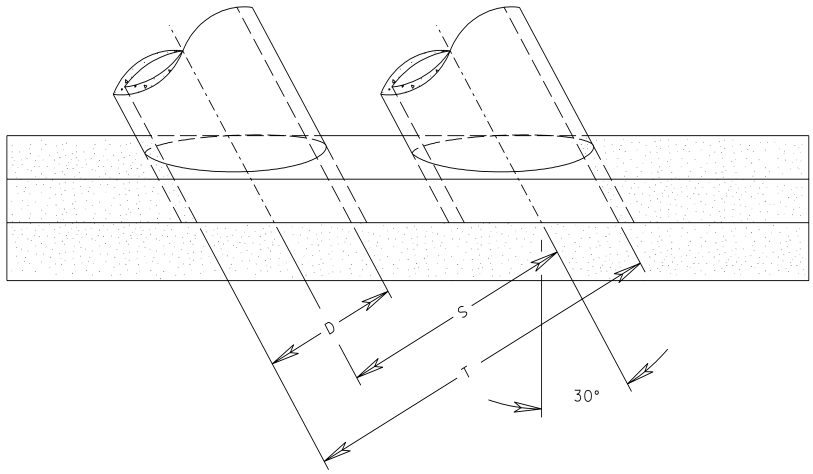
Area for computing ratio

| (D) Diameter of Culvert (inches | Area (A) | | | | | |
|---|---|---|---|---|---|---|
| | Double Line | | Triple Line | | Quadruple Line | |
| | Conc. | C.M. | Conc. | C.M. | Conc. | C.M. |
| | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. |
| 15 | | | 8.18 | 8.52 | 9.94 | 9.50 |
| 18 | 9.96 | 9.79 | 11.29 | 10.96 | 12.63 | 12.13 |
| 24 | 16.67 | 16.39 | 19.00 | 18.44 | 21.33 | 20.50 |
| 30 | 23.88 | 23.50 | 27.13 | 26.38 | 30.38 | 29.25 |
| 36 | 30.88 | 30.44 | 34.75 | 33.88 | 38.63 | 37.31 |
| | Culvert Width (T) | | | | | |
| | Feet | Feet | Feet | Feet | Feet | Feet |
| 15 | | | 5.75 | 5.17 | 8.00 | 7.13 |
| 18 | 4.17 | 3.83 | 6.83 | 6.17 | 9.50 | 8.50 |
| 24 | 5.50 | 5.08 | 9.00 | 8.17 | 12.50 | 11.25 |
| 30 | 6.83 | 6.33 | 11.17 | 10.17 | 15.50 | 14.00 |
| 36 | 8.17 | 7.58 | 13.33 | 12.17 | 18.50 | 16.75 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{\text{T (in feet)} \times \text{Length of Culvert}}$ |

**TABLE D-20 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-6**




**PLAN VIEW**

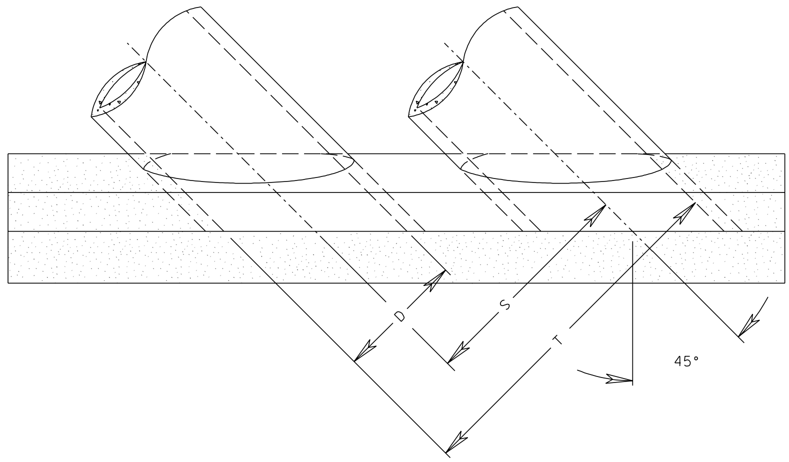
Area for computing ratio

| (D) Diameter of Culvert (inches | Area (A) | | | | | |
|---|---|---|---|---|---|---|
| | Double Line | | Triple Line | | Quadruple Line | |
| | Conc. | C.M. | Conc. | C.M. | Conc. | C.M. |
| | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. |
| 15 | | | 8.94 | 8.61 | 10.23 | 9.74 |
| 18 | 9.88 | 9.69 | 11.43 | 11.04 | 12.98 | 12.40 |
| 24 | 16.56 | 16.25 | 19.26 | 18.63 | 21.95 | 21.00 |
| 30 | 23.69 | 23.27 | 27.44 | 26.59 | 31.18 | 29.91 |
| 36 | 30.44 | 30.04 | 34.81 | 34.01 | 39.17 | 37.97 |
| | Culvert Width (T) | | | | | |
| | Feet | Feet | Feet | Feet | Feet | Feet |
| 15 | | | 5.75 | 5.17 | 8.00 | 7.13 |
| 18 | 4.17 | 3.83 | 6.83 | 6.17 | 9.50 | 8.50 |
| 24 | 5.50 | 5.08 | 9.00 | 8.17 | 12.50 | 11.25 |
| 30 | 6.83 | 6.33 | 11.17 | 10.17 | 15.50 | 14.00 |
| 36 | 8.17 | 7.58 | 13.33 | 12.17 | 18.50 | 16.75 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{\text{T (in feet) x Length of Culvert}}$ |

**TABLE D-21 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-6S (30º )**




**PLAN VIEW**

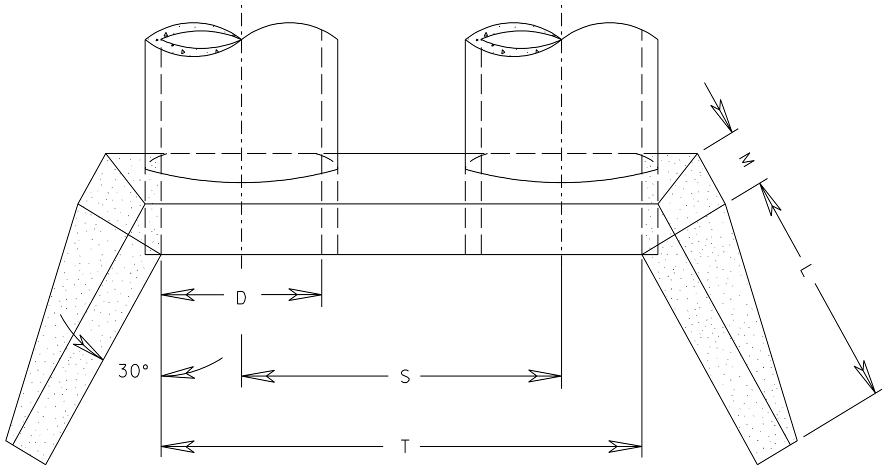
Area for computing ratio

| (D) Diameter of Culvert (inches | Area (A) | | | | | |
|---|---|---|---|---|---|---|
| | Double Line | | Triple Line | | Quadruple Line | |
| | Conc. | C.M. | Conc. | C.M. | Conc. | C.M. |
| | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. | Sq. Ft. |
| 15 | | | 9.17 | 8.78 | 10.75 | 10.16 |
| 18 | 9.73 | 9.50 | 11.62 | 11.16 | 13.50 | 12.81 |
| 24 | 16.39 | 16.01 | 19.68 | 18.92 | 22.98 | 21.84 |
| 30 | 23.40 | 22.87 | 27.99 | 26.92 | 32.58 | 30.98 |
| 36 | 29.98 | 29.37 | 35.45 | 34.22 | 40.92 | 39.08 |
| | Culvert Width (T) | | | | | |
| | Feet | Feet | Feet | Feet | Feet | Feet |
| 15 | | | 5.75 | 5.17 | 8.00 | 7.13 |
| 18 | 4.17 | 3.83 | 6.83 | 6.17 | 9.50 | 8.50 |
| 24 | 5.50 | 5.08 | 9.00 | 8.17 | 12.50 | 11.25 |
| 30 | 6.83 | 6.33 | 11.17 | 10.17 | 15.50 | 14.00 |
| 36 | 8.17 | 7.58 | 13.33 | 12.17 | 18.50 | 16.75 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{\text{T (in feet)} \times \text{Length of Culvert}}$ |

**TABLE D-22 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-6S (45º)**




**PLAN VIEW**

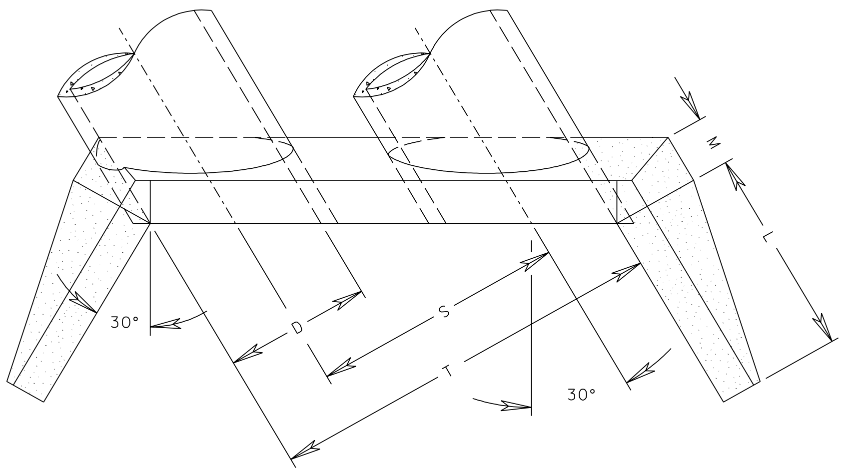
Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) | | Culvert width (T) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 ½ : 1 Slope | 2 :1 Slope | Double Line | | Triple Line | | Quadruple Line | |
| | | | Conc. | C.M. | Conc. | C.M. | Conc. | C.M. |
| | Sq. Ft. | Sq. Ft. | Feet | Feet | Feet | Feet | Feet | Feet |
| 42 | 23.31 | 28.88 | 9.50 | 8.79 | 15.50 | 14.08 | 21.50 | 19.37 |
| 48 | 27.31 | 33.95 | 10.83 | 10.04 | 17.67 | 16.08 | 24.50 | 22.12 |
| 54 | 33.43 | 41.64 | 12.17 | 11.29 | 19.83 | 18.08 | 27.50 | 24.87 |
| 60 | 40.07 | 50.05 | 13.50 | 12.54 | 22.00 | 20.08 | 30.50 | 27.62 |
| 66 | 47.38 | 59.29 | 14.83 | 13.79 | 24.17 | 22.08 | 33.50 | 30.37 |
| 72 | 55.29 | 69.25 | 16.17 | 15.04 | 26.33 | 24.08 | 36.50 | 33.12 |
| 78 | 63.74 | 80.00 | 17.50 | 16.29 | 28.50 | 26.08 | 39.50 | 35.87 |
| 84 | 72.80 | 91.55 | 18.83 | 17.54 | 30.67 | 28.08 | 42.50 | 38.62 |
| | | | | | | | | |

Area is given for one endwall.
Double area shown if two endwalls are used.

| | |
|---|---|
| TO DETERMINE RATIO | $\frac{A}{\text{T (in feet)} \times \text{Length of Culvert}}$ |

**TABLE D-23 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-7S**




**PLAN VIEW**

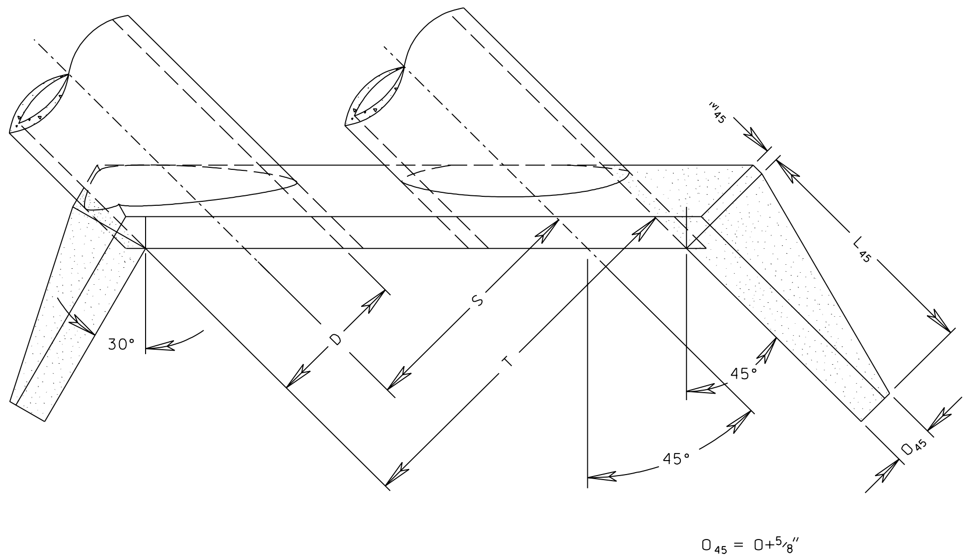
Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) | | Culvert width (T) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 ½ : 1 Slope | 2 :1 Slope | Double Line | | Triple Line | | Quadruple Line | |
| | | | Conc. | C.M. | Conc. | C.M. | Conc. | C.M. |
| | Sq. Ft. | Sq. Ft. | Feet | Feet | Feet | Feet | Feet | Feet |
| 42 | 23.31 | 28.88 | 9.50 | 8.79 | 15.50 | 14.08 | 21.50 | 19.37 |
| 48 | 27.31 | 33.95 | 10.83 | 10.04 | 17.67 | 16.08 | 24.50 | 22.12 |
| 54 | 33.43 | 41.64 | 12.17 | 11.29 | 19.83 | 18.08 | 27.50 | 24.87 |
| 60 | 40.07 | 50.05 | 13.50 | 12.54 | 22.00 | 20.08 | 30.50 | 27.62 |
| 66 | 47.38 | 59.29 | 14.83 | 13.79 | 24.17 | 22.08 | 33.50 | 30.37 |
| 72 | 55.29 | 69.25 | 16.17 | 15.04 | 26.33 | 24.08 | 36.50 | 33.12 |
| 78 | 63.74 | 80.00 | 17.50 | 16.29 | 28.50 | 26.08 | 39.50 | 35.87 |
| 84 | 72.80 | 91.55 | 18.83 | 17.54 | 30.67 | 28.08 | 42.50 | 38.62 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| TO DETERMINE RATIO | $\dfrac{A}{\text{T (in feet)} \times \text{Length of Culvert}}$ |
|---|---|

**TABLE D-24 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-7S (30º)**




**PLAN VIEW**

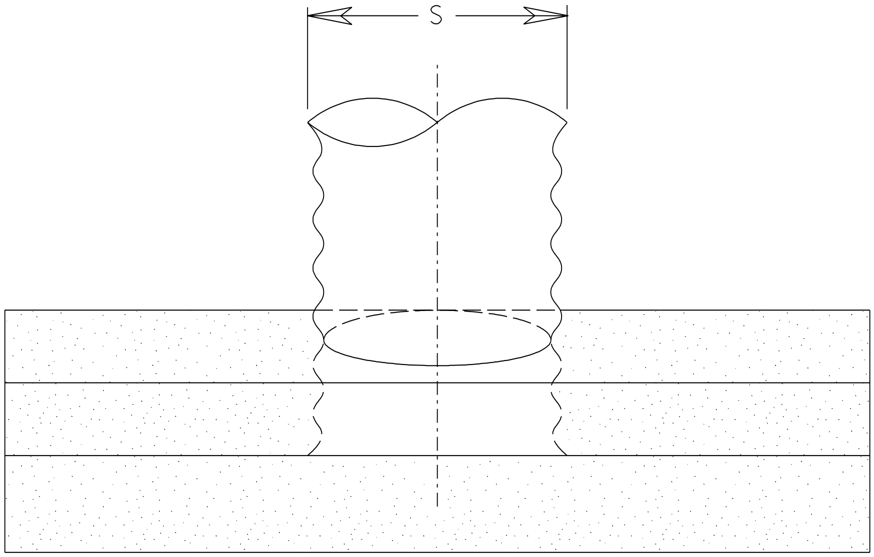
Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) | | Culvert width (T) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 ½ : 1 Slope | 2 :1 Slope | Double Line | | Triple Line | | Quadruple Line | |
| | | | Conc. | C.M. | Conc. | C.M. | Conc. | C.M. |
| | Sq. Ft. | Sq. Ft. | Feet | Feet | Feet | Feet | Feet | Feet |
| 42 | 27.37 | 34.10 | 9.50 | 8.79 | 15.50 | 14.08 | 21.50 | 19.37 |
| 48 | 32.23 | 40.50 | 10.83 | 10.04 | 17.67 | 16.08 | 24.50 | 22.12 |
| 54 | 39.37 | 49.45 | 12.17 | 11.29 | 19.83 | 18.08 | 27.50 | 24.87 |
| 60 | 47.31 | 59.51 | 13.50 | 12.54 | 22.00 | 20.08 | 30.50 | 27.62 |
| 66 | 55.90 | 70.43 | 14.83 | 13.79 | 24.17 | 22.08 | 33.50 | 30.37 |
| 72 | 65.20 | 82.30 | 16.17 | 15.04 | 26.33 | 24.08 | 36.50 | 33.12 |
| 78 | 75.25 | 95.11 | 17.50 | 16.29 | 28.50 | 26.08 | 39.50 | 35.87 |
| 84 | 85.96 | 108.84 | 18.83 | 17.54 | 30.67 | 28.08 | 42.50 | 38.62 |

Area is given for one endwall.
Double area shown if two endwalls are used.

| TO DETERMINE RATIO | $\frac{A}{T \text{ (in feet)} \times \text{Length of Culvert}}$ |
|---|---|

**TABLE D-25 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-7S (45º)**




**PLAN VIEW**

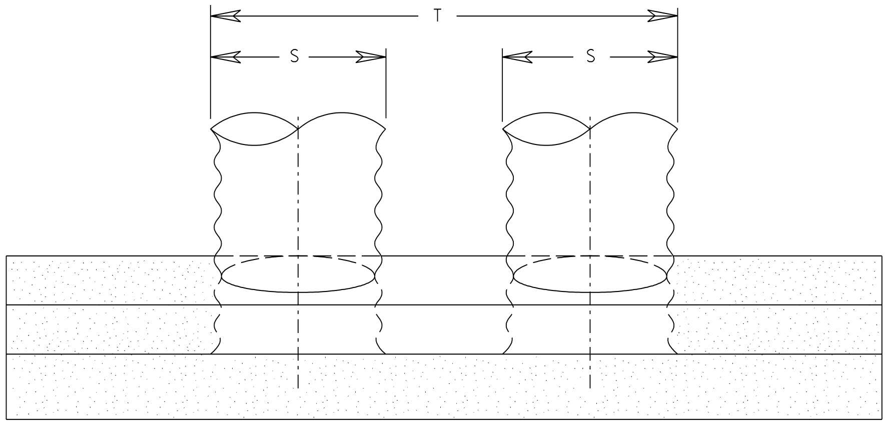
Area for computing ratio

| (S) Span of Culvert (inches) | Area (A) Sq. Ft. |
|---|---|
| 49 | 22.65 |
| *46 | 23.08 |
| 57 | 28.54 |
| *53 | 29.21 |

Area is given for one endwall.
Double area shown if two endwalls are used
* 3"x1" corrugation dimension.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{S \text{ (in feet)} \times \text{Length of Culvert}}$ |

**TABLE D-26 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-9**




**PLAN VIEW**

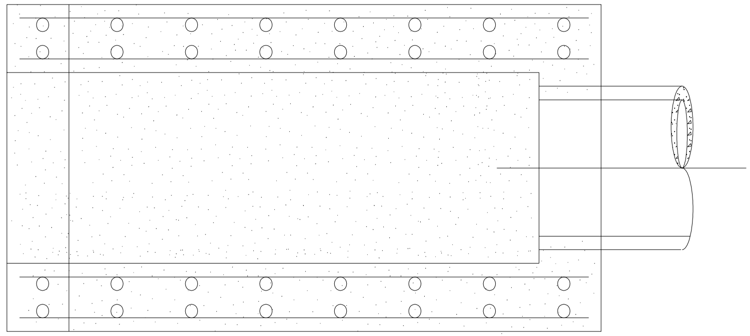
Area for computing ratio

| (S) Span of Culvert (inches | Area (A) | | | Culvert Width (T) | | |
|---|---|---|---|---|---|---|
| | Double Line | Triple Line | Quadruple Line | Double Line | Triple Line | Quadruple Line |
| | Sq. Ft. | Sq. Ft | Sq. Ft | Feet | Feet | Feet |
| 21 | 6.47 | 7.65 | 8.83 | 4.58 | 7.42 | 10.25 |
| 24 | 8.93 | 10.34 | 11.75 | 5.08 | 8.17 | 11.25 |
| 28 | 11.04 | 12.75 | 14.46 | 5.75 | 9.17 | 12.58 |
| 35 | 16.71 | 19.38 | 22.04 | 6.92 | 10.92 | 14.92 |
| 42 | 23.33 | 26.96 | 30.58 | 8.33 | 13.17 | 18.00 |
| *40 | 23.63 | 27.25 | 30.88 | 8.17 | 13.00 | 17.83 |
| 49 | 27.04 | 31.23 | 35.42 | 9.67 | 15.25 | 20.83 |
| *46 | 27.48 | 31.67 | 35.85 | 9.42 | 15.00 | 20.58 |
| 57 | 33.42 | 38.29 | 43.17 | 11.25 | 17.75 | 24.25 |
| *53 | 34.08 | 38.96 | 43.83 | 10.92 | 17.42 | 23.92 |
| | | | | | | |

Area is given for one endwall.
Double area shown if two endwalls are used
* 3”x1” corrugation dimension.

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{A}{T \text{ (in feet) } \times \text{ Length of Culvert}}$ |

**TABLE D-27 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-10**



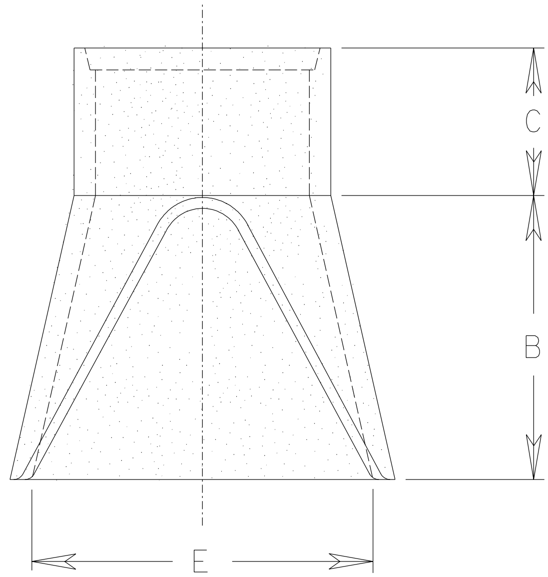
**PLAN VIEW**

Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) | | |
|---|---|---|---|
| | 3:1 Slope | 4:1 Slope | 6:1 Slope |
| | Sq. Ft | Sq. Ft. | Sq. Ft |
| 48 | 114.42 | 150.00 | 221.17 |
| 54 | 143.83 | 188.83 | 278.83 |
| 60 | 156.33 | 205.67 | 304.33 |

| | |
|---|---|
| TO DETERMINE RATIO | $\dfrac{\text{A}}{\text{D (in feet)} \times \text{Length of Culvert}}$ |

**TABLE D-28 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD EW-11**




**PLAN VIEW**

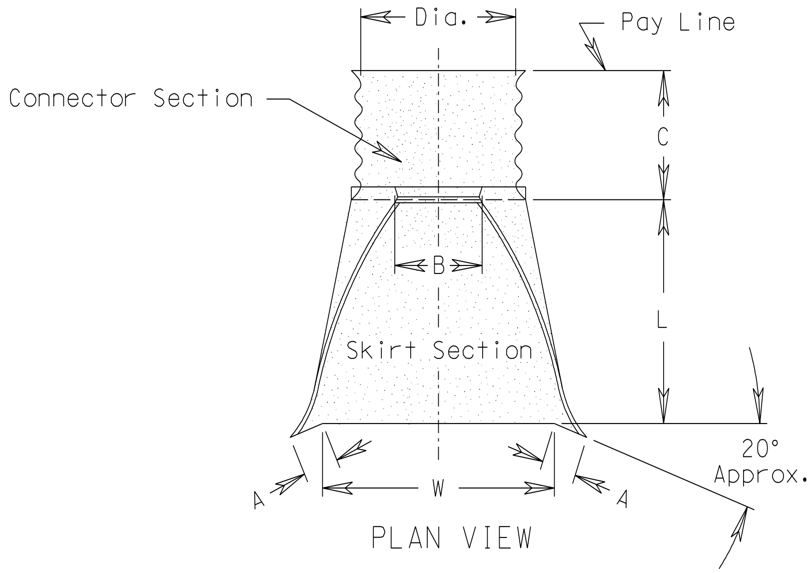
Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) |
|---|---|
| | Sq. Ft. |
| 48 | 48.47 |
| 54 | 52.47 |
| 60 | 57.00 |

Area is given for one endwall.
Double area shown if two endsections are used

| TO DETERMINE RATIO | $\dfrac{A}{D \text{ (in feet)} \times \text{Length of Culvert}}$ |
|---|---|

**TABLE D-29 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD ES-1**



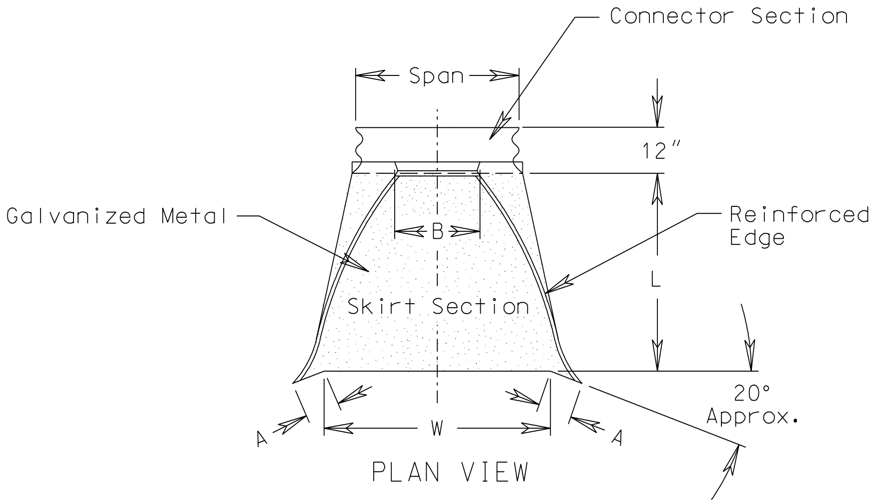

Area for computing ratio

| (D) Diameter of Culvert (inches) | Area (A) |
|---|---|
| | Sq. Ft. |
| 48 | 53.64 |
| 54 | 67.84 |
| 60 | 76.63 |

Area is given for one endwall.
Double area shown if two endsections are used

| TO DETERMINE RATIO | $\dfrac{A}{D \text{ (in feet)} \times \text{Length of Culvert}}$ |
|---|---|

**TABLE D-30 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD ES-2**




Area for computing ratio

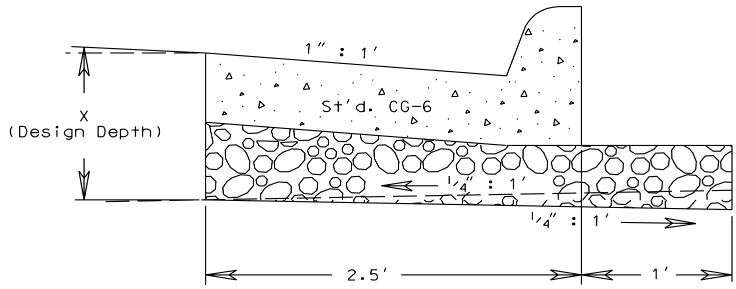
| (S) Span of Culvert (inches) | Area (A) 3" x 1" Corr. Sq. Ft. |
|---|---|
| 46 | 28.31 |
| 53 | 37.63 |
| 60 | 48.03 |
| 66 | 59.27 |

| (S) Span of Culvert (inches | Area (A) 2 2/3 " X !/2 " Corr. Sq. Ft |
|---|---|
| 49 | 28.92 |
| 57 | 38.58 |
| 64 | 49.07 |
| 71 | 60.70 |

Area is given for one end section.
Double area shown if two end sections are used

| TO DETERMINE RATIO | $\frac{A}{S \text{ (in feet) } \times \text{ Length of Culvert}}$ |
|---|---|

**TABLE D-31 COMPUTATION OF RATIOS FOR MINOR STRUCTURE EXCAVATION STANDARD ES-3**

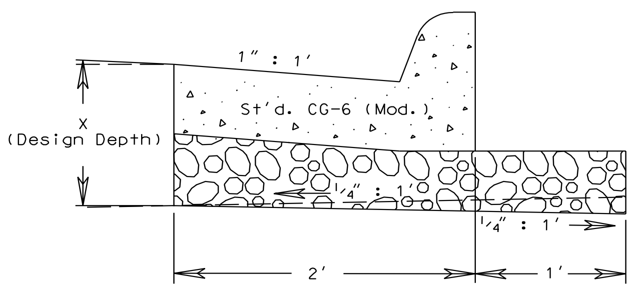



AREA

Normal = (3.5)(X) - 2.3542

Super = (3.5)(X) - 2.6094

2.5' CURB AND GUTTER



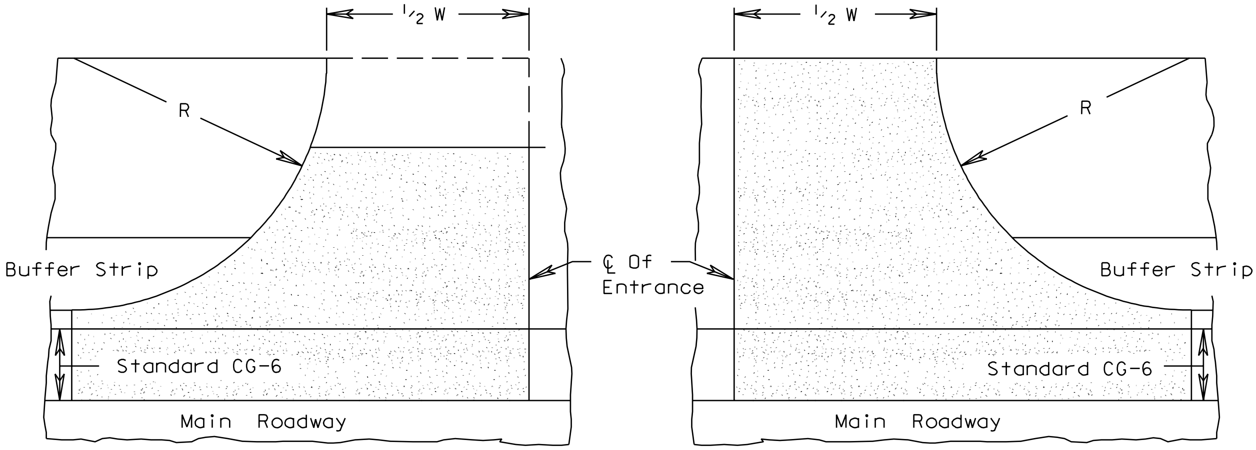

AREA

Normal = (3)(X) - 1.9609

Super = (3)(X) - 2.1484

2' CURB AND GUTTER

**FIGURE D-2 SUBBASE END AREAS AT CURB AND GUTTER LOCATION**




**HALF PLAN**
**AREA WITHOUT SIDEWALK**

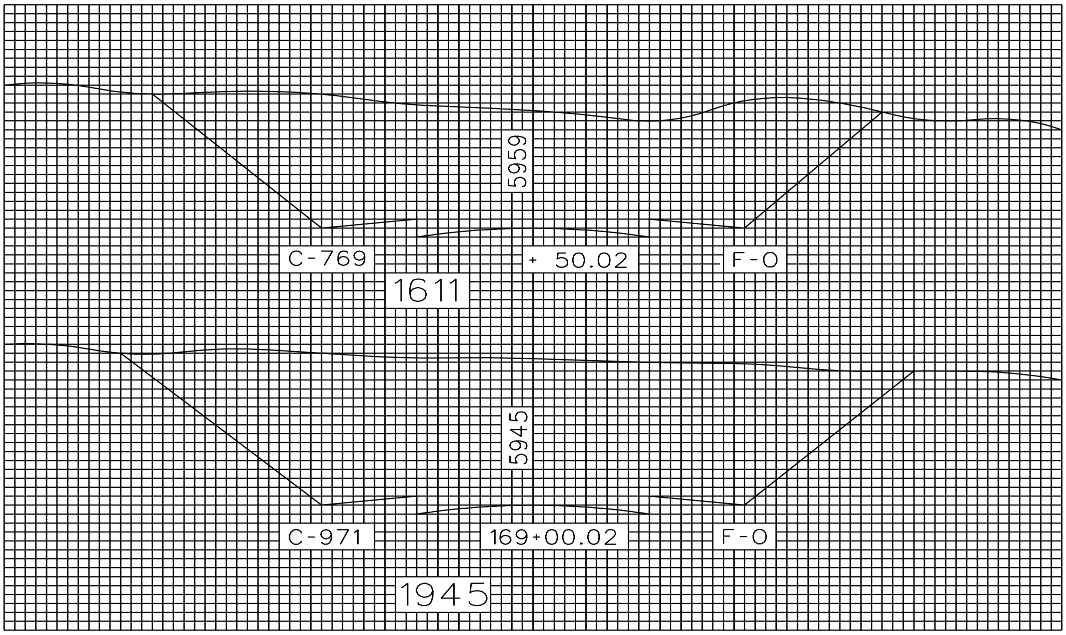
**HALF PLAN**
**AREA WITH SIDEWALK**

W= Width of Entrance

Area for computing ratio

| Width Of Entrance (Feet) | R = 6’ | | R = 7’ | | R = 8.5’ | |
|---|---|---|---|---|---|---|
| | 2’ Buffer Strip | | 2’ Buffer Strip | | 2’ Buffer Strip | |
| | Without Sidewalk | With 4’ Sidewalk | Without Sidewalk | With 5’ Sidewalk | Without Sidewalk | With 5’ Sidewalk |
| | Sq. Yds. | Sq. Yds. | Sq. Yds. | Sq. Yds. | Sq. Yds. | Sq. Yds. |
| 12 | 14.36 | 16.39 | 15.47 | 18.90 | 17.21 | 22.84 |
| 16 | 17.47 | 20.16 | 18.59 | 23.12 | 20.32 | 27.73 |
| 20 | 20.58 | 23.94 | 21.70 | 27.34 | 23.43 | 32.62 |
| 24 | 23.70 | 27.72 | 24.81 | 31.56 | 26.55 | 37.51 |
| 25 | 24.47 | 28.66 | 25.59 | 32.62 | 27.32 | 38.73 |
| 26 | 25.25 | 29.61 | 26.36 | 33.67 | 28.10 | 39.95 |
| 30 | 28.36 | 33.39 | 29.47 | 37.89 | 31.21 | 44.84 |
| 36 | 33.03 | 39.05 | 34.14 | 44.23 | 35.88 | 52.17 |
| 40 | 36.14 | 42.83 | 37.25 | 48.45 | 38.99 | 57.06 |
| 42 | 37.70 | 44.72 | 38.81 | 50.56 | 40.55 | 59.50 |
| 44 | 39.25 | 46.61 | 40.36 | 52.67 | 42.10 | 61.95 |
| 48 | 42.36 | 50.39 | 43.47 | 56.89 | 45.21 | 66.84 |
| 50 | 43.92 | 52.28 | 45.03 | 59.01 | 46.77 | 69.29 |
| Each Additional Foot | 0.778 | 0.944 | 0.778 | 1.056 | 0.778 | 1.222 |

**TABLE D-32 AREAS FOR ENTRANCE GUTTER STANDARD CG-9D**




The cut area of station 163+00.02 is 971 square feet, and the area of station 169+50.02 is 769 square feet. To find the average area of the two, we would add the two and divide by two.

Thus, $\frac{971+769}{2} = \frac{1740}{2} = 870$ Sq. Ft. (average)

Now we must find the volume of the area between the two stations. The cross section has an average of 870 square feet and there is 50 feet between stations. Therefore, 870 multiplied by 50 equals 43,500 cubic feet to be removed from between these stations.

In order to arrive at 1611 cubic yards (this is the unit used as a basis of payment in earthwork) we divide the 43,500 cubic feet by 27, since there are twenty-seven cubic feet in one cubic yard.

The formula used to determine the volume of earthwork is called the AVERAGE END AREA METHOD and is noted below. Examine it closely.

$$\text{Volume} = \frac{L\ (A' + A'')}{2 \times 27}$$

L = distance between stations
A' = area of one station
A'' = area of second station
2 gets the average of A' & A''
27 converts cubic feet to cubic yards

EXAMPLE

$$\text{Volume} = \frac{50\ (971 + 769)}{2 \times 27} = 1611$$

**FIGURE D-4 EARTHWORK QUANTITY COMPUTATIONS**

# ROAD DESIGN MANUAL, VOLUME 1

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