



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

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July 17, 2002

TO: 2002 ROADWAY DESIGN MANUAL HOLDERS

**FROM: VICTOR BARBOUR, P. E.
STATE DESIGN SERVICES ENGINEER**

**SUBJECT: REVISED AND NEW GUIDELINES FOR
THE 2002 ROADWAY DESIGN MANUAL**

EFFECTIVE DATE: July 17, 2002

The following are The Revisions and New Guidelines to Part I and Part II of the Roadway Design Manual. Please insert these Revisions in your Manual in the appropriate place. These Revisions are to become effective immediately. The 2002 Roadway Design Manual on the web site has already been updated.

REVISION NO. 1

Part I - Roadway Design Manual

1. Chapter 1 - Section 4-O NCDOT Paved Shoulder Policy

NOTE: Freeway projects that have ADT greater than or equal to 15,000 ADT, should be designed for 10 foot-paved shoulders on the outside and four-foot paved shoulders in the median.

For Freeway projects with less than 15,000 ADT, you should design for four foot-paved shoulders on the outside and four-foot paved shoulders in the median.

REV. DATE 07/17/02

The ADT was reduced from 40,000 to 15,000 to better reflect changes in "A Policy on Geometric Design of Highways and Streets" and stay within the FHWA's recommendations.

2. Chapter 1 - Section 4-P Guidelines For Sensory Warning Treatment For Paved Shoulders

NOTE: Roadway Standard Drawings, Std. Nos. changed to Reflect the correct Standards.

3. Chapter 5 - Section 13 Median Drop Inlets

NOTE: General Update.

4. Chapter 9 - Section 1, Figure 1 & 2 "Bulb" Type Channelization

NOTE: The Deltas have been removed and replaced with stations.

Part II - Roadway Design Manual

5. Chapter 12 - Section 4, Figure 1 Design of Onsite Detours and Median Crossovers

NOTE: The Clear roadway behind the face of the guardrail changed from 3' to 2'.

6. Chapter 19 - Section 3, Figure 1 Shrinkage Factors

NOTE: Regions and percentages have been redefined.

7. Chapter 21 - Section 2, Figure 1 - Preparation of Public Hearing Maps Legend

NOTE: Color chart reissued to reflected the correct colors.

If you have any questions/comments about this revision or suggestions about any other that should be revised/added to the Roadway Design Manual, Please contact Robert McKeithan (rmckeithan@dot.state.nc.us) or Robert Prince (rprince@dot.state.nc.us) of the Special Services Group, Design Services Unit at (919) 250-4128.

Attachment

REV. DATE 07/17/02

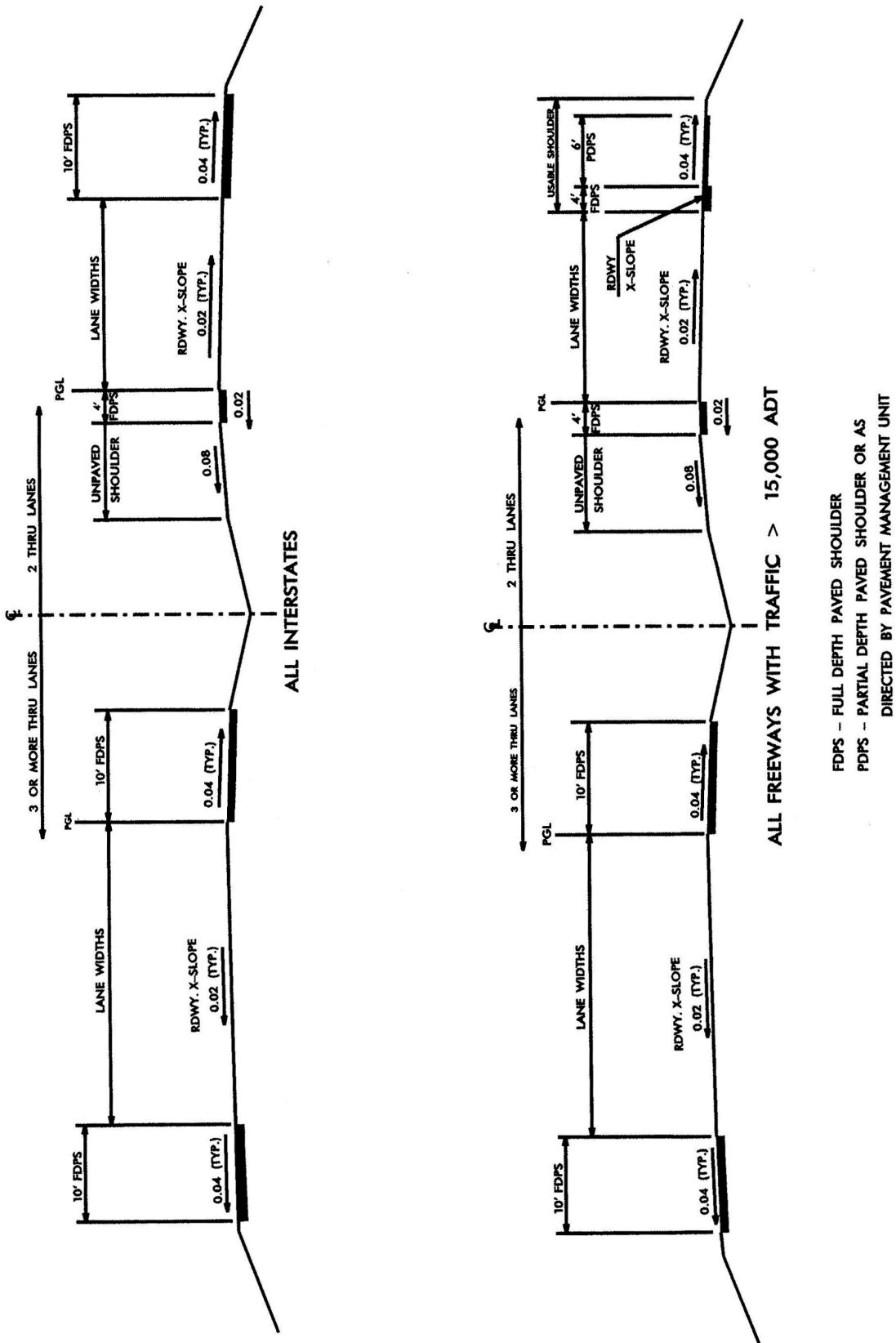
FIGURE 1

NCDOT PAVED SHOULDER POLICY	
INTERSTATE AND FRIEWAYS 6 OR MORE LANES	10' WIDE PAVED OUTSIDE SHOULDERS & 10' WIDE PAVED MEDIAN SHOULDERS (FULL DEPTH OR AS DIRECTED BY THE PAVEMENT MANAGEMENT UNIT.)
INTERSTATE 4 LANES	10' WIDE PAVED OUTSIDE SHOULDERS (FULL DEPTH OR AS DIRECTED BY THE PAVEMENT MANAGEMENT UNIT.) 4' WIDE FULL DEPTH PAVED MEDIAN SHOULDERS (REMAINING WIDTH TO BE TURF.)
FREEWAYS 4 LANES (DES. YR. ADT ≥ 150000)	10' WIDE PAVED OUTSIDE SHOULDERS (4' OF WIDTH TO BE FULL DEPTH, REMAINING PAVED WIDTH TO BE SURFACE COURSE ON ABC, OR AS DIRECTED BY THE PAVEMENT MANAGEMENT UNIT.) 4' WIDE FULL DEPTH PAVED MEDIAN SHOULDERS (REMAINING WIDTH TO BE TURF.)
(DES. YR. ADT < 150000)	4' WIDE OUTSIDE AND 4' WIDE MEDIAN FULL DEPTH PAVED SHOULDERS. (REMAINING SHOULDER WIDTH TO BE TURF)
<u>DIVIDED:</u> ARTERIALS, COLLECTORS 6 OR MORE LANES	10' WIDE PAVED OUTSIDE SHOULDERS (4' OF WIDTH TO BE FULL DEPTH, REMAINING PAVED WIDTH TO BE SURFACE COURSE ON ABC OR AS DIRECTED BY THE PAVEMENT MANAGEMENT UNIT.) 4' WIDE FULL DEPTH PAVED MEDIAN SHOULDER. SEE NOTE 7.
<u>DIVIDED:</u> ARTERIALS, COLLECTORS 4 LANES (DES. YR. ADT ≥ 400000)	10' WIDE PAVED OUTSIDE SHOULDERS (4' OF WIDTH TO BE FULL DEPTH, REMAINING PAVED WIDTH TO BE SURFACE COURSE ON ABC OR AS DIRECTED BY PAVEMENT MANAGEMENT.) 4' WIDE FULL DEPTH PAVED MEDIAN SHOULDERS (REMAINING MEDIAN SHOULDER WIDTH TO BE TURF).
(DES. YR. ADT < 400000)	4' WIDE OUTSIDE & 2' WIDE MEDIAN FULL DEPTH PAVED SHOULDERS. (REMAINING SHOULDER WIDTH TO BE TURF)
<u>MULTILANE UNDIVIDED:</u> 4 OR MORE LANES (DES. YR. ADT ≥ 400000)	10' WIDE PAVED SHOULDERS (4' OF WIDTH TO BE FULL DEPTH. REMAINING PAVED WIDTH TO BE SURFACE COURSE ON ABC, OR AS DIRECTED BY THE PAVEMENT MANAGEMENT UNIT.)
(DES. YR. ADT < 400000)	4' WIDE FULL DEPTH PAVED SHOULDERS. (REMAINING SHOULDER WIDTH TO BE TURF).
<u>TWO LANE - TWO WAY :</u> (DES. YR. ADT ≥ 8000)	4' WIDE FULL DEPTH PAVED SHOULDERS. (REMAINING SHOULDER WIDTH TO BE TURF).
(DES. YR. ADT ≥ 4000)	2' WIDE FULL DEPTH PAVED SHOULDERS. (REMAINING SHOULDER WIDTH TO BE TURF).
(DES. YR. ADT < 4000)	FULL SHOULDER TO BE TURF. NOTE: 4' PAVED SHOULDER MAY BE CONSIDERED FOR BIKE ROUTES.
<u>RAMPS</u> LEFT SHOULDERS	4' WIDE FULL DEPTH PAVED SHOULDER (REMAINING SHOULDER WIDTH TO BE TURF).
RIGHT SHOULDERS	4' WIDE FULL DEPTH PAVED SHOULDER (REMAINING SHOULDER WIDTH TO BE TURF). SEE NOTE 5
<p>NOTES:</p> <ol style="list-style-type: none"> PAVED SHOULDER WIDTH SHOULD NOT EXCEED USABLE WIDTHS AS DEFINED IN ROADWAY DESIGN MANUAL EXCEPT AT GUARDRAIL LOCATIONS AS SHOWN IN STD. 862.01. A 12' WIDE PAVED OUTSIDE SHOULDER SHOULD BE CONSIDERED FOR INTERSTATES AND FREEWAYS HAVING TRUCK TRAFFIC WHICH EXCEEDS 250 DPHY. A 12' WIDE PAVED MEDIAN SHOULDER SHOULD BE CONSIDERED FOR THESE FAC. WHICH HAVE SIX OR MORE LANES AND TRUCK TRAFFIC WHICH EXCEEDS 250 DPHY. RUMBLE STRIPS, PAVEMENT TEXTURING OR OTHER APPROVED METHODS FOR IMPROVING TRUCK TIRE NOISE REDUCTION SHALL BE USED ON RURAL INTERSTATE AND FREEWAY SHOULDER SURFACES. MAINLINE PAVEMENT SURFACES FROM SHOULDER PAVEMENT TO SHOULDER PAVEMENT SHALL BE CONSIDERED AS ONE SURFACE. THE PAVEMENT MANAGEMENT UNIT SHALL DETERMINE THE PAVED SHOULDER DESIGN ON A PROJECT BY PROJECT BASIS. THE FULL USABLE SHOULDER WIDTH OF INDIVIDUAL RAMPS MAY BE PAVED IF A HISTORY OF EXCESSIVE SHOULDER USAGE IS APPARENT OR EXPECTED BASED UPON EXPERIENCE AT SIMILAR FACILITIES IN THE REGION. IF THE FULL USABLE SHOULDER WIDTH SHALL BE FULL DEPTH PAVED, THE PAVED SURFACE SHALL BE CONSIDERED AS ONE SURFACE. THE SURFACE COURSE ON ABC OR AS DIRECTED BY PAVEMENT MANAGEMENT UNIT. A RECOMMENDATION TO PAVE THE FULL USABLE WIDTH CAN BE MADE AT THE PROJECT FIELD INSPECTION AND IS TO BE APPROVED BY THE STATE ROADWAY DESIGN ENGINEER. THE FULL USABLE WIDTH OF AUXILIARY LANE SHOULDERS SHALL BE PAVED IF THE AUXILIARY LANE CONNECTS INTERCHANGES OR IS LONGER THAN 2500 FEET. 4' OF THE PAVED WIDTH SHALL BE FULL DEPTH PAVEMENT AND THE REMAINING PAVED WIDTH SHALL BE SURFACE COURSE ON ABC, OR AS DIRECTED BY THE PAVEMENT MANAGEMENT UNIT. CONSIDER 10' PAVED MEDIAN SHOULDERS FOR SPEEDS ≥ 55 MPH. 	

FIGURE 1

1 - 4 0

FIG - 1A

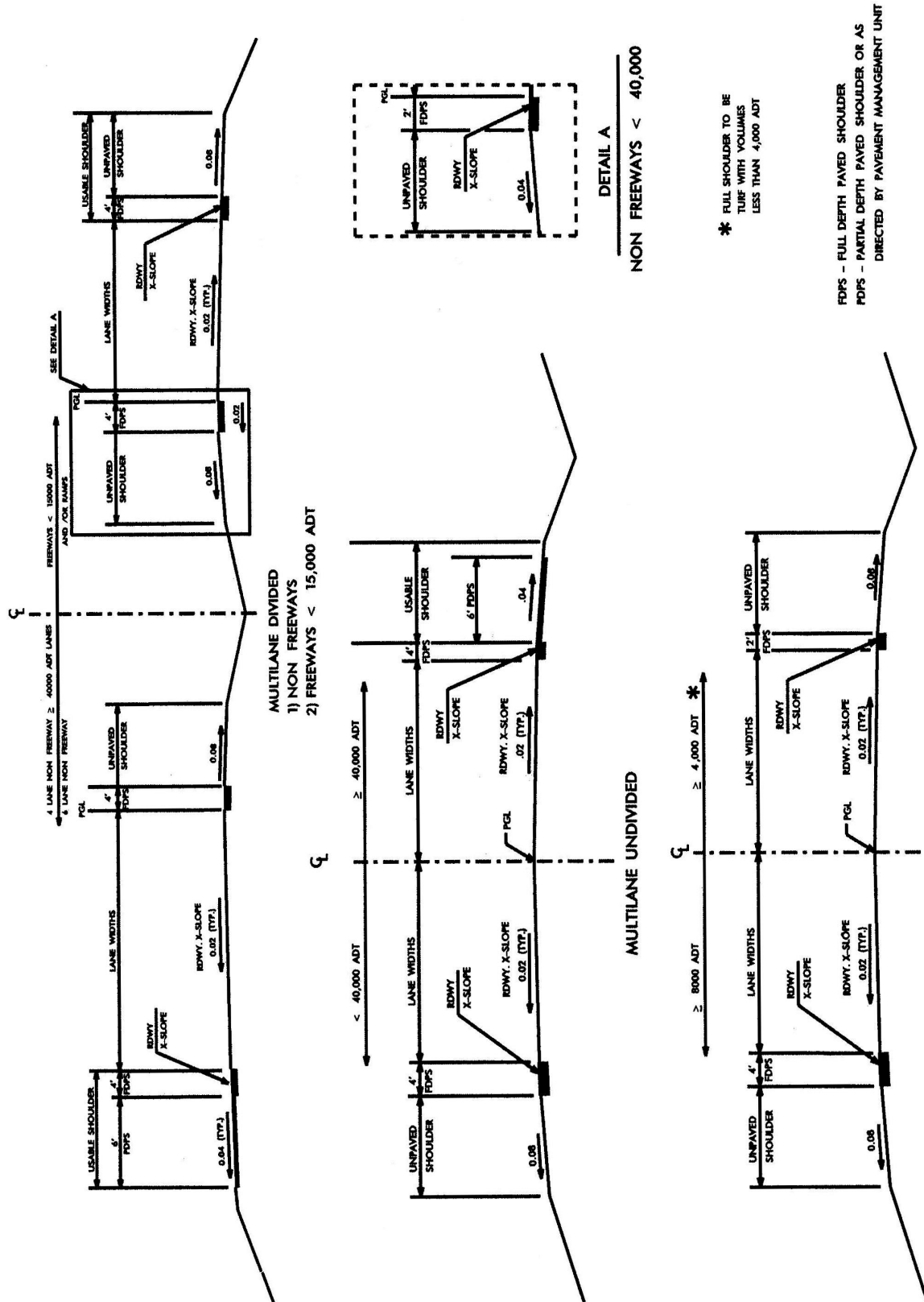


TYPICAL SHOULDER CROSS-SLOPES

FDPS - FULL DEPTH PAVED SHOULDER
PDPS - PARTIAL DEPTH PAVED SHOULDER OR AS
DIRECTED BY PAVEMENT MANAGEMENT UNIT

FIGURE 1

FIG - 1B



TYPICAL SHOULDER CROSS-SLOPES

**GUIDELINES FOR SENSORY WARNING TREATMENT
FOR PAVED SHOULDERS**

1-4P

The purpose of these guidelines is to provide the Highway Design Branch and Traffic Engineering and Safety Systems Branch operations procedure when using paved roadway shoulders. This policy provides guidelines for identifying sections of shoulders on Interstate and other Freeways where special surface treatments are desirable and would be cost-effective if the predicted value of reduced accident costs is considered. This policy also discusses different types of surface treatments and selection for various types and widths of paved shoulders.

It is the responsibility of the State Highway Design Engineer and the Director of Traffic Engineering and Safety Systems to ensure that the following guidelines are followed and applied consistently within their respective area of operation.

Generally, surface treatments should be used on the median shoulder and right shoulder at locations where surface treatments are desired. Shoulder surface treatment would not typically be required on median shoulders when paved medians and median barriers are used. It is not necessary to use the same surface treatment on the median and right shoulders. However, the most effective shoulder treatments available should be considered for paved shoulders having widths less than or equal to four feet because less time is available for inattentive drivers to recover on narrower paved shoulders. Surface treatments, which reduce the amount of concrete cover over steel reinforcement, are not recommended for shoulders on structures. Shoulder surface treatments would not typically be required on urban sections, which have good ambient lighting and where high levels of driver attention are required to operate vehicles.

Shoulder surface treatment will be used on interstates and rural freeways on both median and outside shoulders. In addition, major arterials in rural areas with low-density roadside development should be considered for shoulder surface treatment.

Approved surface treatments include the following:

A. Rumble strips

Rumble strips are sensory warning treatments that are located along the paved shoulders, which are used to alert motorists who leave the roadway travel lanes. These warning treatments are intended to alert the motorists before they cross the median or leave the roadway and strike roadside barriers or roadside hazards.

**GUIDELINES FOR SENSORY WARNING TREATMENT
FOR PAVED SHOULDERS (continued)**

1-4P

Rumble strips are to be used on the following roadways:Interstate through routes

Rural Freeway Segments

Expressway segments that are located in sparsely developed rural areas.

Rumble Strips will not be used on the following roadways:

Urban Freeways and loop projects around urban areas.

Non-Freeways with the exception as listed above.

Type of Rumble strips to be used:

Formed rumble strips will be used on concrete shoulders as shown on Roadway Standard Drawings, Std. No. 720.01. Milled rumble strips will be used on asphalt shoulders as shown on Roadway Standard Drawings, Std. No. 665.01.

Placement of Rumble Strips

Rumble strips will be placed on the median and outside shoulders.

For Concrete PavementRumble strips will be located in accordance with Roadway Standard Drawings, Std. No. 720.01.**For Asphalt Pavement**The rumble strips will be placed as shown on Roadway Standard Drawings, Std. No. 665.01.**For shoulders that have a combination of Concrete and Asphalt Pavement**Formed Rumble Strips as shown on Roadway Standard Drawings, Std. No. 720.01, will be used on the Concrete portion of the Shoulder.

NOTE: In many areas where nighttime visibility is a problem, thermoplastic rumble strips may be used in addition to the milled rumble strips to enhance visibility.

GUIDELINES FOR SENSORY WARNING TREATMENT
FOR PAVED SHOULDERS (continued)

1-4P

B. Other approved surface treatments include the following:

- 1) Ground, or cut grooves – Use primarily on narrow median shoulders. This is the most expensive but most effective method available.
- 2) Rolled-in Grooves – This is the easiest treatment to construct and the least expensive, however it is also the least effective method.
- 3) Thermoplastic Pavement Marking Strips – These provide the advantage of improved visibility of the roadway shoulder during inclement weather. They are moderately effective. Raised Strips such as these may pose a maintenance problem in areas where snow plowing is required.
- 4) Profile Pavement Marking Edgelines – These are various specialty edgelines incorporating some type of texturing to provide audible warning to the driver. They would be a substitute for normal edgeline, and are relatively low in cost. They may also pose a maintenance problem in areas where snow plowing is required. (These should be used along with rumble strips.)
- 5) Other – The Traffic Engineering and Safety Systems Branch evaluates the performance of new technology surface treatments. Contact the Director of Traffic Engineering and Safety Systems for information about other new methods which may be available.

Other surface treatments may be used with the approval of the State Highway Design Engineer and the Director of Traffic Engineering and Safety Systems. Project Engineers from Roadway, Traffic, and Design Services should agree upon the type and extent of shoulder surface treatments, when applicable, as well as the appropriate Division Office. Continuity of corridor sections may also be used as criteria for selection of type. When selecting the type of treatment, consideration should be given to the potential use of the shoulder by traffic during future construction and maintenance operations.

PIPE CLASSIFICATIONS

5-12

Pipe classifications will be provided by the Hydraulics Unit for cross drains under high type pavement, for special situations, and for storm drains and special drainage systems. (High type pavement is any Portland Cement Concrete Pavement, or any Asphalt Concrete Pavement at least 2" thick.)

For cross drains under low type pavement, the contractor has the option of using either reinforced concrete pipe culverts or bituminous coated corrugated steel pipe culverts unless otherwise specified by the Hydraulics Unit. Pipe alternates shall be shown on the summary sheets.

For driveway pipe through 24", the type of pipe will be optional between plain concrete pipe culverts, HDPE smooth lined corrugated plastic pipe and corrugated steel pipe culverts. Pipe shall be shown on the summary sheets. The above procedure will be followed unless otherwise specified by the Hydraulics Unit.

For temporary detours, use plain C. S. Pipe Culverts.

See 5-12, Figure 1 of this Chapter for a detail showing typical pipe installations.

For additional information on drainage quantities sheets, see Part II, 8-2 of this Manual.

MEDIAN DROP INLETS

5-13

Narrow slot grates (Std. No's. 840.24 & 840.29) shall be used with median drop inlets on non-controlled access projects and projects with heavy pedestrian traffic.

Wide slot grates (Std. No's. 840.20 & 840.22) shall be used with median drop inlets on controlled access projects; however narrow slot grates (Std. No's. 840.24 & 840.29) will be used at locations that pedestrian traffic is anticipated.

Traffic bearing drop inlets (Std. No. 840.36) shall be used within a traveling lane (detour or permanent). Traffic bearing drop inlets (Std. No's. 840.35 or 840.36) shall also be used within 4'-0" of lanes, except when placed in a concrete traffic island.

Traffic bearing steel frames and flat steel grates (Std. No. 840.37) are to be used where it has been determined that traffic bearing drop inlets are needed on controlled access projects in locations that pedestrian traffic is not anticipated. The Traffic Engineering and Safety Systems Branch or the Hydraulics Unit may specify other locations where these must be used due to special considerations.

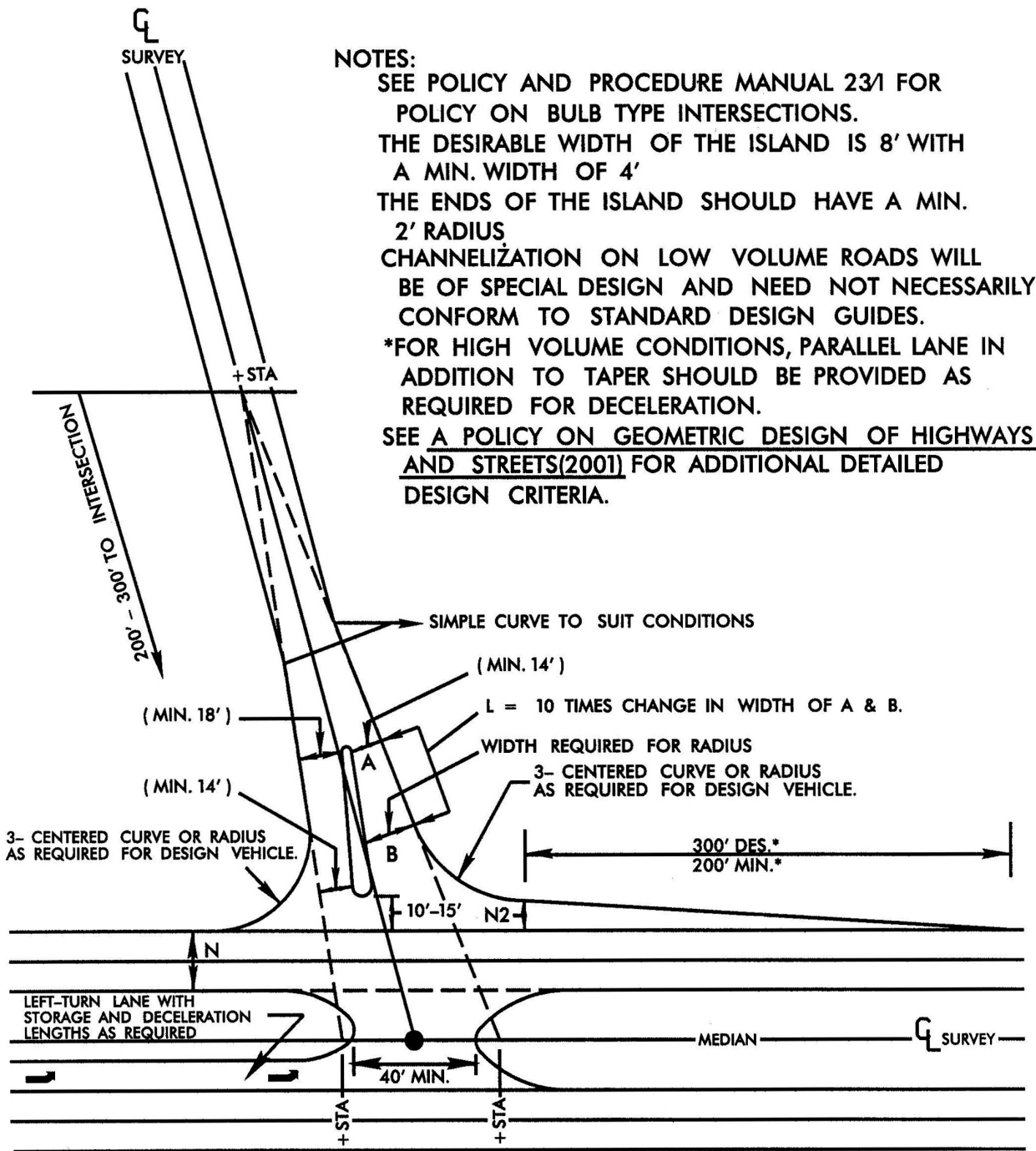
Angled vane grates and frames (Std. No. 840.33) are to be used when specified by the Hydraulics Unit.

STANDARD CATCH BASINS

5-14

The type of grate to be used on a standard catch basin will be determined by the Hydraulics Unit and discussed on field inspection with Division personnel, unless it is known that "bicycle safe" grates should be provided. In this case a type "E", "F", or "G" grate will be used. See Roadway Standard Drawings, Std. No. 840.03.

FIGURE 2



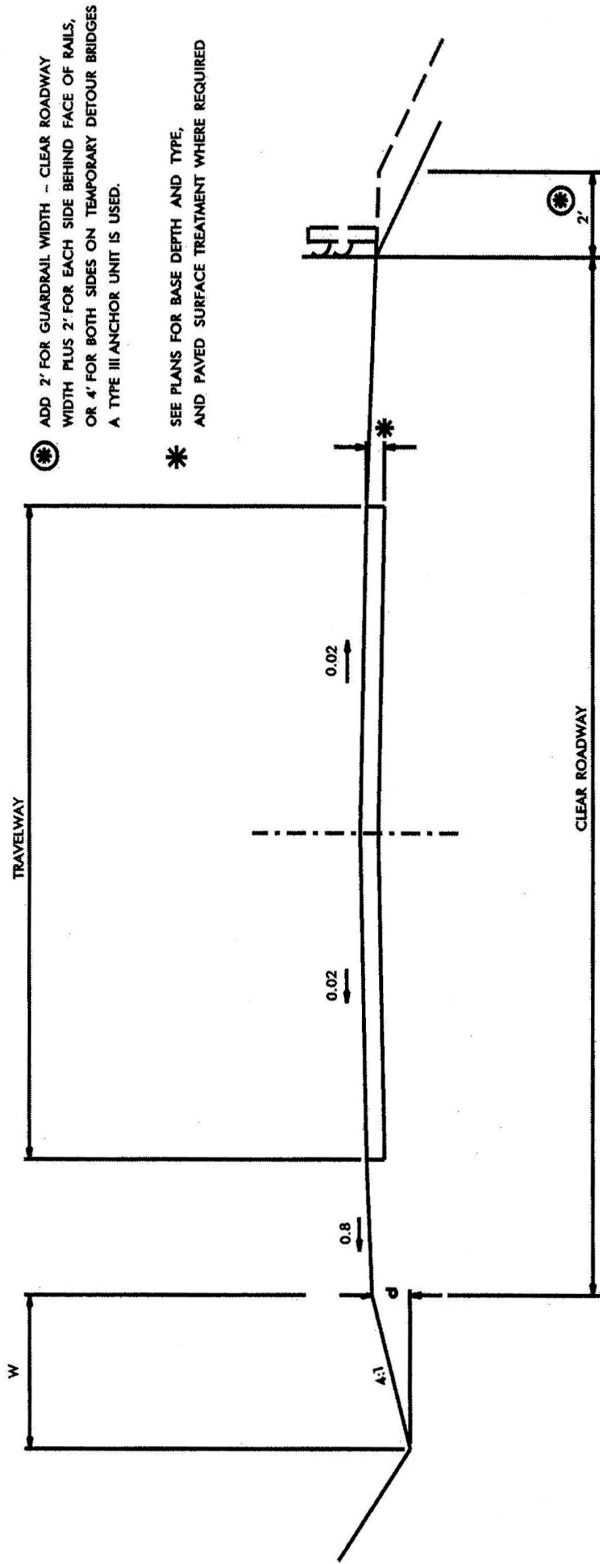
NOTES:

- SEE POLICY AND PROCEDURE MANUAL 23/1 FOR POLICY ON BULB TYPE INTERSECTIONS.
- THE DESIRABLE WIDTH OF THE ISLAND IS 8' WITH A MIN. WIDTH OF 4'
- THE ENDS OF THE ISLAND SHOULD HAVE A MIN. 2' RADIUS
- CHANNELIZATION ON LOW VOLUME ROADS WILL BE OF SPECIAL DESIGN AND NEED NOT NECESSARILY CONFORM TO STANDARD DESIGN GUIDES.
- *FOR HIGH VOLUME CONDITIONS, PARALLEL LANE IN ADDITION TO TAPER SHOULD BE PROVIDED AS REQUIRED FOR DECELERATION.
- SEE A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS(2001) FOR ADDITIONAL DETAILED DESIGN CRITERIA.

DESIGN GUIDE II

INTERSECTION WITH FOUR-LANE DIVIDED FACILITY

FIGURE 1



ADD 2' FOR GUARDRAIL WIDTH - CLEAR ROADWAY WIDTH PLUS 2' FOR EACH SIDE BEHIND FACE OF RAILS, OR 4' FOR BOTH SIDES ON TEMPORARY DETOUR BRIDGES A TYPE III ANCHOR UNIT IS USED.

SEE PLANS FOR BASE DEPTH AND TYPE, AND PAVED SURFACE TREATMENT WHERE REQUIRED

TYPICAL SECTION

	SPEEDS			
	0-25	26-35	36-45	46-55
MAX. DEGREE	30°	30° - 15°	15° - 8° 30'	8° 30' - 5° 30'
MAX. GRADE	15 %	12 %	9 %	8 %
DESIRABLE STOPPING SIGHT DISTANCE	160'	160' - 250'	250' - 375'	375' - 550'
SUPER ELEVATION (MIN.)	.02 - .06	.02 - .06	.02 - .06	.02 - .06
				55 + 5° 30' OR LESS
				7 %
				550'
				.06

TYPE	VPD	SURFACE		MIN. ROADWAY SHOULDER TO SHOULDER	DITCH WIDTH (w)	DITCH DEPTH (d)
		UNPAVED	PAVED			
A	0-250	✓		20'	2'	9"
B	251-750	✓		24'	2'	9"
C	751-2000	✓	DESIRABLE	28'	3'	12"
D	2001-5500		✓	32'	3'	12"
E	5501-15000		✓	38'	3'	12"
F	15000-ABOVE		✓	40'	3'	12"

WIDTHS FOR TWO WAY TRAFFIC (LESSER WIDTH MAY BE USED FOR ONE-WAY)

STANDARD DESIGN CRITERIA FOR TEMPORARY DETOURS (MAINTENANCE OF TRAFFIC)

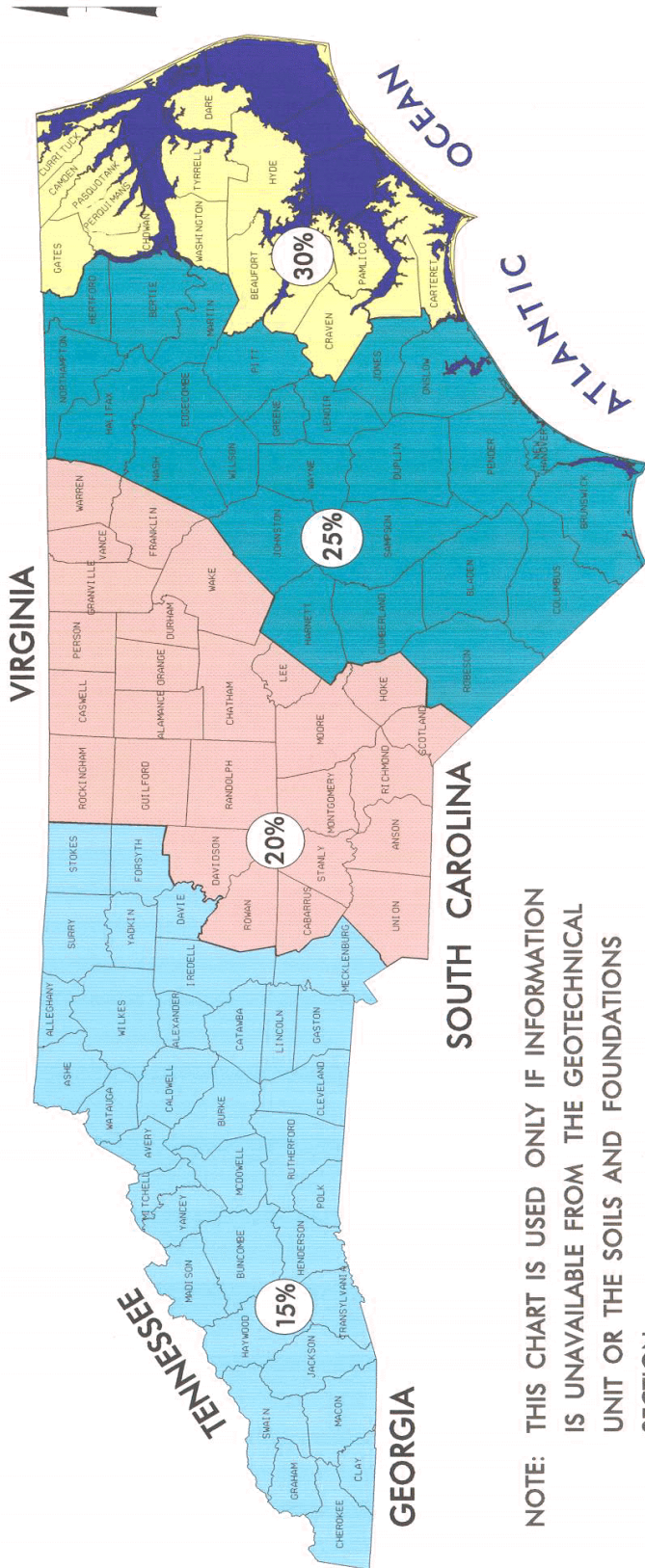
FIGURE 1

19-3
F-1

North Carolina

SHRINKAGE FACTORS

(FOR THE EARTH PORTION OF UNCLASSIFIED
EXCAVATION USED TO CONSTRUCT EMBANKMENTS)



NOTE: THIS CHART IS USED ONLY IF INFORMATION IS UNAVAILABLE FROM THE GEOTECHNICAL UNIT OR THE SOILS AND FOUNDATIONS SECTION.

FIGURE 1

21 - 2

F - 1

