July 14, 2003

MEMORANDUM

To: All Holders of the Virginia Department of Transportation’s 2001 Road and Bridge Standards

The following is a list of standards contained in the 2001 Road and Bridge Standards that have been revised. Please add these pages to your copy of the standards. An insertable sheet will not be required in plan assemblies.

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<td>502.04</td>
<td>Revised post foundation dimension line.</td>
</tr>
<tr>
<td>TC-5.01</td>
<td>802.21</td>
<td>Revised minimum LS length.</td>
</tr>
<tr>
<td></td>
<td>802.22</td>
<td>Revised LS equation to include number of lanes rotated.</td>
</tr>
</tbody>
</table>

The following is a list of revised standards to the 2001 Road and Bridge Standards that do require an insertable sheet to be included in your plan assembly until the next edition of the imperial standards is published. Please add these pages to your copy of the standards. The respective insertable sheet number has been placed with the revised standard in parenthesis. An insertable sheet is available for each of these revised standards. The insertable sheets are available on VDOT’s web site on the FTP server and in Falcon DMS for VDOT personnel. These insertable sheets will be required in plan assemblies for projects utilizing the standard items listed below that have not been turned in for first submission.

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<td>108.03</td>
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<tr>
<td>CD-1 (A84)</td>
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<td>Revised transverse bar depth and tolerance.</td>
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<td>PR-7 (ISD2761)</td>
<td>301.19</td>
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<td>301.20</td>
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<td>PR-8 (ISD2861)</td>
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<td>PR-9 (ISD2862)</td>
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<td>GR-2A (A87)</td>
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</tr>
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<tr>
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<td>Revised notes and dimensions.</td>
</tr>
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<td></td>
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<td>Revised notes, dimensions, and detail f to show second rail.</td>
</tr>
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</tr>
<tr>
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<td>501.14</td>
<td>Revised post and bolt dimensions.</td>
</tr>
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</tr>
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<td>GR-INS(ISD2390)</td>
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</tr>
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<td>MB-5 (ISD2390)</td>
<td>501.42</td>
<td>Revised dimensions, and backup plate details.</td>
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</tbody>
</table>
STANDARD  PAGE  REVISION

RFD-1 (A149)  603.01  Revised general notes.
              603.02  Added turnout details.

If you have any questions or comments regarding the listed revisions to this publication, please contact Mrs. N. E. Berry of the Engineering Services Section at (804) 786-2543.

Sincerely,

Mohammad Mirshahi, P.E.
State Location and Design Engineer
NOTES:

1. TYPICAL ENDWALL TO BE PLACED AT THE ENDS OF ALL UNDERDRAIN OUTLETS WHERE UNDERDRAIN IS TIED INTO OTHER DRAINAGE STRUCTURES. ENDWALL TO BE INSTALLED PERPENDICULAR TO ROADWAY AND FLUSH WITH THE SLOPE.

2. OUTLET PIPES SHALL BE RIGID NONPERFORATED, SMOOTH-BORE PIPE, MEETING THE REQUIREMENTS OF 70 PSI TESTED ACCORDING TO ASTM 2412.

3. EXPANDED STEEL MESH (FLATTENED) SHALL HAVE OPENINGS OF APPROX. 1/8" X 1" AND WEIGHT APPROX. 0.82 LBS PER SQ FT. MESH SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A-123. THE MESH SHALL EXTEND A MINIMUM OF 1" ABOVE THE O.D. OF THE PIPE, AND IS A BARRIER FOR RODENTS, ETC. THE SLOT FOR THE STEEL MESH IS TO BE CONSTRUCTED SO THAT THE MESH CAN BE REMOVED FOR CLEANOUT PURPOSES.

4. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.

5. STEEL POSTS AND PLATES TO BE PAINTED OR GALVANIZED IN ACCORDANCE WITH THE ROAD AND BRIDGE SPECIFICATIONS. IF PAINTED THE FINAL COAT SHALL BE NO. 13 ALUMINUM PAINT OR NO. 11 WHITE PAINT.

6. MARKER TO BE PLACED AT OUTLET END OF ALL UNDERDRAIN INSTALLATIONS BARRING LOCATIONS WHERE UNDERDRAIN IS TIED INTO OTHER DRAINAGE STRUCTURES.

7. MARKER WILL BE PAID FOR IN ACCORDANCE WITH SECTION 501 OF THE ROAD AND BRIDGE SPECIFICATIONS.
NOTES:

1. WHEN THE LONGITUDINAL PIPE CONNECTS DIRECTLY INTO A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), NON-PERFORATED OUTLET PIPES ARE NOT REQUIRED.

2. INVERT ELEVATION AT OUTLET END OF OUTLET PIPE TO BE A MINIMUM OF 1'-0" ABOVE INVERT ELEVATION OF RECEIVING DRAINAGE DITCH OR STRUCTURE.

3. ALL CONNECTIONS (ELBOWS, WYES, ETC.) WITHIN PAY LIMITS FOR OUTLET PIPE ARE TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.

4. OUTLET PIPE ARE TO BE INSTALLED ON 2% MIN. (3% DESIRABLE)GRADE.

5. THE NORMAL DEPTH OF UNDERDRAIN IS TO BE 4'-0" BELOW THE NEAR EDGE OF PAVEMENT AS SHOWN. THE LONGITUDINAL GRADE OF THE UNDERDRAIN SHALL FOLLOW THAT OF THE ROADWAY WITH A MINIMUM GRADE OF 0.2%.

6. WHERE THE BOTTOM OF SELECT MATERIAL IS GREATER THAN 4'-0" BELOW THE PAVEMENT, THE BOTTOM OF THE UNDERDRAIN IS TO BE COINCIDENT WITH THE BOTTOM OF SELECT MATERIAL AND THE TRENCH DEPTH AND BACKFILL QUANTITY INCREASED ACCORDINGLY.

7. WHEN USED WITH STABILIZED OPEN-GRADED DRAINAGE LAYER, THE BOTTOM OF THE CURB AND GUTTER SHALL BE CONSTRUCTED PARALLEL TO THE SLOPE OF SUBGRADE COURSES OUT TO THE DEPTH OF THE PAVEMENT.

8. OUTLET PIPE TO BE SECURELY CONNECTED TO EW-12 OR OTHER DRAINAGE STRUCTURE.

9. ▼ DENOTES WATER TABLE.

10. OUTLET PIPE CONFIGURATION TO PROVIDE FOR PASSAGE OF INSPECTION CAMERA WITH 2½" I.D. HEAD.

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**STANDARD GROUNDWATER UNDERDRAIN**

**VIRGINIA DEPARTMENT OF TRANSPORTATION**

7/03

108.01
LONGITUDINAL PERFORATED PIPE

<table>
<thead>
<tr>
<th>TYPE OF PIPE</th>
<th>CRUSHING STRENGTH</th>
</tr>
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<tbody>
<tr>
<td>SMOOTH WALL PVC</td>
<td>0.153</td>
</tr>
<tr>
<td>CORRUGATED PE</td>
<td>AASHTO M-252</td>
</tr>
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</table>

NON-PERFORATED OUTLET PIPE

<table>
<thead>
<tr>
<th>TYPE OF PIPE</th>
<th>CRUSHING STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMOOTH WALL PVC</td>
<td>0.153</td>
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<tr>
<td>SMOOTH WALL PE</td>
<td>70 PSI X X X</td>
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</tbody>
</table>

WALL THICKNESS MINI - INCHES
X X X TESTED ACCORDING TO ASTM D-2412 AT 5% DEFLECTION.

NOTES:
1. WHEN THE LONGITUDINAL PIPE CONNECTS DIRECTLY INTO A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), NON-PERFORATED OUTLET PIPES ARE NOT REQUIRED.
2. INSERT ELEVATION AT OUTLET END OF OUTLET PIPE TO BE A MINIMUM OF 1'-0" ABOVE INVERT ELEVATION OF RECEIVING DRAINAGE DITCH OR STRUCTURE.
3. ALL CONNECTIONS (ELBOWS, NYLSES, ETC.) WITHIN PAY LIMITS FOR OUTLET PIPES ARE TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.
4. OUTLET PIPE ARE TO BE INSTALLED ON 2% MIN. (3% DESIRABLE) GRADE AND LOCATED AT A MAXIMUM OF 500' APART.
5. OUTLET PIPE TO BE SECURELY CONNECTED TO EW-12 OR OTHER DRAINAGE STRUCTURE.
6. WHEN UNDERDRAIN MUST TRAVERE UNDER CROSSOVER LOCATIONS, NON-PERFORATED OUTLET PIPE ONLY IS TO BE USED UNDER CROSSOVER PAVEMENT.

STANDARD UNDERDRAIN FOR USE WITH RAISED GRASS MEDIAN STRIPS

SPECIFICATION REFERENCE
240
501
701

VIRGINIA DEPARTMENT OF TRANSPORTATION
NOTES:
1. WHEN THE LONGITUDINAL PIPE CONNECTS DIRECTLY INTO A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), NON-PERFORATED OUTLET PIPES ARE NOT REQUIRED.
2. INVERT ELEVATION AT OUTLET END OF OUTLET PIPE TO BE A MINIMUM OF 1'-0" ABOVE INVERT ELEVATION OF RECEIVING DRAINAGE DITCH OR STRUCTURE.
3. ALL CONNECTIONS (ELBOWS, WYES, ETC.) WITHIN PAY LIMITS FOR OUTLET PIPE ARE TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.
4. OUTLET PIPE ARE TO BE INSTALLED ON 2% MINIMUM (3% DESIRABLE) GRADE.
5. OUTLET PIPE TO BE SECURELY CONNECTED TO EW-12 OR OTHER DRAINAGE STRUCTURE.
6. SIDEWALK UNDERDRAIN IS TO BE USED WHEN THE SIDEWALK LONGITUDINAL GRADIENT IS 3% OR MORE AND WHEN THE UNDERLYING SOIL HAS 34% OR MORE PASSING THE NO. 200 SIEVE, AND HAS A PIPID OF 13 OR LESS, AND THE AREA HAS A HISTORY OF SIDEWALK UNDERMINING.
7. SIDEWALK UNDERDRAINS SHOULD BE TIED INTO THE STORM SEWER SYSTEM AT POINTS APPROXIMATELY A CITY BLOCK APART. UNDERDRAIN RUNS MUST NOT EXCEED 1000 FEET IN LENGTH WITHOUT DISCHARGING INTO THE STORM DRAIN SYSTEM OR INTO AN OPEN DRAIN.
8. WITHIN THE LIMITS OF A COMMERCIAL ENTRANCE, NON-PERFORATED PIPE SHALL BE UTILIZED IN LEIU OF PERFORATED PIPE.

LONGITUDINAL PERFORATED PIPE

<table>
<thead>
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<tr>
<td>CORRUGATED PE</td>
<td>AASHTO M-252</td>
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</table>

NON-PERFORATED PIPE FOR USE UNDER COMMERCIAL ENTRANCES AND FOR OUTLETS

<table>
<thead>
<tr>
<th>TYPE OF PIPE</th>
<th>CRUSHING STRENGTH</th>
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<tr>
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<td>0.153</td>
</tr>
<tr>
<td>SMOOTH WALL PE</td>
<td>70 PSI</td>
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</tbody>
</table>

* WALL THICKNESS (MN) - INCHES
* WALLS TESTED ACCORDING TO ASTM D-2412 AT 5% DEFLECTION.

STANDARD SIDEWALK UNDERDRAIN

Virginia Department of Transportation

SPECIFICATION REFERENCE

232
301
701
Combination Underdrain CD-1 at Lower End of Cuts
Center Line Section
(WITH TYPE I SELECT MATERIAL)

Trench Placement

Plan View
(Placement of CD-1 Combination Underdrain)

General Notes

1. Unless specifically indicated, combination underdrain will not be located at this point when both subbase and subgrade are stabilized.

2. Trench shall be filled with aggregate and thoroughly hand tamped to insure compactness.

3. Outlet pipe shall begin at the edge of the travel lane pavement and shall be placed on a grade parallel to the shoulder slope 2% min. 13% desirable grade.

4. On curb and gutter sections, where it is impossible to otherwise provide outlets for underdrains, they are to be located so as to drain into drop inlets or manholes.

5. On super-elevated sections, trench is to be under entire pavement area with outlet pipe on low side only.

6. Invert elevation at outlet end of outlet pipe to be a minimum of 1'-0" above invert elevation of receiving drainage ditch or structure.

7. All connections (elbows, wyes, etc.) with pay limits for outlet pipe are to be of the same crushing strength as the outlet pipe.

8. Outlet pipe to be securely connected to EW-12 or other drainage structure.

Standard Combination Underdrain
(At Lower End of Cuts)

<table>
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<tr>
<th>Type of Pipe</th>
<th>Crushing Strength</th>
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</thead>
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<td></td>
<td>W.T. 14&quot; Nom Diameter</td>
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<tr>
<td>Smooth Wall PVC</td>
<td>.103</td>
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<tr>
<td>Smooth Wall PE</td>
<td>70 PSI ***</td>
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</table>

*W. T. Wall Thickness (MN) - Inches
*** Tested According to ASTM D-2412 At 5% Deflection.

Rev. 7/03
10B.04

Virginia Department of Transportation

Specification Reference
232
501
701
COMBINATION UNDERDRAIN CD-2 ON FILLS CENTER LINE SECTION (WITH TYPE I SELECT MATERIAL)

TRENCH PLACEMENT

PLAN VIEW SHOWING PLACEMENT OF CD-2 UNDERDRAIN

NON-PERFORATED OUTLET PIPE

<table>
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<tr>
<th>TYPE OF PIPE</th>
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<td>1.03 X</td>
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<tr>
<td>SMOOTH WALL PE</td>
<td>70 PSI X</td>
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</table>

* WALL THICKNESS (MIN) INCHES
** TESTED ACCORDING TO ASTM D-2412 AT 5% DEFLECTION.

GENERAL NOTES

1. TRENCH SHALL BE FILLED WITH AGGREGATE AND THOROUGHLY HAND TAMPED TO INSURE COMPACTNESS.
2. OUTLET PIPE SHALL BEGIN AT THE EDGE OF THE TRAVEL LANE PAVEMENT AND SHALL BE PLACED ON A GRADE PARALLEL TO THE SHOULDER SLOPE 2% MIN. (DESIRABLE) GRADE.
3. ON CURB AND OUTER SECTIONS, WHERE IT IS IMPOSSIBLE TO OTHERWISE PROVIDE OUTLETS FOR UNDERDRAINS, THEY ARE TO BE LOCATED SO AS TO DRAG INTO DROP INLETS OR MANHOLES.
4. ON SUPERELEVATED SECTIONS, TRENCH IS TO BE UNDER ENTIRE PAVEMENT AREA WITH OUTLET PIPE ON LOW SIDE ONLY.
5. INVERT ELEVATION AT OUTLET END OF OUTLET PIPE TO BE A MINIMUM OF 1'-0" ABOVE INVERT ELEVATION OF RECEIVING DRAINAGE DITCH OR STRUCTURE.
6. ALL CONNECTIONS (ELBOWS, WYES, ETC.) WITHIN PAY LIMITS FOR OUTLET PIPE ARE TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.
7. OUTLET PIPE TO BE SECURELY CONNECTED TO EW-12 OR OTHER DRAINAGE STRUCTURE.

STANDARD COMBINATION UNDERDRAIN (AT GRADE SAGS AND BRIDGE APPROACHES)
NOTES:

1. 4" MINIMUM, PROVIDED ATTAINING MINIMUM 4" OF AGGREGATE ON TOP OF PIPE.

2. WHEN THE LONGITUDINAL PIPE CONNECTS DIRECTLY INTO A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), NON-PERFORATED OUTLET PIPES ARE NOT REQUIRED.

3. INVERT ELEVATION AT OUTLET END OF OUTLET PIPE TO BE A MINIMUM OF 1'-0" ABOVE INVERT ELEVATION OF RECEIVING DRAINAGE DITCH OR STRUCTURE.

4. ALL CONNECTIONS (ELOWS, WYES, ETC.) WITHIN PAY LIMITS FOR OUTLET PIPE ARE TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.

5. OUTLET PIPES ARE TO BE INSTALLED ON 2% MIN. (3% DESIRABLE) GRADE AND LOCATED EVERY 350' MAXIMUM OR AS NOTED ON PLANS.

6. OUTLET PIPE TO BE SECURELY CONNECTED TO EW-12 OR OTHER DRAINAGE STRUCTURE.

7. WITHIN THE LIMITS OF A COMMERCIAL ENTRANCE, NON-PERFORATED PIPE SHALL BE UTILIZED IN LIEU OF PERFORATED PIPE.

8. THE LENGTH OF PIPE BETWEEN THE WYE CONNECTION AND THE EW-12 SHALL BE LIMITED TO NO MORE THAN 7'-0" TO PERMIT CAMERA INSPECTION OF THE MAIN LINE IN EITHER DIRECTION.

9. IN SITUATIONS WHEN FULL DEPTH OF STABILIZED OPEN-GRADED MATERIAL CANNOT BE MAINTAINED UNDER CURB AND GUTTER, NO. 218 AGGREGATE SHALL BE USED UNDER CURB AND GUTTER. NO. 218 AGGREGATE MAY ALSO BE USED FROM TOP OF STABILIZED OPEN-GRADED MATERIAL LAYER AND CURB AND GUTTER.

STANDARD PAVEMENT EDGEDRAIN

VIRGINIA DEPARTMENT OF TRANSPORTATION

Rev. 7/03

108.07
NOTES:

1. 4" MINIMUM, PROVIDED ATTAINING MINIMUM 4" OF AGGREGATE ON TOP OF PIPE.
2. WHEN THE LONGITUDINAL PIPE CONNECTS DIRECTLY INTO A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), NON-PERFORATED OUTLET PIPES ARE NOT REQUIRED.
3. INVERT ELEVATION AT OUTLET END OF OUTLET PIPE TO BE A MINIMUM OF 1'-6" ABOVE INVERT ELEVATION OF RECEIVING DRAINAGE DITCH OR STRUCTURE.
4. ALL CONNECTIONS (ELBOWS, WYES, ETC.) WITHIN PAY LIMITS FOR OUTLET PIPE ARE TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.
5. OUTLET PIPES ARE TO BE INSTALLED ON 2% MIN. (3% DESIRABLE) GRADE AND LOCATED EVERY 350` MAXIMUM OR AS NOTED ON PLANS.
6. OUTLET PIPE TO BE SECURELY CONNECTED TO EW-12 OR OTHER DRAINAGE STRUCTURE.
7. WITHIN THE LIMITS OF A COMMERCIAL ENTRANCE, NON-PERFORATED PIPE SHALL BE UTILIZED IN LIEU OF PERFORATED PIPE.
8. THE LENGTH OF PIPE BETWEEN THE WYE CONNECTION AND THE EW-12 SHALL BE LIMITED TO NO MORE THAN 1'-0" TO PERMIT CAMERA INSPECTION OF THE MAIN LINE IN EITHER DIRECTION.
9. EXISTING ASPHALT SHOULDER TO BE SAWED TO ACHIEVE A SMOOTH JOINT.

LONGITUDINAL PERFORATED PIPE

<table>
<thead>
<tr>
<th>TYPE OF PIPE</th>
<th>CRUSHING STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMOOTH WALL PVC</td>
<td>.103</td>
</tr>
<tr>
<td>CORRUGATED PE</td>
<td>AASHTO M-252</td>
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</table>

NON-PERFORATED OUTLET PIPE FOR USE UNDER COMMERCIAL ENTRANCES AND FOR OUTLETS

<table>
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<th>CRUSHING STRENGTH</th>
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<tr>
<td>SMOOTH WALL PVC</td>
<td>.103</td>
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<tr>
<td>SMOOTH WALL PE</td>
<td>70 PSI</td>
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</table>

**NOTE:** WALL THICKNESS (MIN.) INCHES. ***TESTED ACCORDING TO ASTM D-2412 AT 5% DEFLECTION.***

STANDARD RETROFIT EDGEDRAIN

SPECIFICATION REFERENCE

240 501 701
**Prefomed Chloroprene Elastomeric Joint Sealant**

**Silicone Joint Sealant**

**General Notes**
- Alternate preformed sealants having a cross-sectional area comparable to Type A (contraction joint) and Type D (expansion joint) and meeting the approval of the Engineer may be substituted.
- Other types of joint material are to be in accordance with the specifications.
- All details not shown herein to be in accordance with Standards PR-2, Sheet 2 of 5.
- All contraction joints to be sawed in conformity with detail to the left, except that where gravel aggregate is used in the concrete, the joint may be prepared by forming 3/4" or less of the width for the depth shown with non-metallic or removable material, followed by sawing to complete the joint to the required width and depth.
- For details of transverse construction joint, see below.

**Sealants for Transverse Contraction Joints**

**Sealants for Transverse Expansion Joints**

**Existing Concrete Pavement**
- Widen top of groove to 3/4" x 1/2" and seal with hot poured elastomeric sealant if asphalt top is not used.

**Methods of Widening Concrete Pavement**
- Drill 1/4" x 1/8" holes, 30" c-c into existing pavement. 24" x 7" dowels with epoxy grout.
- Proposed widening 24" x 7" deformation dowels 30" c-c.

**For 15" Slab Lengths (Plain)**

**Sealant Type**

<table>
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<th>Dimension</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
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<td>1 3/4&quot; or 1&quot;</td>
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**For 30" Slab Lengths (Reinforced)**

<table>
<thead>
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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>X</td>
<td>3/4&quot;</td>
<td>3/4&quot;</td>
<td>1 3/4&quot;</td>
<td>2&quot;</td>
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<td>Y</td>
<td>3/4&quot;</td>
<td>3/4&quot;</td>
<td>1 3/4&quot; or 1&quot;</td>
<td>1 3/4&quot; or 1&quot;</td>
</tr>
<tr>
<td>W</td>
<td>3/4&quot; x 1/4&quot;</td>
<td>-</td>
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</tr>
</tbody>
</table>

**Detail of Transverse Construction (Butt) Joint**
- For use with plain, reinforced, and plain base with asphalt top.
NOTES:

1. Hook bolts or tie bars are to be placed in the same horizontal plane as the #5 transverse bars. Where necessary, adjust the location of the hook bolts or tie bars to a 2/3" minimum clearance between hook bolts or tie bars and transverse bars.

2. Transverse construction joint bars are to be placed in the same horizontal plane as the #6 longitudinal bars.

3. #6 longitudinal bars are to be lapped and tied in the same horizontal plane.

4. For the 38 foot wide pavement use single 12 foot lanes with two longitudinal construction joints or 12 foot and 14 foot lanes with one longitudinal construction joint and one saw cut or tape insert longitudinal joint. Transverse bars shall not extend through longitudinal construction joints, but shall extend full length (20'-0") for saw cut or tape insert longitudinal joint.

5. Smooth surface to be steel troweled 1/8" in from edge of pavement every 500 ft., and the station number stamped into it as shown below. The date is to be shown in a similar manner at the beginning of each day's pour. Both outside edges of divided highway is to be stamped. One edge of undivided highway where feasible travel lanes.

6. Double lap requirement (40") and the extra bar method apply only to bars falling within an area of 10" beyond the construction joint.

7. Concrete for lug anchors shall be poured against compacted subgrade. Concrete for lugs and anchor slab may be poured monolithically or poured using raised key construction joint method. Adequate consolidation of concrete in lugs will be obtained without displacing longitudinal continuous steel. By the use of internal vibration, when less than full width lug and pavement slab is placed, the #5 transverse steel in the lugs shall be extended, lapped and spliced at least 19 3/4" centers.

8. Longitudinal steel to continue through joint. Extra #6 bars 20'-0" long shall be spaced at 15 3/4" C-C.

9. Concrete should be adequately vibrated under beam flange to eliminate honeycombs.

10. In conditions of soft clay underlying soils (AASHTO soil classification of Group A-4, A-5, A-6, or A-7) inclusive of subgroups (per AASHTO materials specifications M 145), an anchor slab type 1 utilizing #5 anchor lug(s) anchor slab length = 85") or an anchor slab type 3 may be used. Reinforcement steel size and spacing will be the same as the continuous concrete pavement.

In conditions of granular underlying soils only (AASHTO soil classification of Group A-1, A-2, or A-3) inclusive of subgroups (per AASHTO materials specifications M 145), an anchor slab type 1 utilizing 3 anchor lugs anchor slab length = 10") or an anchor slab type 3 may be used. Reinforcement size and spacing will be the same as the continuous concrete pavement.

11. Weld steel end plate to both ends of WF beam to seal ends. Weld shear connectors to web and flange of WF beam.

12. 2 inch minimum concrete cover for steel in sub-slabs.

13. Wide flange beam to be treated with corrosion inhibitor per section 407 of the road and bridge specifications.

14. All reinforced bars shall be grade 60 steel.

15. The use of tube feeding to place reinforcement in plastic concrete will not be allowed.
NOTES:
1. HOOK BOLTS OR TIE BARS ARE TO BE PLACED IN THE SAME HORIZONTAL PLANE AS THE #6 TRANSVERSE BARS. WHERE NECESSARY, ADJUST THE LOCATION OF THE HOOK BOLTS OR TIE BARS TO A 2/3" MINIMUM CLEARANCE BETWEEN HOOK BOLTS OR TIE BARS AND TRANSVERSE BARS.
2. TRANSVERSE CONSTRUCTION JOINT BARS ARE TO BE PLACED IN THE SAME HORIZONTAL PLANE AS THE #6 LONGITUDINAL BARS.
3. #6 LONGITUDINAL BARS ARE TO BE LAPPED AND TIED IN THE SAME HORIZONTAL PLANE.
4. FOR THE 30 FOOT WIDTH PAVEMENT USE SINGLE 12 FOOT LANES OR TWO TRANSVERSE CONSTRUCTION JOINTS OR 12 FOOT LANE WITH ONE LONGITUDINAL CONSTRUCTION JOINT AND ONE SAW CUT OR TAPED INSERT LONGITUDINAL JOINT. TRANSVERSE BARS SHALL NOT EXTEND BEYOND LONGITUDINAL CONSTRUCTION JOINTS, BUT SHALL EXTEND FULL LENGTH (25-6") FOR SAW CUT OR TAPED INSERT LONGITUDINAL JOINT.
5. SMOOTH SURFACE TO BE STEEL TROWELED 8" IN FROM EDGE OF PAVEMENT EVERY 500 FT., AND THE STATION NUMBER STAMPED INTO IT AS SHOWN BELOW. THE DATE IS TO BE SHOWN IN A SIMILAR MANOR AT THE BEGINNING OF EACH DAY. BOTH OUTSIDE EDGES OF DIVIDED HIGHWAY IS TO BE TROWELED. ONE EDGE OF UNDIVIDED HIGHWAY WHERE FEASIBLE (TRAVEL LANE).
6. DOUBLE LAP REQUIREMENT (40") AND THE EXTRA BAR METHOD APPLY ONLY TO LAMPS FALLING WITHIN AN AREA OF 10' BEYOND THE CONSTRUCTION JOINT.
7. CONCRETE FOR LUG ANCHORS SHALL BE POURED AGAINST COMPACTED SUBGRADE. CONCRETE FOR LUGS AND ANCHOR SLABS MAY BE POURED MONOLITHICALLY OR POURED USING RAISED KEY CONSTRUCTION JOINT METHOD. ADEQUATE CONSIDERATION OF CONCRETE IN LUGS WILL BE OBTAINED WITHOUT DISPLACING LONGITUDINAL CONTINUOUS STEEL. BY THE USE OF INTERNAL VIBRATION WHEN LESS THAN FULL WIDTH LUG AND PAVEMENT SLAB IS PLACED, THE #5 TRANSVERSE STEEL IN THE LUGS SHALL BE EXTENDED, LAPPED SPliced AT LEAST 25 DIAMETERS.
8. LONGITUDINAL STEEL TO CONTINUE THROUGH JOINT. EXTRA #6 BARS 20' LONG SHALL BE SPACED AT 15'/C-C.
9. CONCRETE SHOULD BE ADEQUATELY VIBRATED UNDER BEAM FLANGE TO ELIMINATE HONEYCOMBS.
10. IN CONDITIONS OF SOFT CLAY UNDERLYING SOILS (AASHTO SOIL CLASSIFICATION OF GROUP A-4, A-5, A-6 OR A-7) INCLUSIVE OF SUBGROUPS (PER AASHTO MATERIAL SPECIFICATIONS M-143), AN ANCHOR SLAB TYPE I UTILIZING 5 ANCHOR LUGS (ANCHOR SLAB LENGTH = 85") OR AN ANCHOR SLAB TYPE II SHALL BE USED. REINFORCEMENT STEEL SIZE AND SPACING WILL BE THE SAME AS THE CONTINUOUS CONCRETE PAVEMENT.
11. IN CONDITIONS OF GRANULAR UNDERLYING SOILS ONLY (AASHTO SOIL CLASSIFICATION OF GROUP A-1, A-2, OR A-3) INCLUSIVE OF SUBGROUPS (PER AASHTO MATERIAL SPECIFICATIONS M-143), AN ANCHOR SLAB TYPE I UTILIZING 3 ANCHOR LUGS (ANCHOR SLAB LENGTH = 55") OR AN ANCHOR SLAB TYPE II MAY BE USED. REINFORCEMENT STEEL SIZE AND SPACING WILL BE THE SAME AS THE CONTINUOUS CONCRETE PAVEMENT.
12. WELD STEEL END PLATE TO BOTH ENDS OF WF BEAM TO SEAL END. WELD SHEAR CONNECTORS TO WEB AND FLANGE OF WF BEAM.
13. 2 INCH MINIMUM CONCRETE COVER FOR STEEL IN SUB-SLABS.
14. ALL REINFORCED BARS SHALL BE GRADE 60 STEEL.
15. THE USE OF TUBE FEEDING TO PLACE REINFORCEMENT IN PLASTIC CONCRETE WILL NOT BE ALLOWED.
NOTES:

1. HOOK BOLTS OR TIE BARS ARE TO BE PLACED IN THE SAME HORIZONTAL PLANE AS THE #5 TRANSVERSE BARS. WHERE NECESSARY, ADJUST THE LOCATION OF THE HOOK BOLTS OR TIE BARS TO A 2½" MINIMUM CLEARANCE BETWEEN HOOK BOLTS OR TIE BARS AND TRANSVERSE BARS.

2. TRANSVERSE CONSTRUCTION JOINT BARS ARE TO BE PLACED IN THE SAME HORIZONTAL PLANE AS THE #6 LONGITUDINAL BARS.

3. #6 LONGITUDINAL BARS ARE TO BE LAPPED AND TIED IN THE SAME HORIZONTAL PLANE.

4. FOR THE 12 FOOT WIDTH PAVEMENT USE SINGLE 12 FOOT LAINES WITH TWO LONGITUDINAL CONSTRUCTION JOINTS OR 12 FOOT AND 14 FOOT LAINES WITH ONE LONGITUDINAL CONSTRUCTION JOINT AND ONE SAW CUT OR TAPE INSERT LONGITUDINAL JOINT. TRANSVERSE BARS SHALL NOT EXTEND THROUGH LONGITUDINAL CONSTRUCTION JOINTS, BUT SHALL EXTEND FULL LENGTH (20'-6") FOR SAW CUT OR TAPE INSERT LONGITUDINAL JOINT.

5. SMOOTH SURFACE TO BE STEEL TREATED 8" IN FROM EDGE OF PAVEMENT EVERY 500 FT. AND THE STATION NUMBER STamped INTO IT AS SHOWN BELOW. THE DATE IS TO BE SHOWN IN A SIMILAR MANNER AT THE BEGINNING OF EACH DAY'S POUR. BOTH OUTSIDE EDGES OF DIVIDED HIGHWAY ARE TO BE STAMPED. ONE EDGE OF UNDIVIDED HIGHWAY WHERE FEASIBLE (TRAVEL LANE).

6. DOUBLE LAP REQUIREMENT (40") AND THE EXTRA BAR METHOD APPLY ONLY TO LAMPS FALING WITHIN AN AREA OF 10' BEYOND THE CONSTRUCTION JOINT.

7. CONCRETE FOR LUG ANCHORS SHALL BE Poured AGAINST COMPACTED SUBGRADE. CONCRETE FOR LUGS AND ANCHOR SLABS MAY BE Poured MONOLITHICALLY OR Poured USING RAISED KEY CONSTRUCTION METCH. ADEQUATE CONSOLIDATION OF CONCRETE IN LUGS WILL BE Obtained WITHOUT DISPLACING LONGITUDINAL CONTINUOUS STEEL. BY THE USE OF INTERNAL VIBRATION. WHEN LESS THAN FULL WIDTH LUG AND PAVEMENT SLAB IS PLACED, THE #5 TRANSVERSE STEEL IN THE LUGS SHALL BE EXTENDED, LAPPED AND SPLICED AT LEAST 2½ DIAMETERS.

8. LONGITUDINAL STEEL TO CONTINUE THROUGH JOINT. EXTRA #6 BARS 20' LONG SHALL BE SPACED AT 13½" C-C.

9. CONCRETE SHOULD BE ADEQUATELY VIBRATED UNDER BEAM FLANGE TO ELIMINATE HONEYCOMBS.

10. IN CONDITIONS OF SOFT CLAY UNDERLYING SOILS (AASHTO SOIL CLASSIFICATION OF GROUP A-4, A-5, A-6, OR A-7) INCLUSIVE OF SUBGROUPS (PER AASHTO MATERIALS SPECIFICATIONS M-140), AN ANCHOR SLAB TYPE I UTILIZING 3 ANCHOR LUGS (ANCHOR SLAB LENGTH = 85") OR AN ANCHOR SLAB TYPE II MAY BE USED. REINFORCEMENT STEEL SIZE AND SPACING WILL BE THE SAME AS THE CONTINUOUS CONCRETE PAVEMENT.

11. WELD STEEL END PLATE TO BOTH ENDS OF WF BEAM TO SEAL ENDS. WELD SHEAR CONNECTORS TO WEB AND FLANGE OF WF BEAM.

12. 2 INCH MINIMUM CONCRETE COVER FOR STEEL IN SUB-SLABS.

13. WIDE FLANGE BEAM TO BE TREATED WITH CORROSION INHIBITOR PER SECTION 407 OF THE ROAD AND BRIDGE SPECIFICATIONS.

14. ALL REINFORCED BARS SHALL BE GRADE 60 STEEL.

15. THE USE OF TUBE FEEDING TO PLACE REINFORCEMENT IN PLASTIC CONCRETE WILL NOT BE ALLOWED.
NOTEs:
1. Hook bolts or tie bars are to be placed in the same horizontal plane as #6 transverse bars, where necessary, adjust the location of the hook bolts or tie bars to a 2½" min. clearance between hook bolts or tie bars and transverse bars.

2. Transverse construction joint bars are to be placed in the same horizontal plane as the #7 longitudinal bars.

3. #7 longitudinal bars are to be lapped and tied in the same horizontal plane.

4. For the 30-foot width pavement use single 12-foot lengths with two longitudinal construction joints or 12-foot and 14-foot lengths with one longitudinal construction joint and one saw cut or tape insert longitudinal joint. Transverse bars shall not extend through longitudinal construction joints but shall extend full length (2½") for saw cut or tape insert longitudinal joint.

5. Smooth surface to be steel troweled 8" from edge of pavement every 500 feet and the station number stamped into it as shown below. The date is to be shown in a similar manner at the beginning of each day's work. Both outside edges of divided highway are to be troweled. One edge of undivided highway where feasible (travel lane).

6. Double lap requirement (40") and the extra bar method apply only to laps falling within an area of 10 ft. beyond the construction joint.

7. Concrete for lug anchors shall be poured against compacted subgrade. Concrete for lug and anchor slab may be poured monolithically or using raised key construction joint method. Adequate consolidation of concrete in lug will be obtained without displacing longitudinal continuous steel, by the use of internal vibration, when less than full width lug and pavement slab is placed. The #5 transverse steel in the lugs shall be extended, lapped, and spaced at least 25 diameters.

8. Longitudinal steel to continue through joint. Extra #6 bars 20" long shall be spaced at 1½" C-C.

9. Concrete should be adequately vibrated under beam flange to eliminate honeycombs.

10. In conditions of soft clay underlying soils (AASHO soil classification of Group A-4, A-5, A-6 or A-71 inclusive of subgroups per AASHO materials specifications M 145), an anchor slab type I utilizing 3 anchor lugs (anchor slab length = 6") or an anchor slab type II shall be used. Reinforcement steel size and spacing will be the same as the continuous concrete pavement.

11. Weld steel end plate to both ends of WF beam to seal ends. Weld shear connectors to web and flange of WF beam.

12. 2 inch minimum concrete cover for steel in sub-slabs.

13. Wide flange beam to be treated with corrosion inhibitor per section 407 of the road and bridge specifications.

14. All reinforced bars shall be grade 60 steel.

15. The use of tube feeding to place reinforcement in plastic concrete will not be allowed.

12" CONTINUOUSLY REINFORCED CONCRETE PAVEMENT
14" TRAVEL LANE

VIRGINIA DEPARTMENT OF TRANSPORTATION
NOTES:

1. Hook bolts or tie bars are to be placed in the same horizontal plane as #5 Transverse bars, where necessary. Adjust the location of the hook bolts or tie bars to a 2½" min. clearance between hook bolts or tie bars and Transverse bars.

2. Transverse construction joint bars are to be placed in the same horizontal plane as the #7 longitudinal bars.

3. #7 longitudinal bars are to be lapped and tied in the same horizontal plane.

4. For the 39 foot width pavement use single 12 foot lanes with two longitudinal construction joints or 12 foot and 14 foot lanes with one longitudinal construction joint and one saw cut or tape insert longitudinal joint. Transverse bars shall not extend through longitudinal construction joints but shall extend full length (25'-6") for saw cut or tape insert longitudinal joint.

5. Smooth surface to be steel troweled 8" from edge of pavement every 500 ft and the station number stamped into it as shown below. The date is to be shown in a similar manner at the beginning of each day's pour. Both outside edges of divided highway are to be stamped, one edge of undivided highway where feasible (travel lane):

6. Double lap requirement (40") and the extra bar method apply only to laps falling within an area of 10' beyond the construction joint.

7. Concrete for lug anchor shall be poured against compacted subgrade. Concrete for lugs and anchor slab may be poured monolithically or using raised key construction joint method. Adequate consolidation of concrete in lugs will be obtained without displacing longitudinal concrete steel, by the use of internal vibration. When less than full width lug and pavement slab is placed, the #5 transverse steel in the lugs shall be extended, lapped and spliced at least 25 diameters.

8. Longitudinal steel to continue through joint, extra #8 bars 20' long shall be spaced at 3½" C-C.

9. Concrete should be adequately vibrated under beam flange to eliminate honeycombs.

10. In conditions of soft clay underlying soils (AASHTO Soil Classification of Group A-1, A-2, or A-3) inclusive of subgroups (per AASHTO Materials Specifications M-145), an anchor slab type I utilizing 3 anchor lugs (anchor slab length = 55") or an anchor slab type II shall be used. Reinforcement steel size and spacing will be the same as the continuous concrete pavement.

11. Weld steel end plate to both ends of web beam to seal ends. Weld shear connectors to web and flange of web beam.

12. 2 inch minimum concrete cover for steel in sub-slabs.

13. Wide flange beam to be treated with corrosion inhibitor per Section 407 of the Road and Bridge Specifications.

14. All reinforced bars shall be Grade 60 steel.

15. The use of tube feeding to place reinforcement in plastic concrete will not be allowed.
**CONCRETE POST**

- **Dimensions:**
  - 8" x 8"
  - 7" (4" + 1/2")
  - 1/4" hole to be cast in post

- **Chamfer:**
  - 1/4" chamfer on top 3'-0" of post

- **Notes:**
  - Chamfer all corners.
  - All concrete shall be class A3.

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**STEEL POST**

- **Dimensions:**
  - 8" x 8"
  - 7" (3'-0"
  - 1/4" hole

- **Bolt:**
  - 1/4" x 18" bolt

- **Notes:**
  - 9-3/4 wire stirrups lapped 10" spacing
  - Varies S" to T'-0" C-C

---

**6x8 WOOD POST**

- **Dimensions:**
  - 6" x 8" x 1'-2"

- **Material:**
  - Treated pine block or recycled material

- **Bolt:**
  - 1/4" x 18" bolt

- **Notes:**
  - Galvanized steel 10d common nail

---

**ROUND WOOD POST**

- **Dimensions:**
  - 6" x 6" x 1'-2"

- **Material:**
  - Treated pine block or recycled material

- **Bolt:**
  - 1/4" x 18" bolt

- **Notes:**
  - Galvanized steel 10d common nail

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**Guardrail Installation Sites Requiring Longer Guardrail Posts**

- **Notes:**
  - 1. All bolts, nuts, washers, and other steel items are to be galvanized.
  - 2. Alternate type posts and blockout may be interchanged on any one project with the restriction that the same type of post and blockout must be used in any single run of guardrail.
  - 3. For details of guardrail element splice joint, hardware, etc., see Sheet Nos. 501.01 & 501.02.
  - 4. The guardrail and median barrier components depicted in A.A.T.B.A. Technical Bulletin Number 265 may be substituted if interchangeable with the standards for guardrail (20) or median barrier (10) and approved by the engineer.
  - 5. Drive nails on both sides within 2" of the top or bottom of blockout after 1/4" x 18 bolt is installed.
  - 6. Standard washer to be used on last 50" of run off end only.

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**Standard Blocked-out W Beam Guardrail (Strong Post System) Post and Blockout Details**

Sheet 2 of 2

Virginia Department of Transportation

**Specification References**

221
236
505
TERMINAL TREATMENT FOR W BEAM GUARDRAIL

NOTES:
1. A second rail is required where the distance between the ground and bottom of the top rail exceeds 18' up to the point where the rail crosses the ditch line. The double rail will extend to post #4.
2. Maximum distance between bottom of the lower W-beam rail and ground line is 8'. When double rail is required, taper both W-beam rails to maintain the 8' distance from the ground.
3. Taper both W-beam rails from height at toe of ditch slopes to 1' below finished grade at post #118' offset.
4. A 8' long post must be used when upper and lower W-beam rails are required, from the beginning of the lower rail through post #3.
5. Standard or 6 terminal treatment may be used at the run-on end of divided highways (left and right of traffic) and at the run-on and run-off ends on undivided highways.
6. All post spacing 6'-3" C-C unless otherwise noted. The post may be W 8.5 steel or 6 x 8 wood. The last 3 terminal posts must be W 8.5 steel.
7. For sections D-D & E-E, and end anchorage details see Sheet 501.10.
8. All terminal run-on or run-off must be installed with lapping the rails in the direction that the terminals were installed when tested to NCHRP 350 requirements.
9. If the backslope is 1:1 or steeper the W-beam may be anchored per solid rock cut installation (details f).

REV. 7/03
501.09

VA DEPARTMENT OF TRANSPORTATION
TERMINAL TREATMENT FOR W BEAM GUARDRAIL

NOTE:
1. ½" STEEL PLATE MAY BE WELDED OR BOLTED TO POST. IF PLATE IS BOLTED TO POST USE 4- ¾" x ½" LG HEX HEAD BOLTS W/ HEX NUTS. IF PLATE IS WELDED TO POST DO NOT DRILL ¾" HOLES IN PLATE OR IN POST FLANGES.
2. CONCRETE END ANCHORAGE MAY BE USED IN PLACE OF STEEL POST AT 8'-0" OFFSET.
NOTES:

1. GUARDRAIL TERMINAL STD GR-7 IS TO BE SRT 350 (AS SHOWN) MANUFACTURED BY SYRO STEEL COMPANY. THE FLOAT 350 MANUFACTURED BY ROAD SYSTEMS, INC., OR OTHER VDOT APPROVED EQUAL MEETING NCHRP 350 TESTING CRITERIA UTILIZING A 4 FT OFFSET.

2. THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE BLOCKOUTS EXCEPT AT THE FIRST TWO POSTS, WHERE THE DIMENSION IS TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENT AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SHOWN. POST ARE TO BE SET APPROXIMATELY RADIAL TO THE RAILING AT EACH POST LOCATION.

3. YELLOW 8' X 36' REFLECTIVE SHEETING, IN ACCORDANCE WITH VDOT SPECIFICATIONS, SHOULD BE APPLIED IN TERMINALS EMPLOYING W-BEAM END SECTIONS. FOR TERMINALS EMPLOYING IMPACT (EXTRUDER) HEADS, AMBER (YELLOW) REFLECTIVE SHEETING WITH BLACK DIAGONAL STRIPES SHOULD BE APPLIED TO THE FULL AREA INSIDE THE IMPACT HEAD WITH THE DIRECTION OF THE BLACK DIAGONAL STRIPES CONFORMING TO CURRENT MUTCD APPLICATION FOR TYPE 3 DELECT MARKERS (GM-3).

4. FOR DETAILS OF GUARDRAIL TERMINAL INSTALLATION SITE PREPARATION REQUIREMENTS SEE STANDARD GR-5P.

5. DRIVE NAIL WITHIN 2' OF THE TOP OR BOTTOM OF BLOCKOUT AFTER 3/4" X 18" LG. BOLT IS INSTALLED.

6. IF THIS TERMINAL IS USED IN A RUNOFF CONDITIONS, DO NOT CHANGE THE LAPPING DIFFERENT THAN WHAT HAS BEEN TESTED BY NCHRP 350 REQUIREMENTS.

7. IF YOU CANNOT GET THE NECESSARY CLEAR RUNOUT AREA FOR THE GR-7 TERMINAL CONSIDER ALTERNATIVE TERMINAL OPTIONS.

SPECIFICATION REFERENCE

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV.7/03
561.11
221505
TYPICAL INSTALLATION

W-BEAM GUARDRAIL SPACES LOCATED AT MID-SPAN BETWEEN POSTS

SEE GUARDRAIL POST CONNECTION DETAIL. 2 SQUARE WASHERS REQUIRED. W-BEAM BACK UP PLATE REQUIRED.

FOR ROCK INSTALLATION, 8" x 24" x 1/2" PLATE IS TO BE ELIMINATED. DRILL OR EXCAVATE HOLE FOR POST, PLACE POST, AND BACKFILL WITH CRUSHER RUN AGGREGATE TO LEVEL OF ROCK.

ALL POSTS, BOLTS, NUTS AND WASHERS ARE TO BE GALVANIZED.

FOR DETAILS OF GUARDRAIL ELEMENT, SPlice JOINT, HARDWARE, ETC. SEE SHEET NO. 501.07.

THE GUARDRAIL AND MEDIAN BARRIER COMPONENTS DEPICTED IN A.R.T.B.A. TECHNICAL BULLETIN NUMBER 268E MAY BE SUBSTITUTED IF INTERCHANGEABLE WITH THE STANDARDS FOR GUARDRAIL (GRI) OR MEDIAN BARRIER (MB) AND APPROVED BY THE ENGINEER.

**POST SPACING ON CURVES**

<table>
<thead>
<tr>
<th>PAVEMENT &amp; Radius</th>
<th>Post Spacing</th>
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<tr>
<td>&gt; 220 FT. R</td>
<td>12&quot; - 6&quot;</td>
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<tr>
<td>219 FT. - 111 FT.</td>
<td>6&quot; - 3&quot;</td>
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<tr>
<td>110 FT. - 76 FT.</td>
<td>3&quot; - 1 1/2&quot;</td>
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<tr>
<td>75 FT. - 50 FT.</td>
<td>1 1/2&quot;</td>
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USE NOT RECOMMENDED

S 3 X 5.7 STEEL POST

2-SQUARE WASHERS REQUIRED EACH POST (SEE DETAIL THIS SHEET)

5/8" BOLT AND NUT (SEE DETAIL THIS SHEET)

5/8" DIA. HOLE FOR 5/8" SUPPORT BOLT 1 1/2" LONG, 2 NUTS, NO WASHER.

SPECIFICATION REFERENCE

221 505

STANDARD W BEAM GUARDRAIL (WEAK POST SYSTEM)

TL-3 (>45 MPH)

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 7/03 501.14
NOTES:

1. THIS DESIGN SHALL BE USED AFTER AN ANALYSIS INDICATES IT IS MORE COST EFFECTIVE THAN PROVIDING THE FLARE FOR A STANDARD GR-9 OR EXTENDING THE GUARDRAIL TO PROVIDE A STANDARD GR-9 TERMINAL.

2. ALL TERMINALS SHALL BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTALLATION INSTRUCTION WITH THE RESTRICTION THAT WITH VDOT STANDARDS A MINIMUM OF (4) FOUR STEEL TUBES ARE REQUIRED WHEN WOOD POSTS ARE USED.

3. ALTERNATE BREAKAWAY CABLE TERMINAL (GR-9) IS TO BE ET-2000 (AS SHOWN), OR CAT AS MANUFACTURED BY SYRO STEEL COMPANY, BRAKEMASTER AS MANUFACTURED BY ENERGY ABSORPTION SYSTEMS, INC., THE BEST SYSTEM AS MANUFACTURED BY INTERSTATE STEEL CORPORATION, THE SKI-350 AS MANUFACTURED BY ROAD SYSTEMS INC., OR OTHER VDOT APPROVED EQUAL MEETING NCHRP 350 TESTING CRITERIA.

4. ALL STANDARD GR-9 TERMINALS WILL BE INSTALLED WITH AN OFFSET TO PREVENT THE GUARDRAIL EXTRUSION FROM ENCROACHING ON THE Shoulders. PLEASE REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR SPECIFIC INFORMATION ON THEIR TERMINAL SYSTEMS RECOMMENDED OFFSETS AND STRAIGHT LINE FLARE RATES.

FOR DETAILS, DIMENSIONS, QUANTITIES, AND OTHER INFORMATION NOT SHOWN HEREIN, SEE INDIVIDUAL MANUFACTURER'S PLANS.

5. THE GUARDRAIL AND MEDIAN BARRIER COMPONENTS DEPICTED IN A.R.T.T.A TECHNICIAN BULLETIN NUMBER 268B MAY BE SUBSTITUTED IF INTERCHANGEABLE WITH THE STANDARDS FOR GUARDRAIL (GR-9) OR MEDIAN BARRIER (MB) AND APPROVED BY THE ENGINEER.

6. CRT POSTS REQUIRED ON POST NUMBERS 5, 6, 7, AND 8.

7. DIRECTION OF TAPE SHALL CONFORM TO MUTCD APPLICATION FOR DIAGONAL STRIPES ON OBJECT MARKERS.

8. AND BRIDGE END PANELS. COLOR OF TAPE SHALL BE AMBER (YELLOW).

SPECIFICATION REFERENCE
505

ALTERNATE BREAKAWAY CABLE TERMINAL
NO FLARE

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 7/03
501.18
TRAILING END TERMINAL TREATMENT

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
505
221
W BEAM GUARDRAIL INSTALLATION CRITERIA

Virginia Department of Transportation

Rev. 7/03
501.38
**GUARDRAIL POST CONNECTION DETAIL**

**S3X5.7 STEEL POST**

**STANDARD W BEAM MEDIAN BARRIER (WEAK POST SYSTEM)**

**TL-3 (>45 MPH)**

**NOTES:**
- STANDARD MB-5 POST SPACING IS 12'-6".
- STANDARD MB-5A POST SPACING IS 6'-3".
- STANDARD MB-5A POST SPACING IS 3'-11/4".
- STANDARD MB-5 DEFLECTION IS 8'-0".

ALL POSTS, BOLTS, NUTS AND WASHERS ARE TO BE GALVANIZED.

FOR DETAILS OF GUARDRAIL ELEMENT, HARDWARE, ETC. SEE SHEET NO. 501.01.

FOR DETAILS OF GUARDRAIL SPLICE JOINT, SEE STD. GR-8 DEPICTING AN ACHRP 350 TL-3 INSTALLATION.
MAILBOXES SHALL BE OF LIGHT SHEET METAL OR PLASTIC CONSTRUCTION CONFORMING TO THE REQUIREMENTS OF THE U.S. POSTAL SERVICE.

MAILBOX SUPPORTS SHALL NOT BE SET IN CONCRETE UNLESS THE SUPPORT DESIGN HAS BEEN SHOWN TO BE SAFE BY CRASH TESTS WHEN SO INSTALLED.

POSTS MAY BE 4" X 4" OR 4 1/2" DIAMETER WOOD POST, 2" DIAMETER STANDARD STRENGTH STEEL PIPE, OR OTHER STEEL OR ALUMINUM POST SHAPES OF EQUAL STRENGTHS.

THE POST-TO-BOX ATTACHMENT DETAILS SHOULD BE OF SUFFICIENT STRENGTH TO PREVENT THE BOX FROM SEPARATING FROM THE POST TOP IF THE INSTALLATION IS STRUCK BY A VEHICLE. HARDWARE SHOWN IS SUGGESTED ONLY, ALL GUIDELINES AS REQUIRED BY THE U.S. POSTAL SERVICE MUST BE FOLLOWED.

* DIMENSIONS VARY ACCORDING TO THE SIZE OF THE MAIL BOX.

STANDARD MAILBOX

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

NONE

Rev. 7/03

603.01
### TURNOUT DETAIL

**NOTES:**

1. If there is a need to provide for increased access, the following may be considered in conjunction with the local postmaster:
   
   | PROVIDE A LEVEL CLEAR FLOOR SPACE 30 in. x 48 in. centered on the box for either side or forward approach. |
   | PROVIDE AN ACCESSIBLE PASSAGE TO AND FROM THE MAILBOX AND PROJECTION INTO A CIRCULATION ROUTE NO MORE THAN 4 in. IF BETWEEN 28 in. AND 30 in. FROM SO THAT THE MAILBOX DOES NOT BECOME A PROTRUDING OBJECT FOR PEDESTRIANS WITH IMPAIRED VISION. |

2. STRIVE FOR A 6 ft. MINIMUM; HOWEVER, IN SOME SITUATIONS THIS MAY NOT BE PRACTICAL. IN THOSE CASES, PROVIDE AS MUCH AS POSSIBLE.

3. IF A TURNOUT IS PROVIDED, THIS MAY REDUCE TO ZERO.

4. BEHIND TRAFFIC-FACE OF CURB.

#### TABLE

<table>
<thead>
<tr>
<th>HIGHWAY TYPE AND ADT, (vpd)</th>
<th>WIDTH OF ALL-WEATHER SURFACE TURNOUT OR AVAILABLE SHOULDER AT MAILBOX, 1 ft.</th>
<th>DISTANCE ROADSIDE FACE OF MAILBOX IS TO BE OFFSET BEHIND EDGE OF TURNOUT OR USEABLE SHOULDER, FT.</th>
<th>MINIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>RURAL HIGHWAY</td>
<td>12</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>OVER 10,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RURAL HIGHWAY</td>
<td>12</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>OVER 1,500 to 10,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RURAL HIGHWAY</td>
<td>10</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>UNDER 400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RURAL HIGHWAY</td>
<td>8 (5)²</td>
<td>8 TO 12</td>
<td></td>
</tr>
<tr>
<td>UNDER 400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESIDENTIAL STREET WITHOUT CURB OR ALL-WEATHER SHOULDER</td>
<td>6</td>
<td>0.00</td>
<td>10³</td>
</tr>
<tr>
<td>CURBED RESIDENTAL STREET</td>
<td>NOT APPLICABLE</td>
<td>(8 TO 12)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES TO TABLE:**

1. ADT- AVERAGE DAILY TRAFFIC VPD= VEHICLES PER DAY

**SPECIFICATION REFERENCE**

302

VIRGINIA DEPARTMENT OF TRANSPORTATION

Rev. 7/03

603.02
### URBAN LOW SPEED DESIGN TABLE

<table>
<thead>
<tr>
<th>DV/NC (MPH)</th>
<th>MAX. f</th>
<th>C</th>
<th>MIN. LS (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>0.161</td>
<td>2.75</td>
<td>125</td>
</tr>
<tr>
<td>40</td>
<td>0.178</td>
<td>3.00</td>
<td>115</td>
</tr>
<tr>
<td>35</td>
<td>0.197</td>
<td>3.25</td>
<td>100</td>
</tr>
<tr>
<td>30</td>
<td>0.221</td>
<td>3.50</td>
<td>90</td>
</tr>
<tr>
<td>25</td>
<td>0.252</td>
<td>3.75</td>
<td>80</td>
</tr>
<tr>
<td>20</td>
<td>0.300</td>
<td>4.00</td>
<td>75</td>
</tr>
</tbody>
</table>

**GENERAL DESIGN CONSIDERATIONS**

1. When "URBAN LOW SPEED" DESIGNS UTILIZE SUPERELEVATION, THEY WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE NORMAL CROWN (TYPICALLY 2.0%) AND THE APPROXIMATE MAXIMUM SAFE SPEED (DV) AFFORDED THEREBY.

2. When "URBAN LOW SPEED DESIGN" WITH NO SUPERELEVATION, THE APPROXIMATE MAXIMUM SAFE SPEED (NC) IS CALCULATED USING A NEGATIVE NORMAL CROWN (TYPICALLY -2.0%).

3. When the curve is superelevated, the LS is applied in the same manner as in urban conditions with the crown runoff (CR) being equal to the LS value. The crown runoff (CR) is always achieved outside of the transition (LS).

4. Please note that the radius values listed on page 802.24 have been rounded up to the nearest foot.

**EXAMPLES**

DV = 21 mph

\[ e = -2.0 \% \]

\[ f = \text{MAX} \left\{ \left| f \right| \right\} \text{INTERPOLATED DIFFERENCE BETWEEN LISTED FRICTION FACTORS} \]

\[ f = 0.300 \times \frac{1}{50} (0.300 - 0.2521) = 0.2904 \text{ (ROUND TO 0.29)} \]

LS = 47.2 ft/V/C

LS = 47.20(0.29/21) + 71.862 ft,

71.862 ft therefore LS=90 ft.

Rmin. = \[ \frac{DV^2}{15(e+f)} \]

\[ Rmin. = \frac{(21)^2}{15(-2.0+0.29)} = 94.83870968 \text{ FT.} \]

NC = 37 mph

\[ e = -2.0 \% \]

\[ f = \text{MAX} \left\{ \left| f \right| \right\} \text{INTERPOLATED DIFFERENCE BETWEEN LISTED FRICTION FACTORS} \]

\[ f = 0.197 \times \frac{1}{50} (0.197 - 0.1751) = 0.1894 \text{ (ROUND TO 0.189)} \]

Rmin. = \[ \frac{NC^2}{15(e+f)} \]

\[ Rmin. = \frac{(37)^2}{15(-2.0+0.29)} = 540.0394477 \text{ FT.} \]

**METHODOLOGIES FOR CALCULATING TC-5.01 VALUES FOR URBAN LOW-SPEED STREETS**

**Rev. 7/03**

**802.21**

**VIRGINIA DEPARTMENT OF TRANSPORTATION**
CURVE WIDENING TABLES

SU DESIGN VEHICLE

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OVERALL WIDTH (w)</td>
<td>8.0 ft</td>
</tr>
<tr>
<td>WHEELBASE (L)</td>
<td>20 ft</td>
</tr>
<tr>
<td>FRONT OVERHANG (A)</td>
<td>4 ft</td>
</tr>
</tbody>
</table>

LATERAL CLEARANCE

<table>
<thead>
<tr>
<th>LANE WIDTH CLEARANCE (c)</th>
<th>9 ft</th>
<th>10 ft</th>
<th>11 ft</th>
<th>12 ft</th>
<th>18 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5 ft</td>
<td>2 ft</td>
<td>2.5 ft</td>
<td>3 ft</td>
<td>5 ft</td>
</tr>
</tbody>
</table>

ADJUSTMENT FACTORS

<table>
<thead>
<tr>
<th>NUMBER OF LANES ROTATED (n)</th>
<th>ADJUSTMENT FACTOR (β)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>1.5</td>
<td>0.8533</td>
</tr>
<tr>
<td>2</td>
<td>0.75</td>
</tr>
<tr>
<td>2.5</td>
<td>0.6667</td>
</tr>
<tr>
<td>3</td>
<td>0.6425</td>
</tr>
</tbody>
</table>

RELATIVE GRADIENTS

<table>
<thead>
<tr>
<th>DESIGN SPEED (V)</th>
<th>MAXIMUM RELATIVE GRADIENT (r)</th>
<th>MIN. TRANSITION LENGTH IN FEET (W) WITH PAVEMENT WIDENING AND REVERSE CURVES FOR ALL CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.74</td>
<td>59</td>
</tr>
<tr>
<td>25</td>
<td>0.70</td>
<td>74</td>
</tr>
<tr>
<td>30</td>
<td>0.66</td>
<td>88</td>
</tr>
<tr>
<td>35</td>
<td>0.62</td>
<td>103</td>
</tr>
<tr>
<td>40</td>
<td>0.58</td>
<td>117</td>
</tr>
<tr>
<td>45</td>
<td>0.54</td>
<td>132</td>
</tr>
<tr>
<td>50</td>
<td>0.50</td>
<td>147</td>
</tr>
<tr>
<td>55</td>
<td>0.47</td>
<td>161</td>
</tr>
<tr>
<td>60</td>
<td>0.45</td>
<td>176</td>
</tr>
<tr>
<td>65</td>
<td>0.43</td>
<td>191</td>
</tr>
<tr>
<td>70</td>
<td>0.40</td>
<td>225</td>
</tr>
</tbody>
</table>

A - FRONT OVERHANG OF DESIGN VEHICLE FROM APPROPRIATE TABLE.
bw - ADJUSTMENT FACTOR FROM TABLE.
C - LATERAL CLEARANCE OF DESIGN VEHICLE FROM APPROPRIATE TABLE.
E - SUPERELEVATION RATE FROM APPROPRIATE TABLE.
FA - CALCULATED WIDTH OF OVERHANG FOR DESIGN VEHICLE.
L - WHEELBASE OF DESIGN VEHICLE FROM APPROPRIATE TABLE.
LS - LENGTH OF SPIRAL OR SUPERELEVATION TRANSITION LENGTH.

DEFINITIONS

M - MULTIPLE LANE FACTOR.
N - NUMBER OF LANES.

r - NUMBER OF LANES ROTATED (FROM TABLES).
Pw - PAVEMENT WIDTH.
R - RADIUS OF CURVE.
w - CALCULATED WIDENING.

Wc - CALCULATED TOTAL CURVE WIDTH.
Wp - WIDTH OF LANE.

Z - CALCULATED EXTRA WIDTH ALLOWANCE.

U - CALCULATED TRACK WIDTH OF DESIGN VEHICLE.
V0 - DESIGN VELOCITY.

GENERAL DESIGN CONSIDERATIONS

1. WHERE PAVEMENT WIDENING IS REQUIRED, THE APPROPRIATE WIDENING IS ADDED TO THE LANE WIDTH WHEN CALCULATING THE TRANSITION LENGTH (LS).
2. THE COMPUTED TRANSITION LENGTH (LS) IS ROUNDED UP TO THE NEAREST FOOT.
3. WHEN THE TRANSITION LENGTH (LS) IS CALCULATED, IT MUST BE COMPARED WITH THE MINIMUM VALUE LISTED IN THE APPROPRIATE COLUMN ON THE RELATIVE GRADIENT TABLE.
4. CROWN RUNOFF IS ALWAYS ACHIEVED OUTSIDE OF THE TRANSITION.
5. NO PAVEMENT WIDENING IS REQUIRED FOR URBAN ROADS.
6. NO PAVEMENT WIDENING IS REQUIRED FOR RURAL ROADS WITH A CURVE RADIUS GREATER THAN 2865 FEET.
7. NO PAVEMENT WIDENING IS REQUIRED FOR RURAL ROADS WITH 12 FOOT WIDE LANES AND A CURVE RADIUS GREATER THAN 600 FEET.
8. PAVEMENT WIDENING IS APPLIED ONLY WHEN CALCULATED WIDENING (w) IS EQUAL TO OR GREATER THAN 2 FEET.
9. WHEN CALCULATING WIDENING (w) FOR MULTI-LANE ROADWAYS, WIDENING IS FIRST CALCULATED USING THE SINGLE LANE WIDTH FOR "w".
10. AN ALTERNATE METHOD FOR MULTI-LANE UNDIVIDED PAVEMENTS (48), THE LS IS 1.5 TIMES (M+1) THE CORRESPONDING LENGTH FOR TWO LANE HIGHWAYS, AND FOR SIX LANE UNDIVIDED PAVEMENTS (72), THE LS IS TWO TIMES (M-2) THE CORRESPONDING LENGTH FOR TWO LANE HIGHWAYS.
11. CALCULATED WIDENING IS MEASURED AS THE NEAREST 0.1 FOOT.
12. CURVES WITH SPIRAL CURVE TRANSITIONS MUST HAVE A MINIMUM TRANSITION LENGTH (LS) EQUAL TO 2 SECONDS OF TRAVEL TIME AT THE ROADWAY'S DESIGN SPEED AS NOTED IN THE RELATIVE GRADIENT TABLE.

FORMULAS USED TO CALCULATE TRANSITION LENGTH (LS) AND WIDENING (w)

LS = b w (R - n E r) (ALT. MULTI-LANE)
LS = M w (R - n E r) (ALT. MULTI-LANE)
LS = M w (R - n E r) (ALT. MULTI-LANE)

U = u = R - v^2 - L^2
Z = (V0 / sqrt R)
W = Wc - 2Wp

FOR SOLVED PROBLEMS USING THIS METHODOLOGY, SEE THE EXAMPLES ON PAGE 802.23

METHODOLOGIES FOR CALCULATING TC-5.01 VALUES

REV. 7/03
802.22