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 for the following seven (7) sheets only. Changes to these sheets will not affect the basis of payment or estimates.

<table>
<thead>
<tr>
<th>PAGE</th>
<th>STANDARD</th>
<th>REVISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>608.01</td>
<td>SD-1</td>
<td>Updated title of sheet.</td>
</tr>
<tr>
<td>608.06</td>
<td>SD-4</td>
<td>Revised title of sheet.</td>
</tr>
<tr>
<td>608.07</td>
<td>SD-4</td>
<td>Revised title of sheet.</td>
</tr>
<tr>
<td>608.08</td>
<td>SD-5</td>
<td>Revised title of sheet.</td>
</tr>
<tr>
<td>608.09</td>
<td>SD-5</td>
<td>Revised title of sheet.</td>
</tr>
<tr>
<td>802.21A</td>
<td>TC-5.04</td>
<td>Added a new sheet for TC-5.04 superelevation table.</td>
</tr>
<tr>
<td>802.24A</td>
<td>TC-5.04</td>
<td>Added a new sheet for TC-5.04 superelevation table.</td>
</tr>
</tbody>
</table>

The previous revision to sheets 802.21 and 802.24 in July 2005 have been voided and replaced with new sheets 802.21A and 802.24A and relabeled TC-5.04 for urban low speed. The revision prior to the July 2005 revision to these sheets is still valid as the TC-5.01 standard for urban low speed.
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. They are available electronically in PDF format on the VDOT web site. The respective insertable sheet number has been placed with the revised standard. An insertable sheet is available for each of these revised standards in Falcon DMS for VDOT personnel and on the FTP server for consultants working on VDOT projects. These insertable sheets will be required in plan assemblies for projects utilizing the standard items listed below effective with the September 2006 advertisement.

<table>
<thead>
<tr>
<th>PAGE</th>
<th>INSERT</th>
<th>STANDARD</th>
<th>REVISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>104.31</td>
<td>a163</td>
<td>DI-12, 12A</td>
<td>Revised previous four-sided frame with a two sided frame and increased the depth of the grate.</td>
</tr>
<tr>
<td>104.33</td>
<td>a164</td>
<td>DI-12B, 12C</td>
<td>Revised previous four-sided frame with a two sided frame and increased the depth of the grate.</td>
</tr>
<tr>
<td>104.34</td>
<td>a164</td>
<td>DI-12B, 12C</td>
<td>Revised previous four-sided frame with a two sided frame and increased the depth of the grate.</td>
</tr>
<tr>
<td>104.38</td>
<td>a170</td>
<td>DI-14</td>
<td>Corrected rebar label for drop inlet structure.</td>
</tr>
<tr>
<td>104.39</td>
<td>a170</td>
<td>DI-14</td>
<td>Corrected an error in the table.</td>
</tr>
<tr>
<td>108.01</td>
<td>a80</td>
<td>UD-1</td>
<td>Revised note regarding connection to drainage structures.</td>
</tr>
<tr>
<td>108.02</td>
<td>a80</td>
<td>UD-2</td>
<td>Revised note regarding connection to drainage structures.</td>
</tr>
<tr>
<td>108.03</td>
<td>a55</td>
<td>UD-3</td>
<td>Revised note regarding connection to drainage structures.</td>
</tr>
<tr>
<td>108.07</td>
<td>a81</td>
<td>UD-4</td>
<td>Revised note regarding connection to drainage structures.</td>
</tr>
<tr>
<td>108.09</td>
<td>a83</td>
<td>UD-7</td>
<td>Revised note regarding connection to drainage structures.</td>
</tr>
<tr>
<td>203.01</td>
<td>a76</td>
<td>CG-9A</td>
<td>Revised the minimum width for pedestrian access routes from 3’ to 4’.</td>
</tr>
<tr>
<td>203.02</td>
<td>a78</td>
<td>CG-9B</td>
<td>Revised the minimum width for pedestrian access routes from 3’ to 4’.</td>
</tr>
<tr>
<td>PAGE</td>
<td>INSERT</td>
<td>STANDARD</td>
<td>REVISION</td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>----------</td>
<td>----------</td>
</tr>
</tbody>
</table>
| 203.03 | a78    | CG-9D    | Revised the minimum width for pedestrian access routes from 3’ to 4’.
| 203.08 | a108   | CG-13    | Revised the minimum width for pedestrian access routes from 3’ to 4’.
| 501.09 | a132   | GR-6     | Correct height of GR-2 leading into terminal treatment. |
| 501.16 | a136   | GR-SP    | Revised to match site preparation requirements in the 2002 AASHTO Roadside Design Guide. |
| 501.17 | a136   | GR-SP    | Revised to match site preparation requirements in the 2002 AASHTO Roadside Design Guide. |
| 605.01 | a171   | NG-1     | Added an additional lock to storage box. |
| 1301.30| a172   | SE-1     | Updated grounding system and identifies non-included pay items. |
| 1301.31| a172   | SE-1     | Updated grounding system and identifies non-included pay items. |
| 1301.32| a173   | SE-2     | Updated grounding system and identifies non-included pay items. |
| 1301.33| a174   | SE-3     | Updated grounding system and identifies non-included pay items. |
| 1301.34| a174   | SE-3     | Updated grounding system and identifies non-included pay items. |
| 1301.35| a173   | SE-4     | Updated grounding system and identifies non-included pay items. |
| 1301.36| a175   | SE-5     | Updated grounding system and identifies non-included pay items. |
| 1301.37| a175   | SE-6     | Updated grounding system and identifies non-included pay items. |
| 1301.38| a176   | SE-7     | Updated grounding system and identifies non-included pay items. |
1301.39  a176  SE-8  Updated grounding system and identifies non-included pay items.

1301.40  a177  SE-9  Updated grounding system and identifies non-included pay items.

1301.86  a178  PM-1  Added plan note and revised mainline pavement marking width.

1301.87  a178  PM-2  Added plan note and revised mainline pavement marking width.

The following three (3) sheets were revised by the Structure and Bridge Division on September 20, 2005 but have not been issued until this revision. The individual standard sheets that are to be placed in the 2001 Road and Bridge Standards have been dated 9/20/05 while the insertable sheets that will be inserted into plan assemblies have the 2/06 revision date.

1301.72  a154  OSS-1  Revised anchor bolt notes.

1301.78  a167  BSS-1  Revised anchor bolt notes.

1301.79  a157  SPD-1  Revised bolts for attaching z-bar to sign panel.

Insertable sheet A-97, Solid Paving Units (Sidewalk and Crosswalk) has been eliminated. Any projects specifying concrete or clay brick pavers for sidewalks or crosswalks will require a special design. Please contact Al Bryan, Landscape Architect, at (804) 371-6737 with questions concerning pavers and their applications.

If you have any questions or comments regarding the listed revisions to this publication, please contact Steve Van Cleef of the Standards and Special Design Section at (804) 786-2543.

Sincerely,

Mohammad Mirshahi, P.E.
State Location and Design Engineer
MULTIGRATE DROP INLET
FOR PIPE SIZES 12'' TO 72''

1. TYPE I GRATE: LIMITED ACCESS AND RURAL UNLIMITED ACCESS; PEDESTRIAN ACCESS UNLIKELY
2. TYPE II GRATE: URBAN AREAS; PEDESTRIAN ACCESSIBLE AREAS.
3. SEE GRATE DIMENSION TABLE FOR SIZE AND NUMBER OF GRATE OPENINGS REQUIRED FOR TYPE I AND TYPE II GRATE.
4. PAVED DITCHES ARE TO BE TRANSITIONED TO MEET INLET GUTTER AS SHOWN IN STANDARD PG-2A.
5. 3'' DIAMETER WEEP HOLE WITH 12'' X 12'' PLASTIC HARDWARE CLOTH 1/4 MESH OR GALVANIZED STEEL WIRE, MINIMUM WIRE DIAMETER 6.035, NUMBER 4 MESH HARDWARE CLOTH ANCHORED FIRMLY TO OUTSIDE OF STRUCTURE.
6. IF NORMAL DITCH GRADE IS TOO FLAT TO ALLOW FOR ADJUSTED GRADE TO INLET, A SPECIAL GUTTER DETAIL WILL BE REQUIRED ON PLANS.
7. GORATE BARS TO BE PARALLEL TO DITCH FLOW.
8. DI-12 AND DI-12A ARE NOT TO BE UTILIZED IN LOCATIONS NORMALLY SUBJECT TO TRAFFIC.

NOTES:

LONGITUDINAL SECTION
(WHEN INLET IS LOCATED ABOVE NORMAL DITCH GRADE)

SECTION A-A
(CHAMBER NOT SHOWN)
(SLOT MAY BE CAST IN PLACE OR PRECAST)

SECTION B-B
(CHAMBER NOT SHOWN)

CONCRETE GUTTER TO BE USED WITH DI-12A ONLY

SEE TABULATION CHART FOR INTERMEDIATE LENGTH

BARS L Ø 6 1/2'' C-C
BARS V Ø 12'' C-C
DOWELS Ø 12'' C-C
BARS C Ø 6'' C-C

FRAME AND GRATE PLAN

FRAME SECTION X-X

FRAME SECTION Y-Y

FRAME ANCHOR 3/8'' DIAMETER BENT BAR

FRAME SECTION X-X

FRAME SECTION Y-Y

FOR 3/8'' DIA. BAR

CONCRETE GUTTER 4'' DEPTH
4'' DEPTH AGGREGATE #68, 478, OR #8 X 6'' WIDTH

12'' C-C

FRAME ANCHOR

HARDWARE CLOTH

01:1 SLOPE

LONGITUDINAL SECTION
(WHEN INLET IS LOCATED ABOVE NORMAL DITCH GRADE)

BACK-UP BERM TO BE PROVIDED AS DIRECTED
NORMAL, MEDIAN, DITCH GRADE

GRADE DIMENSIONS

<table>
<thead>
<tr>
<th>GRATE TYPE</th>
<th>OPENING WIDTH (1)</th>
<th>BAR THICKNESS (2)</th>
<th>END SECTION WIDTH (3)</th>
<th>GRADE THICKNESS (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE I</td>
<td>3/4'' 5 OPENINGS</td>
<td>1 1/2'' 4 BARS</td>
<td>2 1/4''</td>
<td>3 1/4''</td>
</tr>
<tr>
<td>TYPE II</td>
<td>1/2'' 8 OPENINGS</td>
<td>1 1/2'' 7 BARS</td>
<td>2 3/4''</td>
<td>3 1/4''</td>
</tr>
</tbody>
</table>

REV. 2/06
104.31
NOTES

1. DEPTH OF INLET (H) TO BE SHOWN ON PLANS. FOR DEPTH GREATER THAN 6'-6", USE STD. DI-12, DI-12A.

2. THE "H" DIMENSION SHOWN ON THE STANDARDS AND SPECIFIED ON THE PLANS WILL BE MEASURED FROM THE INVERT OF THE OUTFALL PIPE TO THE TOP OF THE STRUCTURE. PLAN "H" DIMENSIONS ARE APPROXIMATE ONLY FOR ESTIMATING PURPOSES AND THE ACTUAL DIMENSIONS SHALL BE DETERMINED BY THE CONTRACTOR FROM FIELD CONDITIONS.

3. WHEN SPECIFIED ON THE PLANS THE INVERT IS TO BE SHAPED IN ACCORDANCE WITH STANDARD IS-1. THE COST OF FURNISHING AND PLACING ALL MATERIALS INCIDENTAL TO THE SHAPING IS TO BE INCLUDED IN THE BID PRICE FOR THE STRUCTURE.


5. STEPS ARE TO BE PROVIDED WHEN H IS 4'-0" OR GREATER. FOR DETAILS SEE STANDARD ST-1.

6. THIS ITEM MAY BE PRECAST OR CAST-IN-PLACE.

7. #1 DOWELS 12" LONG, 2" C-C TO BE PLACED IN ALL AREAS ADJACENT TO ALUMINUM CONCRETE TO PREVENT SETTLEMENT.

8. 3" DIAMETER WEEP HOLE 12"X12" PLASTIC HARDWARE CLOTH 3/8" MESH OR GALVANIZED STEEL WIRE, MINIMUM WIRE DIAMETER 0.03". NUMBER 4 MESH HARDWARE CLOTH ANCHORED FIRMLY TO THE OUTSIDE OF THE STRUCTURE.

9. ALL REINFORCING STEEL SHALL HAVE A MIN. COVER OF 2".

10. ALL REINFORCING STEEL TO BE CUT CLEAR OF ALL OPENINGS BY 2".

11. CAST-IN PLACE CONCRETE IS TO BE CLASS A3 (3000 PSI). PRECAST CONCRETE IS TO BE 4000 PSI.

12. LENGTH OF SLOT L1 WILL BE IN EVERY CASE, BE SHOWN ON PLANS.

13. ALL REINFORCING BARS TO BE #4.

14. DI-12C CONCRETE GUTTER INCREMENT: ADD 0.07 CU. YDS. OF CLASS A3 CONCRETE FOR EACH ADDITIONAL FOOT OF SLOT LENGTH GREATER THAN 3'-8".

15. GUTTER BARS TO BE INSTALLED SO THEY WILL BE ALIGNED PARALLEL TO THE DITCH FLOW.

16. IF NORMAL DITCH GRADE IS TOO FLAT TO ALLOW FOR ADJUSTED GRATE TO INLET A SPECIAL GUTTER DETAIL WILL BE REQUIRED ON PLANS.

17. DI-12B----NO GUTTER, DI-12C----PERIMETRAL GUTTER.

18. PAVED DITCHES ARE TO BE TRANSITIONED TO MEET INLET GUTTER AS SHOWN IN STANDARD PC-2A

19. QUANTITIES SHOWN ARE FOR INLETS WITHOUT PIPES. PIPE DISPLACEMENTS MUST BE DEDUCTED TO OBTAIN TRUE QUANTITIES.

20. PAVED TRANSITION WHERE REQUIRED ON PLANS, TRANSITION IS TO BE SHAPED TO CONFORM TO ROUNDED GUTTER CONCRETE OF DI-12C.

21. TYPE I GRATE: LIMITED ACCESS AND RURAL UNLIMITED ACCESS.

22. TYPE II GRATE: URBAN AREAS: PEDESTRIAN ACCESSIBLE AREAS.

23. L = LENGTH ROUNDED FOR PLAN USE.

24. DI-12C: FOR APPROX. QUANTITIES FOR DI-12C, ADD 0.26 CU. YDS. OF CLASS A3 CONCRETE TO DI-12B QUANTITIES FOR CONCRETE GUTTER. QUANTITY SHOWN IS FOR A MINIMUM SLOT LENGTH OF 3'-8". FOR OTHER LENGTHS SEE CONCRETE GUTTER INCREMENT BELOW.

25. DI-12B AND DI-12C ARE NOT TO BE UTILIZED IN LOCATIONS NORMAL TO TRAFFIC.

TABULATION CHARTS

APPROXIMATE QUANTITIES DI-12B ONLY
(SEE NOTES 19 & 24)

<table>
<thead>
<tr>
<th>L1 (SEE NOTE 23)</th>
<th>L1</th>
<th>CONCRETE CU. YDS.</th>
<th>REINFORCING STEEL LB.</th>
<th>NUMBER GRATES</th>
<th>CONCRETE CHAMBER INCREMENTS PER FOOT CU. YDS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5'</td>
<td>0.39</td>
<td>812.7</td>
<td>2</td>
<td>.35</td>
</tr>
<tr>
<td>6</td>
<td>5'-8'</td>
<td>1.28</td>
<td>122.81</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7'-8'</td>
<td>1.48</td>
<td>161.90</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>9'-8'</td>
<td>1.79</td>
<td>203.37</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>11'-8'</td>
<td>2.09</td>
<td>242.45</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>13'-8'</td>
<td>2.40</td>
<td>283.93</td>
<td>7</td>
<td></td>
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</tbody>
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MULTIGRATE DROP INLET
FOR PIPE SIZES 12" TO 36"

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/06 104.34

SHEET 2 OF 2

SPECIFICATION REFERENCE

241 503
CONCRETE MEDIAN BARRIER DROP INLET

12" - 36" PIPE: DEPTH (H) = 20' - 0" MAX.

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/06

104.3B
<table>
<thead>
<tr>
<th>TYPE</th>
<th>L</th>
<th>CONCRETE</th>
<th>REINFORCING STEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type I</td>
<td>Type II</td>
</tr>
<tr>
<td>D1-14A</td>
<td>4</td>
<td>2.23</td>
<td>2.20</td>
</tr>
<tr>
<td>D1-14B</td>
<td>4</td>
<td>2.45</td>
<td>2.44</td>
</tr>
<tr>
<td>D1-14C</td>
<td>4</td>
<td>2.67</td>
<td>2.66</td>
</tr>
</tbody>
</table>

**NOTES**

1. DEPTH OF INLET (H) TO BE SHOWN ON PLANS.

2. THE "H" DIMENSION SHOWN ON THE STANDARDS AND SPECIFIED ON THE PLANS WILL BE MEASURED FROM THE INVERT OF THE OUTFALL PIPE TO THE TOP OF THE STRUCTURE.

3. WHEN EXECUTED ON THE PLANS THE INVERT IS TO BE SHAPED IN ACCORDANCE WITH STANDARD IS-1 THE COST OF FURNISHING AND PLACING ALL MATERIALS INCIDENTAL TO THE SHAPING IS TO BE INCLUDED IN THE BID PRICE FOR THE STRUCTURE.


5. STEPS ARE TO BE PROVIDED WHEN IT IS 4'-0" OR GREATER, FOR DETAILS SEE STANDARD ST-1.


7. CONCRETE QUANTITIES SHOWN ARE FOR DEPTH (H) OF 3'-0" WITHOUT PIPES, THE EFFECT DISPLACED BY PIPES MUST BE DEDUCTED TO OBTAIN TRUE QUANTITIES. FOR INLETS OF DIFFERENT DEPTHS ADD OR SUBTRACT 0.15 CUBIC YARDS OF CONCRETE FOR EACH FOOT OF DEPTH AND 84 LBS. OF REINFORCING STEEL.

8. LENGTH OF ANGLE IRON AS SHOWN ON SHEET 1 OF 2 IS TO BE 2'-16" AT 4.10 LBS./FT."

9. *DENOTES LENGTH OF ONE (1) BAR.

10. GRADE TO BE INSTALLED so SLOTS WILL DIRECT WATER TOWARD THE INLET THROAT. GRATE MUST BE REVERSIBLE (RIGHT HAND GRATE IS SHOWN).

11. PROVIDE SAFETY SLABS WHEN SPECIFIED ON THE PLANS.

12. FOR DETAILS AND DIMENSIONS NOT SHOWN FOR MEDIU BARRIER SEE STANDARD MB-12.

13. QUANTITIES INCLUDE MB-12.
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>0.53</td>
</tr>
<tr>
<td>CORRUGATED PE</td>
<td>AASHTO M-252</td>
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NON-PERFORATED OUTLET PIPE

<table>
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<tr>
<th>TYPE OF PIPE</th>
<th>CRUSHING STRENGTH</th>
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</thead>
<tbody>
<tr>
<td>SMOOTH WALL PVC</td>
<td>0.53</td>
</tr>
<tr>
<td>SMOOTH WALL PE</td>
<td>70 PSI ☠️</td>
</tr>
</tbody>
</table>

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

NOTES:
1. WHERE THE LONGITUDINAL PERFORATED PIPE ALIGNS WITH A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), A NON-PERFORATED OUTLET PIPE IS NOT REQUIRED. INSTEAD, THE PERFORATED PIPE IS TO BE CONNECTED DIRECTLY TO THE DRAINAGE STRUCTURE, WHERE THE LONGITUDINAL PERFORATED PIPE IS CONTINUOUS, IT SHALL BE CONNECTED TO EACH SIDE OF THE DRAINAGE STRUCTURE.

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 CONCIDENT 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 SUBBASE COURSES OUT TO THE DEPTH OF THE PAVEMENT.

8. OUTLET PIPE TO BE SECURELY CONNECTED TO E.W. 120 OR OTHER DRAINAGE STRUCTURE.

9. ☠️ DENOTES WATER TABLE.

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

SPECIFICATION REFERENCE:
240
501
701

STANDARD GROUNDWATER UNDERDRAIN

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/06
108.01
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>0.153</td>
</tr>
<tr>
<td>CORRUGATED PE</td>
<td>AASHO M-252</td>
</tr>
</tbody>
</table>

NON-PERFORATED OUTLET PIPE

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</tbody>
</table>

NOTES:
1. WHERE THE LONGITUDINAL PERFORATED PIPE ALIGNS WITH A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), A NON-PERFORATED OUTLET PIPE IS NOT REQUIRED. INSTEAD, THE PERFORATED PIPE IS TO BE CONNECTED DIRECTLY TO THE DRAINAGE STRUCTURE, WHERE THE LONGITUDINAL PERFORATED PIPE IS CONTINUOUS, IT SHALL BE CONNECTED TO EACH SIDE OF THE DRAINAGE STRUCTURE.

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 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 TRAVERSE UNDER CROSSOVER LOCATIONS, NON-PERFORATED OUTLET PIPE ONLY IS TO BE USED UNDER CROSSOVER PAVEMENT.

STANDARD UNDERDRAIN FOR USE WITH RAISED GRASS MEDIAN STRIPS

REV. 2/06
VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
240
701
501
NOTE:
1. WHERE THE LONGITUDINAL PERFORATED PIPE ALIGNS WITH A DRAINAGE STRUCTURE (DROP INLET, MANHOLE, ETC.), A NON-PERFORATED OUTLET PIPE IS NOT REQUIRED. INSTEAD, THE PERFORATED PIPE IS TO BE CONNECTED DIRECTLY TO THE DRAINAGE STRUCTURE. WHERE THE LONGITUDINAL PERFORATED PIPE IS CONTINUOUS, IT SHALL BE CONNECTED TO EACH SIDE OF THE DRAINAGE STRUCTURE.

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 TO BE OF THE SAME CRUSHING STRENGTH AS THE OUTLET PIPE.

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

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

6. SELLWALK UNDERDRAIN IS TO BE USED WHEN THE SELLWALK LONGITUDINAL GRADIENT IS 3% OR MORE AND WHEN THE UNDERLYING SOIL HAS 34 % OR MORE PASSING THE NO. 200 SIEVE, AND HAS A PFP OF 13 OR LESS, AND THE AREA HAS A HISTORY OF SELLWALK UNEVENING.

7. SELLWALK UNDERDRAINS SHOULD BE TIED INTO THE STORM SEWER SYSTEM AT POINTS APPROXIMATELY A CITY BLOCK APART. UNDERDRAIN RUNS MUST NOT EXCEED 5000 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 LIEU OF PERFORATED PIPE.

LONGITUDINAL PERFORATED PIPE

<table>
<thead>
<tr>
<th>TYPE OF PIPE</th>
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NON-PERFORATED PIPE FOR USE UNDER COMMERCIAL ENTRANCES AND FOR OUTLETS

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WALL THICKNESS (MIN) - INCHES

TESTED ACCORDING TO ASTM D-2412 AT 5% DEFLECTION.

SPECIFICATION
REFERENCE

232
501
701

STANDARD SIDEWALK UNDERDRAIN

VIRGINIA DEPARTMENT OF TRANSPORTATION
LONGITUDINAL PERFORATED PIPE

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

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

NOTES:
1. 4" minimum, provided attaining minimum 4" of aggregate on top of pipe.
2. Where the longitudinal perforated pipe aligns with a drainage structure (curb, inlet, manhole, etc.), a non-perforated outlet pipe is not required. Instead, the perforated pipe is to be connected directly to the drainage structure. Where the longitudinal perforated pipe is continuous, it shall be connected to each side of the drainage structure.
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 (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-120 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 man line in either direction.
9. In situations when full depth of stabilized open-graded material cannot be maintained under curb and gutter, No. 21B aggregate shall be used under curb and gutter; No. 21B aggregate may also be used from top of stabilized open-graded material layer and curb and gutter.
NOTES:
1. 4" minimum provided attaining minimum 4" of aggregate on top of pipe.
2. Where the longitudinal perforated pipe aligns with a drainage structure (drop inlet, manhole, etc.), a non-perforated outlet pipe is not required. Instead, the perforated pipe is to be connected directly to the drainage structure. Where the longitudinal perforated pipe is continuous, it shall be connected to each side of the drainage structure.
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 (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

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

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* WALL THICKNESS (MIN) - INCHES

XXX TESTED ACCORDING TO ASTM D-2412 AT 5% DEFLECTION.

STANDARD RETROFIT EDGEDRAIN

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/05

108.09
STANDARD ENTRANCE GUTTER WITH FLARED OPENING
FOR USE ACROSS SIDEWALK

WHEN USED IN CONJUNCTION WITH STANDARD CG-3 OR CG-7,
THE CURB FACE ON THIS STANDARD IS TO BE ADJUSTED
TO MATCH THE MOUNTABLE CURB CONFIGURATION.

1. FOR SIDEWALK, CURB AND GUTTER - BUILT CONCURRENTLY.
2. FOR INITIAL CURB AND GUTTER ONLY.
3. FOR INITIAL SIDEWALK ONLY - 7" SIDEWALK TO BE DIPPED.
4. FOR PEDESTRIAN ACCESS ROUTE - MINIMUM 4'-0" TRAVERSABLE
   WIDTH IS REQUIRED WITH A MAXIMUM 2% CROSS SLOPE.
5. FOR CURB AND GUTTER ONLY - AFTER INITIAL SIDEWALK.
6. FOR CURB AND SIDEWALK ONLY - WITHOUT GUTTER.
7. INDICATES POINT OF GRADE CHANGE.
STANDARD ENTRANCE GUTTER
FOR USE WITH UNPAVED SPACE BETWEEN CURB & SIDEWALK

Virginia Department of Transportation

Specification Reference
502

Rev.: 2/05
203.02
STANDARD ENTRANCE GUTTER

REV. 2/06
203.03

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE 502
PEDESTRIAN ACCESS ROUTE DETAIL

ADDITIONAL RIGHT-OF-WAY IS REQUIRED IF THE LIMITS OF PEDESTRIAN ACCESS ROUTE EXTEND BEYOND EXISTING OR PROPOSED FOOT RIGHT-OF-WAY.

DETAIL TO BE USED WHEN THE COMBINED WIDTH OF UNPAVED SPACE AND SIDEWALK SPACE IS LESS THAN 7'.

PEDESTRIAN ACCESS ROUTES PROVIDE A CONTINUOUS UNOBSTRUCTED, STABLE, FIRM AND SLIP RESISTANT PATH CONNECTING ALL ACCESSIBLE ELEMENTS OF A FACILITY THAT CAN BE APPROACHED, ENTERED AND USED BY PEDESTRIANS.

IF PEDESTRIAN ACCESS ROUTES ARE BEING PROVIDED, A MINIMUM 4' NON-TRAVERSABLE WIDTH IS REQUIRED WITH MAX. 2% CROSS SLOPE.

NOTES:
1. PROP. 7" SIDEWALK IS TO BE POURED MONOLITHICALLY WITH ENTRANCE OR BY USING PERMISSIBLE CONSTRUCTION JOINT WITH REQUIRED BARS.
2. PROPOSED 7" SIDEWALK TO BE CLASS A-3 CONCRETE.
3. REQUIRED BARS ARE TO BE NO. 5X8' PLACED 1 CENTER TO CENTER ALONG BACK OF CURB, MID-DEPTH OF SIDEWALK. MINIMUM CONCRETE COVER 1/3.
4. ALL DETAILS AND DIMENSIONS NOT SHOWN ARE THE SAME AS STANDARD CG-90.
5. THIS DESIGN MAY ALSO BE APPLIED TO OTHER ENTRANCE STANDARDS AS THE NEED ARISES.
6. WHEN USED IN CONJUNCTION WITH STANDARD CG-3 OR CG-7, THE CURB FACE ON THIS STANDARD IS TO BE ADJUSTED TO MATCH THE MOUNTABLE CURB CONFIGURATION.
7. SEE INSERTABLE SHEET A-59 FOR STANDARD CG-12 DETECTABLE WARNING DETAILS.

COMMERCIAL ENTRANCE
(HEAVY TRUCK TRAFFIC ANTICIPATED)
VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
502

REV. 2/06
203.08
BEND LOWER W-BEAM RAIL BEHIND POST AND ATTACH WITH 5/8" BOLT

TOE OF DITCH SLOPE

EDGE OF GRADED SHOULDER

EDGE OF TRAVEL LANE

EDGE OF SHOULDER

PLAN

W-BEAM RAIL HEIGHT CONSTANT RELATIVE TO ROADWAY PROFILE GRADE - SEE NOTES 1, 2 & 4

TAPER W-BEAM RAIL TO END ANCHORAGE SEE NOTES 3 & 4

SEE END ANCHORAGE DETAIL A SHEET 501.10

DISTANCE FROM TOP OF GUARD RAIL TO BOTTOM OF DITCH SHOULD NEVER EXCEED 45°

ELEVATION

27°1/4" + 2 1/2" MAX

SECTION A-A

SECTION B-B

SECTION C-C

TERMINAL TREATMENT FOR W BEAM GUARDRAIL

NOTES:
2. MAXIMUM DISTANCE BETWEEN BOTTOM OF THE LOWER W-BEAM RAIL AND GROUND LINE IS 56" WHEN DOUBLE RAIL IS REQ'D. TAPER BOTH W-BEAM RAILS TO MAINTAIN THE 18" DISTANCE FROM THE GROUND.
3. TAPER BOTH W-BEAM RAILS FROM HEIGHT AT TOE OF DITCH SLOPES TO 1'-0" BELOW FINISHED GRADE AT POST #1 (8'-0" OFFSET).
4. A 8'-0" 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 GR-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 6" X 6" X 6" X 6" WOOD EXCEPT THE LAST 3 TERMINAL POSTS MUST BE 6" X 6" X 6" STEEL.
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 RACKSLOPE IS 8° OR STEEPER THE W-BEAM MAY BEanchored PER SOLID ROCK CUT INSTALLATION (DETAIL F).
NOTES:
2. THE AREA IMMEDIATELY BEHIND AND BEYOND THE TERMINAL SHOULD BE TRAVERSABLE AND FREE FROM FIXED OBJECTS. IF A CLEAR RUN OUT IS NOT ATTAINABLE THIS AREA SHOULD AT LEAST BE SIMILAR IN CHARACTER TO THE UPSTREAM UN-SHIELDED ROADSIDE AREAS.
3. FOR NEW CONSTRUCTION, RECONSTRUCTION, AND 3R WORK THE 10:1 SLOPE GRADING MUST EXTEND A MINIMUM OF 5'-0" BEHIND THE END POST.
4. FOR PROPRIETARY GUARDRAIL TERMINALS, THE MANUFACTURER'S SITE PREPARATION REQUIREMENTS TAKE PREECEDENCE OVER THIS STANDARD.

GUARDRAIL TERMINAL INSTALLATION SITE PREPARATION REQUIREMENTS FOR GR-7

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
Rev. 2/06
NOTES:


2. THE AREA IMMEDIATELY BEHIND AND BEYOND THE TERMINAL SHOULD BE TRAVERSABLE AND FREE FROM FIXED OBJECTS. IF A CLEAR RUN OUT IS NOT ATTAINABLE THIS AREA SHOULD AT LEAST BE SIMILAR IN CHARACTER TO THE UPSTREAM UNSHIELDED ROADSIDE AREAS.

3. FOR NEW CONSTRUCTION AND RECONSTRUCTION THE 10:1 SLOPE GRADING MUST EXTEND A MINIMUM OF 5' BEHIND THE END POST.


6. FOR PROPRIETARY GUARDRAIL TERMINALS THE MANUFACTURER'S SITE PREPARATION REQUIREMENTS TAKE PREDENCE OVER THIS STANDARD.
NOTES:

NO SEPARATE PAYMENT WILL BE MADE FOR FURNISHING, INSTALLING, AND PROVIDING MAINTENANCE OF THE STORAGE FACILITY FOR NUCLEAR GAUGE AND THE PRICE THEREOF SHALL BE INCLUDED IN THE PRICE BID FOR FIELD OFFICE (TYPE) SPECIFIED IN SECTION 510 OF THE PROPERTY CONTRACT AND SPECIFICATIONS.

BOX TO BE CONSTRUCTED OF A36 SHEET STEEL 16GA MIN. THICKNESS.

WHEN WELDING TO FRAME USE 1/8" FILLET WELDS.

ALL FRAME WORK IS TO BE A36 STEEL ANGLE L 2" X 2" X 1/4".

ALL FRAME WELDS ARE TO BE 1/4" FILLET OR BUTT WELDED ACCORDINGLY.

METAL SCREEN SHALL HAVE A MAXIMUM OF 50 SQUARES PER INCH TO A MINIMUM OF 25 SQUARES PER INCH AND BE SPOT WELDED TO INSIDE OF THE BOX OVER VENT OPENINGS.

THE HOOK SHALL BE WELDED TO THE CENTER OF THE TOP VENT OPENINGS SHALL BE PARTIALLY COVERED EXTERNALLY BY METAL VENT COVERS.

STORAGE UNIT SHALL BE PAINTED INNERNALLY AND EXTERNALLY WITH A ONE COAT ACRYLIC DIRECT TO METAL (DTM) COATING, WITH A THICKNESS OF 4-6 MILS (WET MIL THICKNESS). COLOR SHALL BE EQUAL TO FEDERAL STANDARD COLOR NUM.595-17888 (WHITE).

THE DESIGN IS TO BE 4" D AND MOUNTED AT A 45° ANGLE OVER "HE HASP OPENING IN THE DOOR.

OPTIONAL SHOULDER DESIGN IS TO BE SUBMITTED FOR THE ENGINEERS REVIEW AND APPROVAL.

CONTRASTING PAINT IS REQUIRED TO DEPICT STORAGE AREA.

STORAGE UNIT TO HAVE TWO (2) TAMPER-RESISTANT HASPS WITH A LOCK BOX EACH, OPEN ON THE BOTTOM AND TOP.

STORAGE FACILITY FOR NUCLEAR GAUGE

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/08
605.01
LENGTH OF ARC SUBLTENDED OR CLEAR SIGHT DISTANCE MEASURED ALONG CENTER LINE OF INSIDE LANE (S)

INTERMEDIATE VALUES OF S AND M NOT LISTED ON GRAPH CAN

MARK EQUAL TO 10' SIGHT DISTANCE (S) AND 1' OF RADIAL DISTANCE (M).

SIGHT DISTANCES ON HORIZONTAL CURVES
HEIGHT OF EYE 3.5 FT.; HEIGHT OF OBJECT 2.0 AND 3.5 FT.

2.0 FEET STOPPING
3.5 FEET PASSING
LINE OF SIGHT AT MID-POINT TO BE 2.0' ABOVE EDGE OF PAVEMENT FOR STOPPING SIGHT DISTANCE, AND 4.0' FOR PASSING SIGHT DISTANCE.
### Length of Vertical Curve in Feet

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### Stopping Sight Distance on Crest Vertical Curves

**Height of Eye = 3.5 feet**

**Height of Object = 2.00 feet**

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV 02/06

608.06
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</tr>
<tr>
<td>2000</td>
<td>1980</td>
<td>1982</td>
</tr>
</tbody>
</table>

\( L = \text{Length of Vertical Curve in Feet} \)

\( S = \text{Sight Distance in Feet} \)

VEHICLE SIZES (FOOT) 3.5 FEET

VEHICLE SIZES (FOOT) 4.5 FEET

VEHICLE SIZES (FOOT) 5.5 FEET

VEHICLE SIZES (FOOT) 6.5 FEET

VEHICLE SIZES (FOOT) 7.5 FEET

VEHICLE SIZES (FOOT) 8.5 FEET

VEHICLE SIZES (FOOT) 9.5 FEET

VEHICLE SIZES (FOOT) 10.5 FEET

VEHICLE SIZES (FOOT) 11.5 FEET

VEHICLE SIZES (FOOT) 12.5 FEET

VEHICLE SIZES (FOOT) 13.5 FEET

VEHICLE SIZES (FOOT) 14.5 FEET

VEHICLE SIZES (FOOT) 15.5 FEET

VEHICLE SIZES (FOOT) 16.5 FEET

VEHICLE SIZES (FOOT) 17.5 FEET

VEHICLE SIZES (FOOT) 18.5 FEET

VEHICLE SIZES (FOOT) 19.5 FEET

VEHICLE SIZES (FOOT) 20.5 FEET

**Stopping Sight Distance on Crest Vertical Curves**

**Height of Eye = 3.5 Feet**

**Height of Object = 2.0 Feet**

**Virginia Department of Transportation**

**REV_02/06**

**608.07**
| A. | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | 9.0 | 9.5 | 10.0 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 50 | 725 | 750 | 775 | 800 | 825 | 850 | 875 | 900 | 925 | 950 | 975 | 1000 | 1025 | 1050 | 1075 | 1100 | 1125 | 1150 |
| 100| 585 | 610 | 635 | 660 | 685 | 710 | 735 | 760 | 785 | 810 | 835 | 860 | 885 | 910 | 935 | 960 | 985 | 1010 |
| 150| 452 | 477 | 502 | 527 | 552 | 577 | 602 | 627 | 652 | 677 | 702 | 727 | 752 | 777 | 802 | 827 | 852 | 877 |
| 200| 350 | 375 | 400 | 425 | 450 | 475 | 500 | 525 | 550 | 575 | 600 | 625 | 650 | 675 | 700 | 725 | 750 | 775 |
| 250| 283 | 308 | 333 | 358 | 383 | 408 | 433 | 458 | 483 | 508 | 533 | 558 | 583 | 608 | 633 | 658 | 683 | 708 |
| 300| 240 | 265 | 290 | 315 | 340 | 365 | 390 | 415 | 440 | 465 | 490 | 515 | 540 | 565 | 590 | 615 | 640 | 665 |
| 350| 225 | 250 | 275 | 300 | 325 | 350 | 375 | 400 | 425 | 450 | 475 | 500 | 525 | 550 | 575 | 600 | 625 | 650 |
| 400| 202 | 227 | 252 | 277 | 302 | 327 | 352 | 377 | 402 | 427 | 452 | 477 | 502 | 527 | 552 | 577 | 602 | 627 |
| 450| 181 | 206 | 231 | 256 | 281 | 306 | 331 | 356 | 381 | 406 | 431 | 456 | 481 | 506 | 531 | 556 | 581 | 606 |
| 500| 165 | 190 | 215 | 240 | 265 | 290 | 315 | 340 | 365 | 390 | 415 | 440 | 465 | 490 | 515 | 540 | 565 | 590 |

L = Length of Vertical Curve in feet

S = Sight Distance in Feet

A. Absolute Difference of Grades in Percent

When SSL: \( S = \frac{14.00}{A} + \frac{L}{2} \)

When SSL: \( S = 52.915 \sqrt{\frac{L}{A}} \)

PASSING SIGHT DISTANCE ON CREST VERTICAL CURVES

HEIGHT OF EYE = 3.5 FEET

HEIGHT OF OBJECT = 3.5 FEET

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 02/06

608B.08
<table>
<thead>
<tr>
<th>A (in Degrees)</th>
<th>When ( SL : S = \frac{1400}{A} + \frac{L}{2} )</th>
<th>When ( SL : S = 52.915 \sqrt{\frac{L}{A}} )</th>
<th>( S = \text{Sight Distance in Feet} )</th>
<th>Sheet 2 of 2</th>
</tr>
</thead>
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<tr>
<td>1050</td>
<td>1225</td>
<td>1250</td>
<td>1275</td>
<td>1300</td>
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<td>1200</td>
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<td>2000</td>
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<td>1673</td>
<td>1694</td>
<td>1715</td>
</tr>
</tbody>
</table>

**PASSING SIGHT DISTANCE ON CREST VERTICAL CURVES**

*HEIGHT OF EYE = 3.5 FEET*  
*HEIGHT OF OBJECT = 3.5 FEET*

**Virginia Department of Transportation**

*REV. 02/06  
608.09*
### URBAN LOW SPEED DESIGN TABLE

<table>
<thead>
<tr>
<th>DV/NC (MPH)</th>
<th>45</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX f</td>
<td>0.100</td>
<td>0.160</td>
<td>0.180</td>
<td>0.200</td>
<td>0.230</td>
<td>0.270</td>
</tr>
</tbody>
</table>

Friction factors (f) for 0.30 velocities not listed should be derived by interpolation.

**Legend**

- **e**: Superelevation rate.
- **f**: Friction factor.
- **R**: Radius of curve.
- **DV**: Design velocity utilizing superelevation.
- **NC**: Maximum velocity with no superelevation (normal crown).

**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 802.24A have been rounded up to the nearest foot.

**Examples**

- **DV** = 21 mph
  - e = 12.0%
  - f = MAX f ± interpolated difference between listed friction factors
  - f = 0.270 - (1/50)(0.270 - 0.230) = 0.262
  - Rmin. = DV^2/(15(e + f))
  - Rmin. = (21)^2/(15(0.02 + 0.262)) = 104.255,391 FT.

- **NC** = 37 mph
  - e = -2.0%
  - f = MAX f ± interpolated difference between listed friction factors
  - f = 0.18 - (2/50)(0.18 - 0.16) = 0.172
  - Rmin. = NC^2/(15(e + f))
  - Rmin. = (37)^2/(15(-0.02 + 0.172)) = 600.4385965 FT.

**Methodologies for Calculating TC-5.04 Values for Urban Low-Speed Streets**

Virginia Department of Transportation

NEW 2/06

802.21A
### Minimum Radii and Transition Lengths for +2% Superelevation

<table>
<thead>
<tr>
<th>RADIUS (FEET)</th>
<th>E (%)</th>
<th>f</th>
<th>DV (MPH)</th>
<th>LENGTH OF SUPERELEVATION TRANSITION (LS) IN FEET</th>
<th>PAVEMENT WIDTH (W)</th>
<th>W &gt; 72</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24(^{1}) (1012(^{1}))</td>
<td>36(^{1}) (15012(^{1}))</td>
<td>48(^{1}) (2012(^{1}))</td>
</tr>
<tr>
<td>&gt; 795</td>
<td>2.0</td>
<td>0.150</td>
<td>45</td>
<td>45</td>
<td>56</td>
<td>67</td>
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<td>2.0</td>
<td>0.160</td>
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<td>42</td>
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<td>63</td>
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<tr>
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<td>0.180</td>
<td>35</td>
<td>39</td>
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<td>59</td>
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<td>0.200</td>
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<td>37</td>
<td>46</td>
<td>55</td>
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<tr>
<td>167</td>
<td>2.0</td>
<td>0.230</td>
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<td>35</td>
<td>43</td>
<td>52</td>
</tr>
<tr>
<td>92</td>
<td>2.0</td>
<td>0.270</td>
<td>20</td>
<td>33</td>
<td>41</td>
<td>49</td>
</tr>
</tbody>
</table>

* For pavement widths greater than 72 feet use LS values developed by the design software.

### Minimum Radii for Designs Utilizing -2% Superelevation Normal Pavement Crown

<table>
<thead>
<tr>
<th>RADIUS (FEET)</th>
<th>f</th>
<th>NC (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 10.39</td>
<td>.150</td>
<td>45</td>
</tr>
<tr>
<td>7.62</td>
<td>.160</td>
<td>40</td>
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<td>5.10</td>
<td>.180</td>
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<tr>
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<td>.230</td>
<td>25</td>
</tr>
<tr>
<td>1.07</td>
<td>.270</td>
<td>20</td>
</tr>
</tbody>
</table>

---

**Summary of STD. TC-5.04 ULS (Urban-Low Speed) Design Factors**

**Virginia Department of Transportation**
Notes:

No other conductors shall be run in the same conduit with electrical service cable.

Concrete pad required when cabinet mounted on pole in earth areas. (See Standard CTE-1 for pad detail).

For alternate method of grounding conductor entering breaker box see Standard SC-5.
Concrete pad required when mounted on pole in earth areas. (See standard CTE-1 for pad detail)

1" extra close nipple through wall of pole and meter base

1" metal conduit coupling

1" metal conduit elbow

1" rigid to liquid tight flexible metal conduit coupling

1" extra close nipple through wall of pole and breaker box.

Stainless steel band for attachment of meter base to pole.

2 - 90° fittings and close nipple.

Conduit

1" Liquid tight flexible metal conduit w/
service cable

Grounding conductor to breaker box.

1" rigid to liquid tight flexible metal conduit coupling

1" metal conduit coupling

1"/pvc threaded adapter

Foundation (separate pay item)

Underground service cable coiled in box with sufficient length to allow the cables to extend at least 2' above the junction box.

J8-B1A, IB, or IC junction box. Top of junction box shall read "UTILITY".

See detail above for components

Note: Local power utility company will install service cable from their power source to the junction box and make required splices to the service cable coiled in the junction box.

Type B
Notes:

No other conductors shall be run in the same conduit with electrical service cable.

Concrete pad required when cabinet mounted on pole in earth areas. The pad shall be 18" from pole. (See standard CTE-1 for pad details).

For underground service installations, local power utility company will install service power utility cable from their power source to the junction box and make required splices to the service cable called in the junction box.
Notes:
No other conductors shall be run in the same conduit with electrical service cable.
For alternate method of service cable and grounding conductor entering breaker box, see standard SE-5

Signal pole (separate pay item)

Foundation (separate pay item)

Augmented grounding electrode 4" cover

Electrical service grounding electrode

10'-0" Separation Minimum

1" conduit

3' minimum to 20' maximum

Conduit as specified on plans

TYPE A

ELECTRICAL SERVICE DETAILS
SIGNAL INSTALLATION
VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/06
1301.33
Notes:

No other conductors shall be run in the same conduit with electrical service cable.

For underground service installations, local power utility company will install service power utility cable from their power source to the junction box and make required splices to the service cable coiled in the junction box.

* JB-1A, 1B or 1C junction box Top of of junction box shall read "UTILITY".

** Underground service cable coiled in box with sufficient length to allow the cable to extend at least two feet above the junction box.

*** 2" PVC conduit stubout (location as required by local utility company).

---

ELECTRICAL SERVICE DETAILS
SIGNAL INSTALLATION
VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 2/06
1301.35
ALTERNATE METHOD OF SERVICE CABLE AND GROUNDING CONDUCTOR ENTERING BREAKER BOX

Standard PF-2 Pedestal Pole and Foundation (cost to be included with Electrical Service pay item)

9/16" Metal riser conduit

Stainless steel band

Breaker box required

Breaker box to be locked at door

Conduit and close nipple

Feeder cable inside pole

Grounding conductor to breaker box

Stainless steel bends

Underground service cable coiled in box with sufficient length to allow the cable to extend at least 2 above the junction box.

J8-1A, 1B or 1C Junction box

Top of junction box shall read "UTILITY"

2" PVC conduit stubout (Location as required by local power utility company.)

Notes:

No other conductors shall be run in the same conduit with electrical service cable.

Local power utility company will install service power utility cable from their power source to the junction box and make required splices to the service cable coiled in the junction box.

PEDESTAL POLE WITH GROUND MOUNTED CABINET

ELECTRICAL SERVICE DETAILS

SIGNAL INSTALLATION

VIRGINIA DEPARTMENT OF TRANSPORTATION
Notes:

- The conduit and service cable shall extend from the cabinet to the utility junction box.
- The control center cabinet at the inside and outside foundation joints shall be sealed with a silicone sealant.
- For alternate method of service cable entering safety switch see Standard SE-5.

When 200 amp or greater service is required, service shall enter meter base at right bottom.

No other conductors shall be run in the same conduit with electrical service cable.

Local power utility company will install service power utility cable from their power source to the junction box and make required splices to the service cable coiled in the junction box.

This standard is applicable for all electrical services other than 480V/277. For 480V/277 service, see Standard SE-9.
Notes:

This standard is applicable for all electrical services other than 480Y/277.

No other conductors shall be run in the same conduit with electrical service cable.

When 200 amp or greater service is required, service shall enter meter base at right bottom.

For underground service installations, local power utility company will install service power utility cable from their power source to the junction box and make required splices to the service cable called in the junction box.

*JB-1A, 1B or 1C junction box Top of junction box shall read "UTILITY"

**Conductor cables and Conduit as specified on plans.

Underground service cable coiled in box with sufficient length to allow the cable to extend at least 2' above the junction box.

[type A diagram]

[type B diagram]
**Notes:**

This standard is applicable for all electrical services other than 480Y/277.
For 480Y/277 service, see standard SE-9.

No other conductors shall be run in the same conduit with electrical service cable.

When 200 amp or greater service is required, service shall enter meter base at right bottom.

For underground service installations, local power utility company will install service power utility cable from their power source to the junction box and make required splices to the service cable coiled in the junction box.

* JB-1A, 1B or 1C junction box Top of junction box shall read “UTILITY”.

** The conduit and conductor cable shall be as specified on the plans.

13" wood pole w/5" in ground
(included in the electrical service pay item)

Closeipple

Control Center
(separate pay item)

Drill 1%4" hole in control center cabinet for grounding conductor. Hole to be sealed with duct seal.

2 grounding conductors to grounding electrode with staples (6" centers). One (1) to safety switch and One (1) to control center cabinet.

2" PVC conduit stubout
(Located as required by local utility power company).

Electrical service
grounding electrode

Augmented grounding
electrode 4" cover

Type A

Type B

J8-2C Junction Box
10'-0" Separation Minimum

Ground line

3" flat square washers

25' wood pole w/5" in ground
(Included in the electrical service pay item)

Clamps (3" centers)

Service entrance head
Service thimbleye

3" metal riser conduit

Clamps

Grounded riser conduit

Electrical service
grounding electrode

Augmented electrode 4" cover

J8-2C Junction Box
10'-0" Separation Minimum
TYPE A

Conduit shall be stubbed out 6" past concrete foundation pad. Location of the stubbed conduit shall be as required by the local power company. All exposed concrete edges shall be chamfered ¼". Grounding bushings shall be installed on each end of metal conduits. Ball ends shall be installed on the ends of PVC conduits. Local power company will install service cable from their power source to the current transformer cabinet and meter base. Safety switch, meter base, wireway, current transformer cabinet and control center shall be attached to the channeling with ½" galvanized bolts, lock washers and nuts. Four cross channels shall be utilized.

Each foundation shall be permanently marked to indicate all sides from which conduits pass. This mark shall be made with a trowel when finishing the concrete and shall be ¼" deep and 4" to 6" long.

This standard is applicable for 480Y/277 electrical service only. The contractor shall leave a sufficient amount of conductor cable coiled inside the current transformer cabinet to permit the local power company to make their connection.

Notes:

1. Conduit shall be stubbed out 6" past concrete foundation pad. Location of the stubbed conduit shall be as required by the local power company. All exposed concrete edges shall be chamfered ¼". Grounding bushings shall be installed on each end of metal conduits. Ball ends shall be installed on the ends of PVC conduits. Local power company will install service cable from their power source to the current transformer cabinet and meter base. Safety switch, meter base, wireway, current transformer cabinet and control center shall be attached to the channeling with ½" galvanized bolts, lock washers and nuts. Four cross channels shall be utilized.

2. Each foundation shall be permanently marked to indicate all sides from which conduits pass. This mark shall be made with a trowel when finishing the concrete and shall be ¼" deep and 4" to 6" long.

3. This standard is applicable for 480Y/277 electrical service only. The contractor shall leave a sufficient amount of conductor cable coiled inside the current transformer cabinet to permit the local power company to make their connection.

**SERVICE ENTRANCE FOUNDATION DETAIL (SIDE VIEW)**

Concrete pad shall be installed on the front of control side of foundation.

<table>
<thead>
<tr>
<th>AMP RATING</th>
<th>CONDUIT SIZE</th>
<th>CONDUCTOR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 AMP</td>
<td>1&quot;</td>
<td>#8</td>
</tr>
<tr>
<td>60 AMP</td>
<td>1¼&quot;</td>
<td>#6</td>
</tr>
<tr>
<td>100 AMP</td>
<td>1½&quot;</td>
<td>#3</td>
</tr>
<tr>
<td>200 AMP</td>
<td>2&quot;</td>
<td>#000</td>
</tr>
</tbody>
</table>

**ELECTRICAL SERVICE DETAILS**

SIGN AND LIGHTING INSTALLATIONS

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPAN STRUCTURE

Hand hole and cover 4" x 8" minimum.

End Pole

Wire Inlet (Typical). See Note 1.

Ventral clearance (See Note 6)

Guardrail

Top of Pedestal

1/2" Min.

3" Max.

End Elevation

CANTILEVER STRUCTURE

Pole Arm connection

1/2" diameter wire inlets Install on side opposite traffic.

1/2" diameter wire inlet at centerline of sign panel, behind first sign only.

Hand hole and cover 4" x 8" minimum.

NOTE:

1. 1/2" diameter wire inlets shall be provided at the following locations:
   A. On span structures on the front leg of end pole 12" below bottom chord.
   B. On cantilever structures on pole 12" below bottom chord.
   C. On span structures below bottom chord at centerline behind first sign panel from each end pole.
   D. On cantilever structures below bottom chord at centerline behind first sign panel from pole.
   E. All unused wire inlets shall be capped water tight.

3. Distance shall be no less than the minimum indicated in Standard CR-INS.

4. No mortar, grout, or concrete shall be placed between bottom of base plate and top of pedestal.

5. The maximum space between the bottom of the base plate and the top of the foundation shall be no more than the diameter of the anchor bolt plus one inch.

6. Vertical clearance for overhead and bridge mounted sign structures shall be no less than 5.8 meters and no more than 6.4 meters from the bottom of the lowest mounted sign panel to the crown of the roadway, unless otherwise specified on the plans. Luminaires assemblies shall have a vertical clearance of no less than 3.3 meters from the bottom of the assembly to the crown of the roadway.

7. All poles/uhights of overhead sign structures including "butterfly" structures shall have a minimum of six anchor bolts, each having a minimum diameter of 1/2". Anchor bolts shall be cast in place. Adhesive anchors with epoxy or non-shrink grout shall not be allowed.

TYPICAL DETAILS FOR OVERHEAD SIGN STRUCTURES

VIRGINIA DEPARTMENT OF TRANSPORTATION
1. The size of members and weld size(s) shall be designed by the contractor for the sign to be supported. Minimum size fillet weld shall be 1/4".

2. Minimum clearances are as specified by AASHTO or approved by the Virginia Department of Transportation.

3. For attachment to concrete superstructures or to painted or galvanized steel superstructures, supporting frames may be either aluminum or galvanized steel. For attachment to unpainted weathering steel superstructures, the supporting frame shall be of weathering steel.

4. The spacing of zees and supports shall be as shown on the plans.

5. Gaskets shall be braced for lateral forces.

6. Bolts shall be High-Strength ASTM A325, galvanized except when attachment is made to unpainted weathering steel in which case bolts shall be ASTM A325 Type 3.

Anchors shall be cast-in-place. Thru-bolting may also be used for attachments to parapets. When cast-in-place anchors are used, they shall develop the strength of the bolts. When thru-bolting is used, anchorage on the traffic side of the parapet shall be flush with the parapet face.

Anchors shall be placed no higher than 3" above top of deck slab. Adhesive anchors (with epoxy or non-shrink grout) shall not be allowed.

7. When required by the plans bridge mounted sign structure luminaires shall be installed on a luminaire retrieval system with supports and electrical system designed for track mounted luminaires. Retrieval system including the electrical system shall be equal to "LUMI-TRAK" and designed for the number of luminaires as indicated on the plans. Spacing of hangers used to support the retrieval system shall be increased to a maximum 7-foot distance only where hangers do not support sign panels. Turntable end of retrieval system shall be of sufficient length to align with the vertical edge of the outside paved shoulder (±6") or shall extend five feet beyond the vertical edge (±6") of outermost sign luminaire wherever is greater. The opposite end of retrieval system shall extend a minimum of 6 inches past the outermost vertical edge of the sign hanger arm. Luminaire support channels and associated equipment will not be required with the luminaire retrieval system.

BSS-1

Typical Bridge Parapet Sign
Mounting Details

Virginia Department of Transportation

REV. 2/06
REV. 7/05
1301.78
Signs having a height greater than 10' may have one horizontal joint. Horizontal joint shall be between lines of message.

**SECTION A-A**

**ALL INSTALLATIONS EXCEPT TOP AND BOTTOM ZEE BARS ON OVERHEAD SIGNS**

\[ \frac{3}{8}\text{"} \text{diameter rivet} \]

Rivets shall be dome head, break mandrel, blind rivets conforming to Industrial Fasteners Institute Standard IFI-M14, Style 1. Grades 10 or 11 except that the minimum ultimate tensile strength shall be 360 pounds. Rivets shall have a grip range accommodating the combined thickness of the sign panel and zee bar and shall be installed in accordance with the manufacturer’s recommendations.

\[ \frac{3}{8}\text{"} \text{diameter steel } \]

ASTM F593, Alloy 304 stainless steel. \[ \frac{3}{8}\text{"} \times 1" \] length carriage bolt with stainless steel nut and flat washer.

**SECTION B-B**

**TOP AND BOTTOM ZEE BAR INSTALLATION ON OVERHEAD SIGNS**

\[ \frac{3}{8}\text{"} \text{ thick aluminum backing strip (Material same as sign panel) } \]

Rivet (Same as used for connecting sign to zee bar). In lieu of using rivets, tape equal to 3M’s VHB Double Coated Acrylic Foam Tape may be used except on horizontal backing strip. Tape shall be installed in accordance with the manufacturer’s recommendations.
**Notes:**

Place pavement center line marking on center line of bituminous surface.

All pavement markings shall be installed in accordance with the MUTCD.

* The pavement marking for the mainline of Interstate Highways shall be 6" wide; all other highways the pavement marking shall be 4" wide unless otherwise noted on the plans.

**Lateral Placement for Pavement Line Marking on Hydraulic Cement Concrete**

- **Pavement center line**
- **Outside shoulder**
- **Median shoulder**
- **Longitudinal construction joint at center line of pavement**
- **Pavement edge line**
- **8' white line**

**Typical Pavement Marking Details**

* Virginia Department of Transportation*
LIMITED ACCESS LANE DROP EXIT RAMPS
BESIDE CHOICE LANE THRU / EXIT

Elephant tracks should be placed a minimum of \( \frac{1}{2} \) mi up to a maximum distance to begin at the point where the first notice of the lane drop is signed.

200' - solid white line should be installed in advance of the theoretical gore.

LIMITED ACCESS LANE DROP EXIT RAMPS

Elephant tracks should be placed a minimum of \( \frac{1}{2} \) mi up to a maximum distance to begin at the point where the first notice of the lane drop is signed.

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STANDARD ELEPHANT TRACKS

TYPICAL PAVEMENT MARKING DETAILS

VIRGINIA DEPARTMENT OF TRANSPORTATION