VIRGINIA DEPARTMENT OF TRANSPORTATION

LOCATION AND DESIGN DIVISION

INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: GUARDRAIL REPLACEMENT AND UPGRADE GUIDELINES FOR CONSTRUCTION PROJECTS	NUMBER: IIM-LD-220.4
SPECIFIC SUBJECT: GUARDRAIL APPLICATION REQUIREMENTS	DATE: SEPTEMBER 10, 2012
	SUPERSEDES: IIM-LD-220.3
APPROVED: Mohammad Mirshahi, P.E. Deputy Chief Engineer / State Location & Design Engineer Approved September 10, 2012	

Changes are shaded.

CURRENT REVISION

- This memorandum was revised regarding guardrail complying with current Standards on Developer Constructed Roadways under consideration for acceptance into the System of State Highways. VDOT approved Developer Street Construction Plans are to be accepted in accordance with the VDOT Secondary Street Acceptance Requirements (SSAR).

EFFECTIVE DATE

- These instructions are effective upon receipt.

DEFINITIONS

- For definitions of RRR utilizing Federal Funding on National Highway System (NHS) Roadways, see VDOT's Road Design Manual, Appendix A, Section A-4 Guidelines for RRR Projects, which can be accessed at:
  http://www.extranet.vdot.state.va.us/locdes/Electronic%20Pubs/2005%20RDM/appenda.pdf

POLICY FOR REPLACEMENT AND UPGRADE OF GUARDRAIL / GUARDRAIL COMPONENTS WITHIN THE PROJECT LIMITS FOR ALL CONSTRUCTION PROJECTS INCLUDING HEAVY MAINTENANCE AND RRR PROJECTS

- These instructions apply to the Replacement and Upgrade of Existing Guardrail Installations Only. New Installations SHALL be in accordance with current VDOT Standards.

- The following guidance is provided to ensure the guardrail height complies with the appropriate NCHRP 350, MASH, and VDOT requirements.

    1. For w-beam systems, measure the height at the posts or posts at a splice, as appropriate, in increments of 50 feet. At transitions, measure the height at the posts at the beginning and end of the transition between standard systems. Refer to the Road and Bridge GR-INS Standard for measuring w-beam guardrail based on location on a slope.

    2. For GR-3 cable guardrail, measure the height at the posts in increments of 48 feet.

    3. For proprietary systems, follow the manufacturer's instructions.

- Weathering steel (COR-TEN) w-beam guardrail is no longer acceptable for use in new construction due to the potential for premature material failure from excessive rust. Guardrail terminals are no longer available with weathering steel. If aesthetic guardrail is required, contact the Materials Division for approved treatment methods.

- In cases where guardrail height is less than minimum, it shall be raised or reset as part of the current project.

- Any other existing guardrail, or guardrail components, found to be substandard shall also be upgraded as part of the current project.

- For the following situations, all existing substandard guardrail systems and components shall be upgraded to the latest standard in accordance with current VDOT Road and Bridge Standards and this memorandum.

    1. **When located within the project limits of a construction project**. When the line of rail extends outside the project limits with more than 60% of the existing substandard line of rail within the project limits, then the entire run shall be replaced and upgraded to meet the current Standards. If less than 60% is within the project limits, then only the rail within the project limits is to be upgraded. Consideration should be given to upgrading the entire line of rail even when less than 60% is within the project limits.

2. **When located within the project limits of transportation improvements associated with permitted land development projects.**

3. **When any road is accepted into the state roadway system, all guardrail must comply with current Standards and must include NCHRP 350 or MASH (Manual for Assessing Safety Hardware) approved terminals and rail systems. (For VDOT approved Developer Construction Plans, the Secondary Street Acceptance Requirements (SSAR) govern.)**

PAVEMENT DROP-OFFS WITH GUARDRAIL

- Whenever the pavement drop-off is within 2'-0" in front of the face of rail and in order to ensure that a pavement drop-off does not become a factor in guardrail performance, the guardrail and blockout shall be removed during the paving operation to allow the pavement to be placed as close as possible to the post. This will place the drop-off to at least the face of guardrail or behind the face of guardrail. No more than 2" drop-off allowed. Any drop-offs at the edge of pavement will have to be feathered down across a paved shoulder to the guardrail. It is critical that the guardrail height measured from the top of the overlay to the top of the guardrail be within the guardrail height tolerance limits.

- Whenever it is not practical to have the pavement drop-off at or behind the face of guardrail, the drop-off shall not be located any closer than 2'-0" in front of the face of guardrail. The drop-off shall be limited to a range of 1½" to 2" in height with a 3:1 or flatter wedge to minimize the effect of the drop-off on a vehicle. Any drop-off that should happen to fall within 2'-0" of the face of guardrail and/or have a height greater than 2" shall be reviewed on a per project basis. Any drop-off that should happen to fall within 2'-0" of the face of guardrail and/or have a height greater than 2" on the NHS shall be jointly reviewed by VDOT and FHWA.

GUARDRAIL TERMINALS

- All terminals shall be installed as they were tested in accordance with NCHRP 350 or MASH. Lapping of guardrail terminals must be per the Standards.

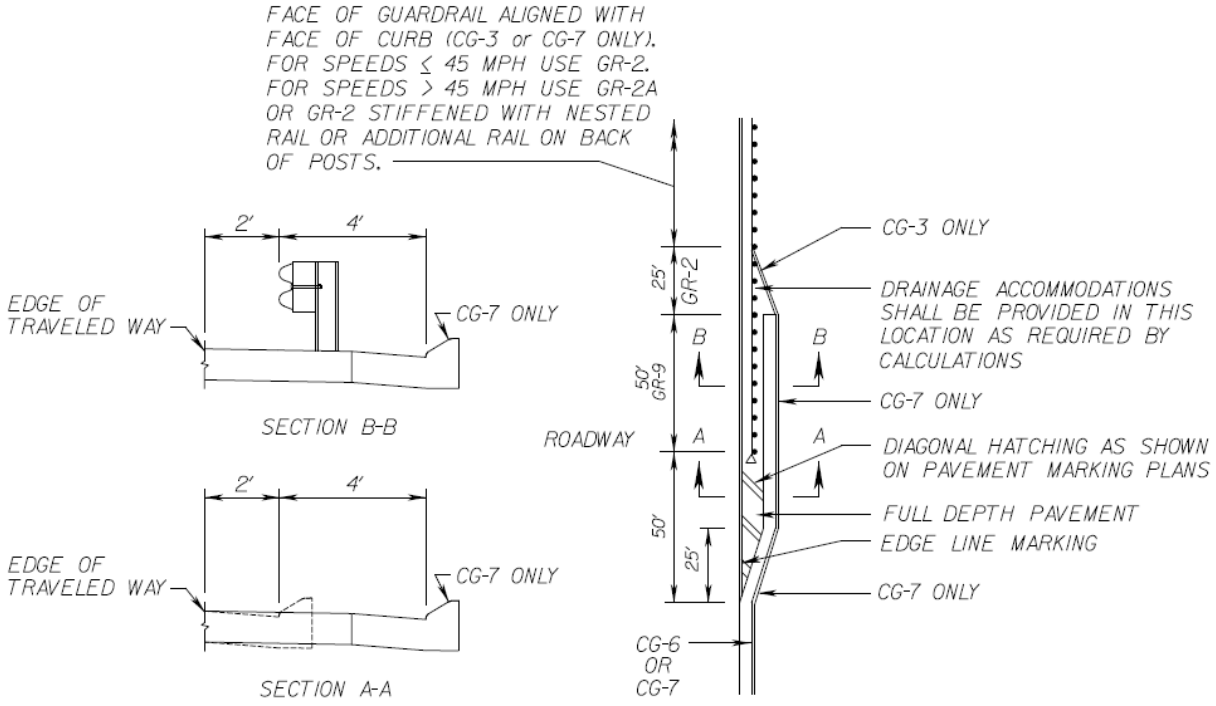
- A site investigation shall be made to determine whether a terminal should be upgraded, or eliminated. For gaps between two runs of guardrail $\leq$ 200'$\pm$, closing the gap by continuing the run of guardrail is recommended, thereby eliminating the need for a terminal. If a cut slope is within approximately 200'$\pm$ longitudinal distance from the location of the terminal and is sufficient to install a Standard GR-6, the guardrail shall be extended to the cut slope and a cut slope terminal (Standard GR-6) shall be used.

- Radial guardrail not to be used in place of a MASH or NCHRP 350 approved terminal section. Radial terminal sections that exist within the project limits shall be upgraded to an approved terminal section. For guidance on the use of radial guardrail, contact the Central Office Standards and Special Design Section.

- If the installation site does not provide at least 75' of clear run-out path in addition to the length of need required for the barrier (exclusive of the terminal), a parallel terminal (Standard GR-9) shall be used instead of a flared terminal (Standard GR-7). If an extensive amount of grading would be required for site preparation to install a flared terminal (Standard GR-7), consideration should be given to using a parallel terminal (Standard GR-9) that does not require as much site preparation. Before replacing a substandard terminal, the location of the existing terminal shall be checked to ensure sufficient length of need has been provided in the run of guardrail to adequately shield the hazard for which it was installed. In some cases it may be necessary to extend the guardrail to better shield the hazard or to provide for a more suitable site that would not require grading.

- The site preparation for all installations shall be in accordance with current Standards.

- For new construction or upgrading, where guardrail is aligned with the face of curb, use the recommended curb layout as shown below or as approved by the engineer at the terminal location. The designer should adjust the typical cross section as necessary to account for the curb layout. When existing curb cannot be removed or relocated, contact the Central Office Standards and Special Design Section.



RECOMMENDED CURB LAYOUT FOR TERMINATING GUARDRAIL

Not to Scale

Breakaway Cable Terminals (BCT's)

BCT's had concrete footings for the first two posts, did not have the metal strut at ground level between the first two posts and all posts were not breakaway.

Completely replace BCT's with new NCHRP 350 or MASH approved terminals whenever they are within the limits of a construction project.

- **Modified Eccentric Loading Terminals (MELT's)**

The MELT provides a 4' offset, a 5' flat area behind the first post and a metal strut at ground level between the first two wooden breakaway posts.

Replace any existing MELT with a new NCHRP 350 or MASH approved terminal (revised Standard GR-7) such as the SRT-350, FLEAT-350, or other approved NCHRP 350/MASH product whenever they are within the limits of a construction project. When replacing substandard GR-7 terminals, make sure that the section of rail and posts adjoining the new terminal installation is at the proper height.

- **Strong Post Turned-down Terminals (Std. GR-5's)**

All turned-down strong post terminals (run-on locations) should have already been removed from roadways on the National Highway System. Any that have not been removed shall be removed immediately and replaced with NCHRP 350 or MASH approved terminals.

Any turned-down strong post terminals (run-on locations) that still remain on non-NHS roadways, shall be scheduled to be replaced with NCHRP 350 or MASH approved terminals.

- **Weak Post Turned-down Terminals (Std. GR-8, Type II's)**

Since no weak post terminals have been approved in accordance with NCHRP 350 for use in run-on locations, any of these within the limits of a construction project shall be replaced with NCHRP 350 or MASH approved strong post terminals incorporating the appropriate transition required between a strong post terminal and weak post guardrail (in accordance with VDOT Road and Bridge Standards), regardless of the design speed of the roadway.

For run-off locations, turned down terminals incorporating a concrete anchor (Standard GR-8, type I or II) are acceptable, regardless of the design speed of the roadway; however, the Type I and II terminals shall be outside of the clear zone of opposing traffic on two-way roadways. This includes existing installations in locations with design speeds greater than 45 mph for which new installation of weak post guardrail must be in accordance with the new approved TL-3 weak post design.

- **TERMINALS BURIED IN THE CUT SLOPE (OLD STANDARD GR-6)**

Existing GR-6 installations that are not NCHRP 350 or MASH compliant (in accordance with current VDOT Standards) shall be evaluated to ensure the following:

1. Proper Height per current standards. Where existing GR-6 terminals were installed with the height of rail following the ground line at a height of 27” to 28”, this installation method caused the terminals to be low, both in front of and behind the ditch line. These low installations may allow an errant vehicle to vault over the top rail and go behind the guardrail, failing its intended protection from hazards.

2. The end anchorage is sufficiently buried in the slope with 1’ min. cover.

3. Upgrading or replacement for either of these situations shall be to current VDOT Standards.

- **RUN OFF TERMINAL (Std. GR-11)**

  Use of a Standard GR-11 is required for trailing end terminal anchorage on divided highways for run off conditions only, in place of an additional 50’ of GR-2 with washers.

FIXED OBJECT ATTACHMENTS (FOA’S)

- When substandard FOA’s or BR-GR’s exist within the limits of construction projects; both FOA’s and BR-GR’s shall be upgraded or replaced in accordance with the current VDOT Road and Bridge Standard or Special Design BRGR.

W-BEAM GUARDRAIL

- During NEW CONSTRUCTION, always install to the current Standard heights.

- ALL W-beam guardrail panels shall be lapped in the direction of traffic. With two-way traffic, the laps on the right side of traffic are to be in the direction of traffic or toward the downstream end.

- **Strong Post W-beam with 12' 6" Post Spacing and no blockout (Std. GR-1)**

  Existing strong post guardrail (Standard GR-1) and end terminals within the project limits of any construction project shall always be replaced with a new NCHRP 350 or MASH approved system.

  For sections of GR-1 where the line of rail extends outside the project limits with more than 60% of the existing substandard line of rail within the project limits, the entire run shall be replaced with Standard GR-2. If less than 60% is within the project limits, then only the rail within the project limits is to be replaced. Consideration should be given to replace entire line of rail even when less than 60% is within the project limits.

- **Strong Post W-beam Guardrail (Std. GR-2)**

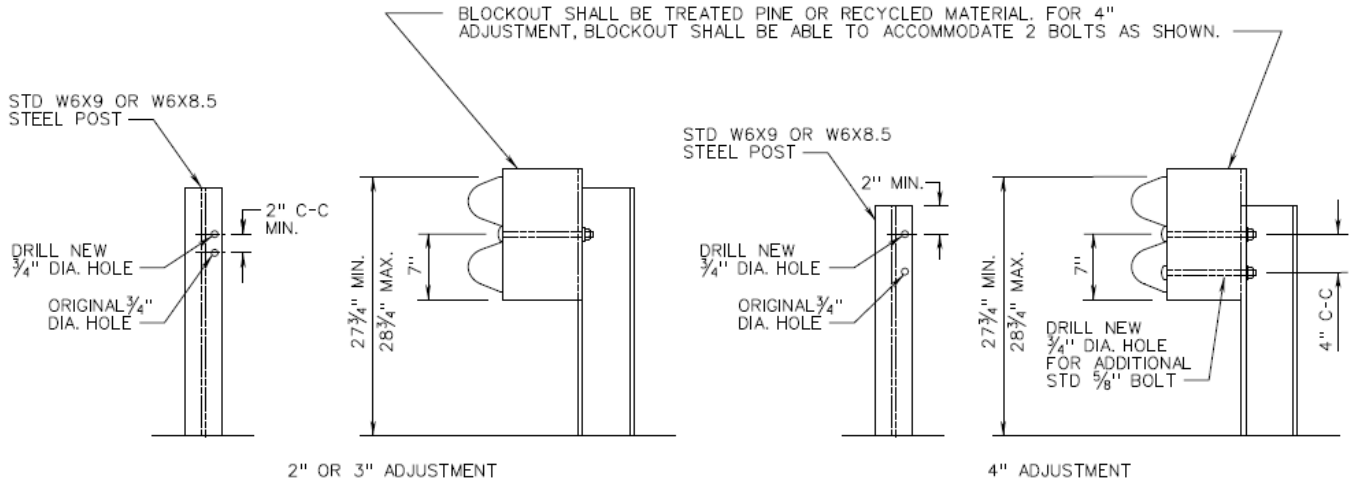
  For GR-2, the **minimum height is 27 3/4"** to the top of the rail with a **maximum height of 28 3/4"**.

  The wood and composite blockouts can be used interchangeably within a single run of guardrail for new installations, replacements, and upgrades. When existing 6"x8" wood or composite blockouts are replaced, the blockouts shall include routing to prevent blockouts from rotating. When wood posts with wood blockouts are used, they shall have **TWO** nails (one on each side) to prevent rotation of blockouts.

  When posts are **removed** and meet current specifications for **reuse,** they shall be reused only with Standard wood or composite blockouts. When resetting rail, the posts shall be removed and the holes backfilled prior to reinstalling the posts. The height of the rail shall be measured to ensure it meets the current VDOT Road and Bridge Standards.

  For existing CG-3 (4" curb) or CG-7 (4" curb and gutter), install GR-2 for design speeds ≤ 45 mph or GR-2A for design speeds > 45 mph and align face of rail with the face of curb per the current GR-INS Standard. In place of GR-2A, stiffened GR-2, using nested rail or an additional rail on the back of the posts, can be used. Existing CG-2 (6" curb), CG-6 (6" curb and gutter), or vertical face curb greater than 4" tall shall be removed, milled down to a height no greater than 4", or replaced with CG-3 or CG-7 prior to installation of guardrail.

  For raising existing GR-2 rail height only, a 2", 3" or 4" vertical adjustment of the GR-2 (steel post only) rail is allowed by adjusting the blockout and redrilling the post provided the post is acceptable to use. Centerline of holes shall be no closer than 2" to another hole and no less than 2" from top of post. Hole diameter shall be 3/4". For 4" adjustment, 2 bolts shall be used; one above the other with centerlines of holes 4" apart. Blockouts must be able to accommodate the additional bolt for a 4" adjustment. See detail below.



ONE TIME 2", 3" OR 4" ADJUSTMENT OF GR-2 BLOCKOUT
FOR STANDARD GR-2 STEEL POST ONLY

FOR RAISING EXISTING GR-2 RAIL HEIGHT ONLY

If the GR-2 rail cannot be adjusted to the current Standard GR-2 height, then the guardrail is to be reset.

No metal blockouts are to be replaced in-kind or installed new, and no washers will be used.

- **Weak Post W-beam Guardrail (Std. GR-8)**

  Existing weak post W-beam not meeting NCHRP 350 or MASH within the limits of a construction project shall be upgraded to the new Standard design. When resetting or reusing rail, the height of the rail shall be installed to meet the current VDOT Road and Bridge Standards. If the particular site conditions are appropriate, a Standard GR-2 system can be used.

  The latest GR-8 design can be used even for speeds greater than 45 mph.

  When upgrading existing weak post guardrail to the current weak post Standard GR-8, curb shall be removed. If curb cannot be removed and it is existing CG-3 (4" curb) or CG-7 (4" curb and gutter), install GR-2 for design speeds ≤ 45 mph or GR-2A for design speeds > 45 mph and align face of rail with the face of curb per the current GR-INS Standard. In place of GR-2A, stiffened GR-2, using nested rail or an additional rail on the back of the posts, can be used. Existing CG-2 (6" curb), CG-6 (6" curb and gutter), or vertical face curb greater than 4" tall shall be removed, milled down to a height no greater than 4", or replaced with CG-3 or CG-7 prior to installation of guardrail.

- For any existing **GR-2 or GR-8** where the line of rail extends outside the project limits with more than 60% of the existing substandard line of rail within the project limits, the entire run shall be replaced or upgraded. If less than 60% is within the project limits, then only the rail within the project limits is to be replaced or upgraded. Consideration should be given to replacing the entire line of rail even when less than 60% is within the project limits.

  When either of these designs is used, the proper transitions MUST be incorporated. Transitions to the new height, splice locations and backup plates for the GR-8, and for the GR-2 transitions from GR-8, 8A, 8B to the GR-2 must be done in accordance with current Standard designs.

- **Cable Guardrail (Std. GR-3)**

  Any existing GR-3 and GR-3 terminal where the line of cable extends outside the project limits with more than 60% of the existing substandard line of cable within the project limits, the entire run shall be replaced or upgraded. If less than 60% is within the project limits, then only the cable and terminal within the project limits is to be upgraded. Consideration should be given to replacing or upgrading the entire line of cable and terminals even when less than 60% is within the project limits.