12.30 STEEL BEAM GUARDRAIL

12.31 GENERAL INSTRUCTIONS

Safety implications make it very important that engineer, inspector, and contractor know the plans, *Specifications 2505 and 4155*, and *Standard Road Plans* that apply to this work.

Letting date and *Standard Road Plan* date should be compatible. *Standard Road Plan* dates are listed in *Tabulation105-4* in the plans. When these dates do not match the date of current *Standard Road Plan*, contact the Office of Construction. Determination will be made on the appropriate *Standard Road* Plan to be applied.

A guardrail installation checklist is provided in *Appendix 12-3*. This checklist may be helpful in preparation and inspection of guardrail work. The installation checklist identifies important checks that should be made prior to installation and again at the completion of the installation to ensure that the installed guardrail system will perform as intended. The inspection and material acceptance requirements are identified in *Materials I.M. 204 Supplemental Guide Basis of Acceptance.*

Guardrail installations are dependent on correct location of shoulder or bridge approach paving and 10:1 approach slope to guardrail. Prior to the start of guardrail installations, these need to be reviewed and verified.

Specific attention should be given to location of curb and intake in the area of paved shoulders. *Section RK of the Standard Road Plans* identifies length of shoulder paving and curb for bridge approaches. For guardrail post locations at *RF-38* intakes, the guardrail posts may require adjustment if in conflict with the intake location. For this situation contact the Office of Design-Methods Section for guidance. For guardrail post locations at *RF-39 Scour Protection* and *RF-40 Rock Flume For Bridge End Drains*, the guardrail post can be installed within the flume if necessary.

Slope on finished surface between shoulder edge and a point at least 1.2 m (4 feet) behind the front face of the post shall be 10:1 or flatter. This provides a slope which will keep vehicle wheels in contact with the ground and provide adequate soil support for the posts.

If inspector or engineer observes a variance from plans or specifications, contractor should be advised immediately. *When situations arise that are not covered by specifications, plans, Standard Road Plans, or this instruction, contact the Office of Construction.*

12.32 STEEL BEAM GUARDRAIL INSTALLATION

Rail Alignment

Rail shall be installed with reasonably smooth vertical and horizontal lines. Kinks in both straight and factory curved sections shall be avoided. Face of rail shall have no protrusions that could catch a vehicle sliding along the rail. Minor adjustments may be made to meet this requirement. The installation line, from which offsets to the face of guardrail are measured, is parallel to the edge of traveled way whether in tangent or in curves.

Guardrail Posts

Posts shall be installed at intervals shown on specified *Standard Road Plans*. All posts shall be reasonably plumb in both directions. An occasional post out of plumb may be accepted.

Standard Road Plan BA-210 provides for guardrail installations at culverts where it is not possible to get 1.0 m (3 feet) of wood post embedment because of a low-fill situation over the culvert. *BA-210* details the use of steel guardrail posts which are bolted to the top slab of the culvert.

Where longitudinal obstructions (electric cables, intakes, etc.) are encountered, posts may have 2 blockouts to provide an offset. Only one post in an installation can have 3 blockouts. If this cannot be done, contact the Office of Design-Methods Section for guidance.

Specification 2505.03 states that guardrail posts may be driven provided that:

- Driving does not damage the posts, and
- Resulting post installation is firm, plumb, and at the location, spacing, and elevation designated.

Rail Section Location

All prepunched rail sections should be in proper location within each guardrail assembly. This involves sections with 952 mm (3 feet 1 ½ inch) post spacing, sections with 1.90 m (6 feet 3 inch) post spacing, *and BA-205 Steel Beam Guardrail End Terminals* or *BA-206 Steel Beam Guardrail Flared End Terminals.*

Rail Height

Guardrail installations are constructed with W-beam and Thrie-beam rail. *BA-200* indicates the mounting height is measured, from surface of ground or surface of pavement when there is a curb, at face of rail to top of rail. Target height is 787 mm (31 inches) for W-beam and 813 mm (32 inches) for Thrie-beam.

Where all new guardrail is being installed or existing guardrail is being removed, reinstalled, or raised, tolerance will be plus or minus 25 mm (1 inch). Allowable mounting height is 762 to 813 mm (30 to 32 inches) for W-beam and 787 to 838 mm (31 to 33 inches) for Thrie-beam.

Note that on *BA-201* the guardrail height transitions from 32 inches at the beginning of the BTS (Thrie-beam) to 31 inches at the end of the BTS (W-beam).

Rail height should be based on edge of pavement so shoulder can be adjusted to meet correct cross section. Following completion of guardrail installation, the rail height from surface of ground at face of rail should be verified. If rail height is outside allowable tolerance, correction of ground surface will be required to provide for specified rail height.

At posts on existing guardrail, spacer blocks may be raised a maximum of 75 mm (3 inches) according to detail in *Appendix 12-5* when the installation is not being removed and reinstalled.

Lapping of Guardrail

A change has been made in the procedure for lapping of guardrail. The following guardrail lapping procedure has been recommended by FHWA through their Roadside Hardware Policy and Guidance. An additional benefit from the following lapping procedure is the reduction of guardrail section 'snagging' by snow plows resulting in incidental guardrail damage.

Lapping of rail sections must be accomplished in a uniform manner. The Standard Road Plans indicate that guardrail shall be lapped in the same direction as the traffic nearest to the guardrail installation.

Refer to Appendix 12-6 for examples of how to properly lap guardrail.

12.33 END TERMINALS

The standard guardrail end terminal is shown on *BA-205*. This end terminal is used in most situations. The flared guardrail end terminal is shown on *BA-206*. This end terminal is not common, and should only be used where high tension cable guardrail is being attached to steel beam guardrail.

BA-205 and *BA-206* each list two different brands of end terminals that are approved for use. The contractor has the option of installing either brand. However, the same brand should be used throughout a single project. Installation manuals can be accessed on the web sites of the manufacturers listed on *BA-205* and *BA-206*.

Note the ground strut located between posts 1 and 2. When the end terminal is installed correctly, the bottom of the ground strut should lay flush with the top of the ground. In no case should the bottom of the ground strut be more than 50 mm (2 inches) above the top of the ground. If this occurs, either the guardrail height needs to be adjusted or the area needs to be regraded.

Note the 200 mm x 200 mm (8 inch x 8 inch) square bearing plate at the base of post 1. The hole in the plate is not located in the center of the plate. When installed correctly, there should be a 125 mm (5 inches) of plate showing above the bolt and 75 mm (3 inches) of plate showing below the bolt.

The approach ends of guardrail must be marked with yellow and black reflective sheeting that is similar in appearance to the Type 3 object marker. The orientation of the stripes is important. The stripes should point down towards the side where traffic is supposed to pass the guardrail. Refer to *SI-173*.

12.34 BRIDGE CONNECTIONS

BA-202 Thrie-Beam Terminal Connector shall be installed under rail so a vehicle cannot be snagged by end section. Exception to this is on trailing end of a one-way bridge where *Thrie-Beam Terminal Connector* shall be installed on outside of rail.

On new construction, bridge rail or retrofit rail 25 mm (1 inch) inner diameter sleeves may be placed for attachment bolts. Be positive that location and height of each sleeve are right. CHECK HEIGHT ABOVE DECK!

On guardrail attachments to concrete which require a bolt longer than 610 mm (24 inches), 22 mm (7/8 inch) bolt anchors may be grouted into concrete using threaded insert anchors with epoxy listed in *Materials I.M. 491.22*.

All bolts on bridge end connections shall be high strength, galvanized hex bolts. Surface of bolt head should be marked A-325, A-449 or have three radial marks at 120 degree intervals.

12.35 OBJECT MARKERS

The correct placement of object markers with guardrail is shown on *SI-211*. Types 3 object markers (OM3-L and OM3-R) should be installed so the inside edge of the marker is in line with the face of the guardrail. All object markers shall be attached to the delineator post by installation of an offset bracket as detailed on *SI-173*. Note that neoprene washers are required on the face of the object marker under each bolt head. If the delineator post cannot be driven into the ground, the post may be cut short and attached to a guardrail post (not spacer block) with two bolts.

12.36 DELINEATORS

Location of delineator placement with guardrail is shown on *SI-211*. Specific attention should be given to Type 1, 2, 4, 7, and 8 installations on *SI-211*. These installations involve guardrail encroaching on shoulder or shoulder not full width through guardrail installation.