

605 GUARDRAILS AND GUARDRAIL TERMINALS**605.01 GUARDRAIL**

- (A) **DESCRIPTION.** Work shall consist of the fabrication and erection of new guardrail installations or the reconstruction and re-setting to proper line and grade of existing guardrails, as indicated in the contract documents. The guardrails shall consist of steel and/or wood systems of either single face or double face configurations, installed to the dimensions and at locations shown in the contract documents or as directed by the Chief Engineer.

The guardrail systems are designated as follows:

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| Type I | W-beam (standard-block-out) |
| Type ID | W-beam (double faced) |
| Type II | W-beam (weak post) |
| Type III | Box beam |
| Type IV | Thrie beam (standard-block-out) |
| Type IVD | Thrie beam (double faced) |
| Type V | Corrosion resistant (weathering steel W- beam) |
| SBT | Steel-backed timber guardrail/timber posts and block-out |

- (B) **MATERIALS.** Materials shall meet the following requirements:

W/Thrie Beam Rail Elements, Back-up

Pieces, and Terminal Sections – AASHTO M 180, Class A, Type I

Rail Posts, Offsets, Angles, Channels and Shims – [815.01\(A\)](#)

Corrosion resistant steel (weathering steel) – [815.01\(B\)](#)

Tie Rods – [815.01\(A\)](#)

Splice Bolts, Nuts and Washers – [815.01\(L\)](#)

Anchor Bolts and Nuts – [815.01\(D\)](#)

Anchor Rods and Nuts – [815.01\(A\)](#)

Anchorage Casting Plates – [815.01\(I\)](#)

Timber posts – [813.07](#)

Timber rails – [813.05](#)

Wood Offset Blocks – [813.05](#)

Composite Offset Blocks – NCHRP 350

Reflectors – [822.13\(C\)](#)

Turnbuckles – [815.13](#)

PCC – [817. Class F](#)

Epoxy – [822.08](#)

Galvanizing – [811.07](#)

Reinforcing Steel – [812.02](#)

(C) CONSTRUCTION REQUIREMENTS.

(1) **GENERAL.** Prior to erection, all parts shall be inspected for damage and for chipped or marred coatings. Pieces warped, deformed or with damage to galvanizing will be rejected and the Contractor will be required to replace any such damaged parts at his expense. Paint touch-up of marred or chipped galvanizing will not be permitted.

(2) **POSTS.** Posts shall be driven unless an alternative method is approved by the Chief Engineer. The post driving method shall be such as to avoid battering or distorting the posts. Posts not driven shall be set in holes of sufficient diameter to permit tamping of the backfill. Post holes shall be backfilled with approved material placed in 6 inch layers and thoroughly compacted. When the posts are to be set in existing pavement, all loose material shall be removed and paving material replaced.

If rock is encountered while placing the posts, the hole shall be enlarged to provide not less than 6 inches clearance on all sides, and the hole shall be excavated to a minimum depth of 2.5 feet. The post shall be set in concrete to within 6 inches of the top of the hole. The hole shall be backfilled with approved material, properly placed and compacted.

Any post damaged from driving shall be withdrawn, not used, and another post placed at no additional cost to the District.

Posts may also be driven in existing sidewalk areas where there will be no interference with utilities, catch basins, sewers, etc. In these areas, the existing concrete shall be removed by cutting a square 8 inches by 8 inches to a depth of 1-1/2 inches below the bottom of the sidewalk with a power masonry saw. The remainder of the concrete may be removed by other methods. After the posts are driven, the concrete shall be replaced. Payment for concrete will be made under "PCC for Post Anchorage".

(3) **ANCHOR BOLT ALTERNATIVE.** Where the existing concrete is of sufficient depth to accommodate the anchor bolts, installation shall be made in predrilled anchor holes.

(a) **Predrilled Anchor Holes** – Holes shall be drilled to diameters as specified in (c) below. Drilling templates shall be used for all drilling operations to insure properly aligned true anchorage holes. Where dry drilling is employed, the holes shall be vacuumed or blown out using oil-free compressed air. Where the drilling process requires the use of water, holes shall be carefully washed out

after drilling to remove any drilling slurry residue that may remain. Holes shall then be permitted to dry thoroughly before placing bolts.

The Contractor is warned that reinforcing, utilities or other obstructions may be encountered during drilling of anchor holes in concrete. Diamond drilling or other special procedures necessary to construct anchorage shall be included as part of the work. All cost involved in connection with drilled anchorages shall be included as part of work. The Contractor shall assume the entire responsibility for all damage and injury to electrical conduits, utilities and the structure. Repair of any damage shall be included as part of the work.

- (b) Where existing concrete is of insufficient depth to accommodate the anchor bolts, the existing concrete shall be removed to a rectangle approximately 4 inches greater in each dimension than the base plate to be used. The concrete shall be cut to a neat line to a depth of 1-1/2 inches below the concrete surface with a masonry power saw. The rest of the concrete and soils may be removed by other methods.
- (c) Epoxy Installation of Anchor Bolts – Bolts and bolt holes shall be clean, degreased with toluene and dry at the time of installation. Bolts may be installed by either of the following methods:

Holes shall be drilled in existing concrete to diameters not to exceed one quarter (1/4) inch greater than the diameter of the bolts or dowels being embedded or as recommended by the epoxy manufacturer. The bolts and dowels shall be fixed with an epoxy resin adhesive meeting the requirements of [822.08\(B\)\(2\)](#).

Holes shall be drilled in existing concrete to diameters at least one (1) inch greater than the diameter of the bolt or dowel being embedded. The bolts and dowels shall be fixed with an epoxy mortar meeting the requirements of [822.08\(C\)](#).

When using either of the methods specified above, the locations of the holes to be drilled shall be accurately determined by means of templates. The templates shall also be used to hold the bolts in position until the epoxy resin or mortar has cured. The temperature of the concrete where bolts are being installed shall conform to the requirements of [501.10\(B\)](#) at the time of installation.

- (d) Anchor Dowel Installation – Where bolted anchorages are to be set on PCC mortar blocks, anchor dowels shall be carefully preset by template prior to placing the PCC sidewalk, median or anchor block.
- (e) Base plates shall be set level by the use of steel shims or an epoxy mortar bed to insure plumb posts.

When steel shims are used, they shall be designed to provide full bearing between the full area of base plate and shims and no gaps shall appear between base plates and concrete.

If an epoxy mortar bed is used, it shall be applied to provide a level bed of mortar 1 inch greater in each horizontal direction than the base plate. It shall be a minimum of 1/4 inch thick on the high side and the complete area of the base plate shall be in contact with the mortar bed.

- (4) **ANCHORAGE ON CONCRETE DECKS.** Where installation is to be made on an existing structure and the depth of the deck is less than the required depth for anchor bolts, the installation shall be made as follows:
- (a) Holes shall be drilled through the concrete deck. The Contractor shall prevent broken concrete, other materials and tools from falling onto any traveled roadway, sidewalk or other public space where the safety of the public may be endangered.
 - (b) The base plates, on neoprene pads if required, shall then be anchored to the deck with bolts, anchor plates or any other method as shown on the plans or as directed.

Prior to setting the rails or cables, the posts shall be properly aligned to within a 1/4 inch tolerance of line and grade. Posts shall be plumb.

- (5) **RAIL ELEMENTS.** Rail elements shall be erected to produce a smooth rail paralleling the set line and grade of the highway or as shown on the plans.

All bolts, except expansion joint bolts and adjustment bolts, shall be drawn tight when the rails have been properly aligned and adjusted and approved by the Chief Engineer. Bolts through expansion joints shall be drawn sufficiently tight to prevent the rail elements from slipping over longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch beyond the nuts. Except when required for adjustment, bolts shall not extend more than 1/2 inch beyond the nuts.

All splices shall be lapped in the direction of traffic. The trailing end of every installation shall be fitted with a rounded type terminal section and lapped on the face of the rail.

All metal shall be fabricated in the shop. Shop-bend all curved guardrail with radii of 150 feet or less. Burning, drilling or welding may be performed in the field when indicated on the plans. Field punching, cutting and drilling may be permitted after the Contractor demonstrates that the process will not damage the metal surrounding the field adjustments, and the process has been approved by the Chief Engineer.

Timber guardrail bolts shall be equally spaced along the front face of the timber rail to match the holes in the steel backing. Steel backing shall have the same vertical dimension as the timber rail. Align timber guardrail along the top and front edges of the rail. Field cut timber rails to produce a close fit at the joints. Field cuts shall be treated with wood preservative as per [811.08](#).

After final tightening of nuts, projecting threads on all bolts shall be burred to prevent removal.

- (D) **MEASURE AND PAYMENT.** The unit of measure for Guardrail will be the linear foot. The number of linear feet will be the actual length of guardrail measured, complete in place, along face of the guardrail center to center of end posts for each installation.

For double-faced guardrail, measurement will be made along the centerline of posts, center to center of end posts.

Where types of installation change, measurement for each type will begin and/or end mid-way between the posts but will not include terminal sections.

The unit of measure for PCC for Post Anchorage will be the cubic yard, based on field measurement.

Payment will be made at the contract unit price per linear foot, which payment will include all labor, equipment, tools and incidentals) necessary to construct all components of the guardrail system complete in place.

Payment for PCC for Post Anchorage will be made at the contract unit price per cubic yard. Payment will include furnishing and curing PCC, backfilling and all other incidentals.

Payment for anchor bolts or bolt holes will be included in the contract unit price for the appropriate Guardrail pay item.

Payment for additional excavation will be made under the appropriate excavation items.

605.02 GUARDRAIL TERMINAL SECTIONS

(A) **DESCRIPTION.** Work consists of the construction of the guardrail terminal sections that are the end components of the guardrail systems. Terminal sections shall be constructed as shown in the DDOT standard drawings or as specified by the manufacturer of a particular type of end treatment. Terminal section construction also includes the proper termination and connection to vertical faces of abutments piers, end walls and safety shaped barriers. Materials, fabrication and construction shall meet the requirements of [605.01\(B\)](#) and [\(C\)](#)

(1) **GUARDRAIL STANDARD TRAILING TERMINAL** – Work consists of the construction of Guardrail Standard Trailing Terminal at locations as shown on the contract documents or as directed by the Chief Engineer. The unit shall consist of:

6 feet 3 inch section of rail

Standard End Terminal piece

1-1/2 inch diameter galvanized rod, turnbuckle and anchor plate

Miscellaneous hardware

PCC anchor and W6-9 steel anchor post and plate

The anchor blocks shall not be constructed until anchor posts are in the proper place. Stay-in-place forms may be used, or concrete may be placed against plumb, undisturbed earth if approved by the Chief Engineer.

Tie rods shall be positioned prior to concrete placement so that the tie rod is oriented correctly and loosely connected to the anchor at the post. After the anchor block has cured, the tie rod and turnbuckle shall be securely tightened.

The area around the block shall be backfilled and graded with embankment material meeting requirements of [204](#).

- (2) **GUARDRAIL APPROACH TERMINAL.** Work consists of the construction of Guardrail Approach Terminal sections at locations shown in the contract documents or as directed by the Chief Engineer. Approach Terminal sections shall consist of posts, railing, hardware and the anchorage assembly necessary to construct the type of terminal section specified. Approach Terminal sections shall be installed according to the manufacturer's recommendations.
 - (3) **GUARDRAIL EXIT TERMINAL.** Work consists of the construction of Guardrail Exit Terminal sections at locations shown in the contract documents or as directed by the Chief Engineer. Exit Terminal sections shall consist of posts, railing, hardware and the anchorage assembly necessary to construct the type of terminal section specified. Exit Terminal sections shall be installed according to the manufacturer's recommendations.
 - (4) **W-BEAM/THRIE BEAM TRANSITION PANEL.** The unit shall consist of one (1) section, as detailed in the contract documents, for connecting W-beam guardrail to thrie beam guardrail, thrie beam impact attenuators or thrie beam guardrail to fixed objects, both approach and exit. Also included is the incidental hardware required for installation.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Guardrail Terminal Sections will be each. The number will be the actual number of each type of Guardrail Terminal Sections installed complete in place and accepted. Payment will be at the contract unit price per each for the respective unit. Payment will include furnishing all components as specified for the particular Guardrail Terminal Sections, to include: all steel components including galvanizing, PCC units, treated timber posts, cable assemblies and anchors. Payment will also include work performed for erection of Guardrail Terminal Sections complete, including excavation, backfilling, disposal of unsuitable materials, shop drawings and all labor, material, tools, equipment and incidentals necessary to complete the work.

605.03 RUB RAIL

- (A) **DESCRIPTION.** Work consists of adding a channel section, to be used as a rub rail, on existing or new guardrail installations at the locations as shown on the contract documents or as directed by the Chief Engineer..
- (B) **CONSTRUCTION REQUIREMENTS.** [605.01\(C\)](#) applies with the following additions:
 - 1. New posts shall be pre-drilled at the fabricator.
 - 2. Existing posts shall be field drilled.
 - 3. Edges of field-drilled holes shall be given one coat of zinc primer.
 - 4. Expansion splices shall be located as shown on the plans, or as directed.
 - 5. Channels shall be of such a length as to accommodate the post spacing with a 50 foot maximum length.
 - 6. The Contractor shall make a field inspection of existing guardrail installations so that required channel lengths can be accurately determined.

7. On curves greater than 3 degrees, 15 minutes, the channel shall be fabricated to fit the required curvature.
- (C) **MEASURE AND PAYMENT.** The unit of measure for Rub Rail will be the linear foot, with measurements made along the top of the channel section. Payment shall be the contract unit price per linear foot, which payment will include furnishing, fabricating, galvanizing, field drilling, touch- up painting, installation, tools, labor, equipment and incidentals necessary to complete the work.

605.04 PCC TERMINAL BLOCK

- (A) **DESCRIPTION.** Work consists of the construction of PCC Terminal Blocks of various dimensions and at locations as shown in the contract documents, or as directed by the Chief Engineer. Work shall include excavation, forming, reinforcing steel, PCC, labor, tools and equipment necessary to complete the item.
- (B) **CONSTRUCTION REQUIREMENTS.** The Contractor shall perform the necessary excavation to construct the PCC Terminal Block. Whenever possible, the excavation shall be done in undisturbed earth. Unsuitable excavated materials shall be disposed of by the Contractor. PCC work shall be done in conformance with applicable provisions of [501](#). After the PCC has cured, the area around the PCC Terminal shall be backfilled with embankment fill meeting the requirements of [204](#). Anchor bolts may be inserted in the plastic concrete or in expansion shields that may be installed in pre-drilled holes. The anchors shall be included as part of Guardrail Items.
- (C) **MEASURE AND PAYMENT.** The unit of measure for PCC Terminal Block will be the cubic yard, with measurement based on the plan dimensions. Payment will be made at the contract price per cubic yard, which payment will include excavation, backfill, disposal of excess and unsuitable excavated materials, forming, PCC, reinforcing steel, tools, labor, equipment and incidentals necessary to complete the work.

605.05 REMOVE GUARDRAIL BURIED TERMINAL

- (A) **DESCRIPTION.** All existing buried terminal sections shall be removed and replaced with modified eccentric loader terminal sections or various impact attenuator devices. Work consists of the complete removal of buried terminal sections including single and double rail, the PCC anchor block, anchorage shoe or shoes, 25 feet of twisted guardrail(s) plus the runout rail(s), and intervening posts, brackets and hardware. Work also includes necessary excavation and backfilling of holes from which anchor block and posts are removed and the disposal of all unusable guardrail elements including anchor blocks. Usable elements, if any, shall be saved for reuse.
- (B) **MEASURE AND PAYMENT.** The unit of measure for Remove Guardrail Buried Terminal will be each. The number will be the actual number of buried terminals, single or double rail, completely removed. Payment for Remove Guardrail Buried Terminal will be made at the contract unit price per each, which payment will include complete removal of the buried terminal sections, including excavation and backfilling, disposal of all unsuitable elements, and all labor, materials tools, equipment and incidentals necessary to complete the work.

605.06 REMOVE GUARDRAIL

- (A) **DESCRIPTION.** Work consists of removing, dismantling, cleaning, touch-up painting, and storing of existing guardrail.

All guardrail elements shall be carefully removed from the posts and be carefully examined. Those elements meeting the Chief Engineer's approval shall be stockpiled in an area acceptable to the Chief Engineer. All rails and posts shall be cleaned and any marred or chipped areas in the galvanizing shall be painted with a zinc-rich paint. Elements determined by the Chief Engineer to be unsuitable shall be disposed of properly.

All post holes shall be backfilled with applicable material and compacted. Anchor bolts in existing PCC shall be removed by burning off flush with the PCC, and the area shall be painted with zinc-rich paint.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Remove Guardrail will be the linear foot of guardrail removed with measurement made along the front face of the guardrail or along the posts for double-faced guardrail. Payment will be made at the contract unit price per linear foot, which payment will include removal, dismantling, cleaning, touch-up painting, stockpiling, disposal of unusable elements, backfill and compaction of post holes, and all labor, tools, equipment and incidentals necessary to complete the work.

605.07 RESET GUARDRAIL

- (A) **DESCRIPTION.** Work consists of resetting usable guardrail, removed and stored as per [605.06](#)

Sections [605.01\(B\)](#) and [605.01\(C\)](#) apply.

- (B) **CONSTRUCTION REQUIREMENTS.** [Section 605.01\(B\)](#) applies with the following additions:

Any materials damaged or missing prior to, during or subsequent to removal due to the Contractor's negligence, shall be replaced at the Contractor's expense. Additional posts, offsets, back-up pieces, plate washers, bolts, nuts, reflectors and other necessary equipment needed to provide 6 feet 3 inches post spacing will be included as part of this item.

Additional rail-post bolt holes shall be drilled after the rail is reset. Edges of field-drilled holes shall be given 1 coat of zinc-rich paint.

- (C) **MEASURE AND PAYMENT.** The unit of measure for Reset Guardrail will be the linear foot of guardrail reset, with measurement made along the front face of the guardrail. Payment will be made at the contract unit price per linear foot, which payment will include furnishing all additional required materials, shop drawings, galvanizing, field drilling, touch-up painting, and all labor, tools, equipment and incidentals necessary to complete the work.

605.08 EXTRA GUARDRAIL COMPONENTS

- (A) **DESCRIPTION.** Work consists of furnishing and installing guardrail components that are in addition to the standard guardrail configuration. Transitions to rigid barriers as well as backup plates, posts, rails, offsets and other materials used to stiffen sections as directed by the contract plans will be paid for under this item.
- (B) **MATERIALS.** Requirements of [605.01\(B\)](#) apply.
- (C) **METHODS OF CONSTRUCTION.** Requirements of [605.01\(C\)](#) apply.
- (D) **MEASURE.** The unit of measure for Extra Guardrail Components will be the pound. The weight shall be for the finished galvanized components with galvanizing and allowable overrun percentage in accordance with AASHTO M 111 and AASHTO M 160 respectively. No deduction will be made for bolt holes. No measure will be made for weight of weld metal or for spike bolts and nuts.
- Weights of the hardware components will be computed from the weight determined by the Chief Engineer or from weights furnished by the manufacturer and approved by the Chief Engineer.
- (E) **PAYMENT.** Payment for Extra Guardrail Components will be made at the contract unit price per pound, which payment will include furnishing and installing galvanized and reflectorized hardware, galvanizing, furnishing, storage, transportation, erection, drilling of bolt holes and all labor, materials, tools, equipment and incidentals needed to complete the work specified.