

ENGINEERING POLICY BALLOT

Effective: April 1, 2019

Issue 1: **Containment of Blast Materials**

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Boyd Denson – BR
 Rhonda Luck - BR

Summary: This proposal updates Sec 202.2.1 to include "containment" as part of the procedure when blasting abrasions/particles are used in removal processes such as: bridge paint, masonry work, pavement repairs, and flexible joints. Sections 505, 613, 623, 703, 704, and 717 are also being updated to be in accordance with Sec 202.2.1.

Publication: Secs 202, 505, 613, 623, 703, 704, and 717.

Issue 2: **Clarifications and Documentation Regarding Clear Zone Strategies**

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: James E Smith - DE

Summary: The proposed revision incorporates additional *Roadside Design Guide* language and recommends a safety analysis as a means of documenting decisions for safety strategies and use of safety devices.

Publication: EPG 231.2

Issue 3: Asphalt Shoulder Surface Mix

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Sarah Kleinschmit - DE

Summary: The proposed revision establishes all shoulders 4 feet and less will be monolithically resurfaced with the same type of asphaltic mix used on the mainline roadway. This change will eliminate one paving operation per narrow (4' or less) shoulder when the shoulder is paved with the mainline. This previously required two operations: one with a paver on mainline and one with a road widener. This will improve safety by reducing the time exposed to hazardous situations, and will improve the quality of the shoulder by eliminating a joint between high type and low type mixes and better compaction.

Publication: EPG 626.1 and EPG Other Aspects of Pavement Design, Shoulder Surface.

Issue 4: Clarifications and Improvements to C.E.T. Grading Limits

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Sarah Kleinschmit – DE
Richard G. Prosser - DE

Summary: The proposed changes to Std. Plans 606.31 and 606.81 required CET grading limits are quicker to interpret than previous (required length vs. required ratio). The proposed changes also indicate that when shown on the plans, the preferred grading limits will be constructed. The flared CETs have not been updated due to no MASH approved flared end sections.

Publication: Std. 606.31 and 606.81



SECTION 202

REMOVAL OF ROADWAYS AND BUILDINGS

202.1 Description. This work shall consist of the removal and disposal of all existing improvements from the right of way and within the limits of any construction area outside the right of way, except improvements designated or permitted to remain in place or to be removed under other items of work. These specifications will apply to all removal work performed by the contractor.

202.2 General Requirements.

202.2.1 Containment and Disposal of Material. All abrasives used in blasting activities shall be collected using a containment system or enclosure to prevent the release of material to the environment. All improvements not designated to remain shall be removed or disposed of by the contractor as required. The work may involve the generation of excess material, which may be solid waste under the definitions of the MDNR Solid Waste Management Program. The contractor shall dispose of solid waste in accordance with the Missouri Solid Waste Management Law and implementing regulations, 10 CSR 80.

202.2.1.1 Regulated solid waste, including waste tires, shall be handled, transported and disposed of in accordance with applicable regulations. Documentary proof of proper transport and disposal of this waste, including transport forms, disposal forms, scale tickets, cancelled checks and receipts, shall be provided to MDNR and to the engineer prior to acceptance of the work.

202.2.1.2 Material designated for use elsewhere shall not be removed from the project. Open burning of material shall be conducted in accordance with [Sec 201.2.5.1](#). Uncontaminated underground storage facilities not requiring removal shall be dewatered, filled with sand or grout to within one foot of the top of the facility, and crushed.

202.2.2 Damaged Items. Any item damaged by the contractor's operations that is designated to remain in place, to be used elsewhere, or to be used by the public or an adjoining property owner, shall be repaired or replaced at the contractor's expense, in a manner satisfactory to the engineer in accordance with [Sec 107.12](#).

202.2.3 Dust and Emissions Control. All operations during demolition and removal shall be adequately controlled to prevent dust and visible emissions, unless otherwise approved by the engineer. All measures taken shall be provided by the contractor at the contractor's expense unless specified otherwise.

202.2.4 Salvage. All material designated in the contract to be salvaged for Commission use from existing structures or improvements shall be removed without damage, in sections that may be readily handled, transported and stored as approved by the engineer. Unless otherwise designated in the contract, all coldmilled material, existing guardrail, and guard cable material designated for removal shall become the property of the contractor. All buildings, material and equipment of any description not designated for salvage by the Commission shall become the property of the contractor, unless owned and claimed by a political subdivision or utility company. Salvaged material becoming the property of the contractor shall not be stored on

505.10.6 Surface Preparation.

505.10.6.1 On new concrete decks, the surface shall be given a very rough texture while still plastic by use of a wire comb or other approved texturing device which will produce a bondable surface acceptable to the engineer.

505.10.6.2 On old existing concrete decks with existing wearing surfaces, the wearing surface shall be removed in accordance with [Sec 216](#). On existing concrete decks without existing wearing surfaces, the surface shall be scarified in accordance with [Sec 216](#).

505.10.6.3 The textured or scarified deck shall be sandblasted followed by an air blast. The sandblast shall remove all dirt, oil and other foreign material, as well as any unsound concrete or laitance from the surface and edges against which new concrete is to be placed. The compressor shall be equipped to prevent oil in the air supply. That portion of the curb and previously placed overlays against which new concrete is to be placed shall be sandblasted. Any loose or foreign material detected on the concrete surface prior to placement of the overlay shall be removed by sand or air blasting. Containment and disposal of material shall be in accordance with Sec 202.2. The concrete surface may require retexturing where penetration of foreign material is evident. No contamination of the retextured or scarified concrete surface will be permitted.

505.10.6.4 To assure that the thickness of the concrete overlay above the prepared surface will be as specified on the plans, the clearance shall be checked in the following manner before concrete is placed. A filler block having a thickness 1/8 inch less than the overlay thickness shall be attached to the bottom of the screed. With screed guides in place, the screed shall be passed over the area to be concreted. Where the intended clearance does not allow use of this method, a stringline or other means shall be used, subject to approval from the engineer. All old concrete that does not have sufficient clearance shall be removed.

505.10.7 Finishing Equipment.

505.10.7.1 The finishing machine shall be designed for striking off and finishing low slump concrete overlay. The machine shall be mechanically powered to operate forward and reverse in a smooth manner, under positive control of the operator. The basic machine shall be of a width to finish a basic 12-foot width of overlay and shall be adjustable for wider placements. The finishing machine shall be designed to allow the screeds to be extended with bolted units to match the extension of the basic unit. The drive wheels shall be of the type that may be replaced with solid rubber wheels to permit travel upon previously completed lanes of overlay when striking off the abutting lanes.

505.10.7.2 The finishing machine shall be equipped with two oscillating transverse screeds. The screeds shall oscillate in a straight line. A swinging pendulum stroke shall not be used. The front screed shall vibrate uniformly for the full length of the screed. The vibrators shall be placed such that the screed vibrates efficiently and the frequency of the vibrators shall be controlled by the operator from the console to achieve the required density.

505.10.7.2.1 Screeds shall be held positive to the machine with rollers and, unless otherwise approved by the engineer, shall be equipped with screed guides such as to control the profile grade of the finished overlay. The screed stroke shall be synchronized to speeds not exceeding 50 strokes per minute, with infinite variable control from the console. The screeds shall be capable of vertical lift when the machine is reversed for travel, and controlled for downward direction to the finishing position to permit feathering of the screeds to any previously finished surface.

505.20.6.2 On both old and new decks, within 24 hours prior to placing latex modified concrete, the entire surface shall be thoroughly cleaned by sandblasting followed by an air blast. [Containment and disposal of material shall be in accordance with Sec 202.2.](#)

505.20.7 Finishing Equipment.

505.20.7.1 The finishing machine shall be self-propelled and shall be capable of forward and reverse movement under positive control, with a provision for raising all screeds to clear the screeded surface for traveling in reverse. A self-propelled finishing machine with one or more rollers, augers and 1,500 to 2,500 vpm vibratory pans shall be used. A drag float may be necessary. Any modifications will be subject to approval from the engineer.

505.20.7.2 Support rails shall be in accordance with [Sec 505.10.7.4](#).

505.20.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with [Sec 505.10.8](#) except as specified herein.

505.20.8.1 Prior to placement of latex modified concrete, the cleaned surface shall be thoroughly wetted for a minimum of three hours, then covered with polyethylene sheeting until time of concrete placement. The surface shall be damp at the time the overlay is placed. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air. No free water or puddles of standing water shall exist at the time of placement.

505.20.8.2 Expansion joints and dams shall be formed in the concrete overlay. Formation of the joint by sawing through the overlay will not be permitted.

505.20.8.3 Texturing shall occur immediately after finishing and before the plastic film forms on the surface. Texturing shall be performed in a manner to prevent pulling the concrete away from an existing vertical face. Care shall be taken not to texture too deep and not to tear the surface.

505.20.8.4 Screed rails and headers shall be separated from the newly placed material by passing a pointing trowel along the inside face. Metal expansion dams shall not be separated from the overlayment. The trowel cut shall be made for the entire depth and length of rails or headers after the mixture has stiffened sufficiently and shall prevent the concrete from flowing back into the cut.

505.20.8.5 During placement of the overlay, all joints with adjacent concrete shall be sealed with a mortar paste of equal parts cement and fine aggregate, using latex emulsion in lieu of mixing water.

505.20.8.6 The wet cure shall be applied promptly after the concrete has been placed on the deck without deforming the finished surface.

505.20.8.7 The surface shall receive a wet cure for at least 48 hours.

505.20.8.8 After placement and cure of the latex modified concrete, the finished deck will be tested to detect unbonded areas.

505.20.8.9 No surface sealing shall be applied to the latex modified concrete wearing surface.

505.20.9 Limitations of Operations.

control of the latex emulsion into the mixing chamber, and the latex emulsion shall calibrate to within ± 2 percent of that required. The mixer shall be capable of continuously circulating the latex emulsion and have a flow-through screen between the storage tank and the discharge.

505.40.6.2 The concrete discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that initial and final finishing operations can proceed at a steady pace. Final finishing shall be completed before the formation of a plastic surface film on the surface.

505.40.6.3 The moisture content of aggregates at the time of proportioning shall be such that water will not drain or drip from a sample. Coarse and fine aggregate shall be furnished and handled to avoid variations in the moisture content affecting the uniform consistency of the concrete.

505.40.6.4 Each drum of latex admixture shall be mechanically agitated or hand rolled until thoroughly mixed prior to being introduced into the mixer storage compartment. Latex admixture that is stored in the mixer storage compartment overnight or during delays in mixing of four hours or more shall be agitated by at least two complete cycles in a continuous circulating pump or by mechanical means in the storage compartment. The flow through screen shall be cleaned immediately prior to beginning proportioning and as often as necessary thereafter. Latex admixtures of different brands shall not be combined together in any manner.

505.40.6.5 The water/cement ratio shall be within 0.02 of that specified in the approved mix design. If adjustments for water content beyond that are necessary, a previously tested and approved mixture shall be used.

505.40.6.6 Prior to placement of concrete in the work, the contractor shall be required to prepare trial batches of concrete for testing. Trial batches shall comply with the limits specified in this provision.

505.40.7 Surface Preparation. Surface preparation shall be in accordance with [Sec 505.10](#) except as specified herein.

505.40.7.1 Prior to scarifying or chipping on concrete adjacent to latex modified very early strength concrete, 24 hours of curing shall elapse. If practical, or unless otherwise shown on the plans, all scarifying by mechanical units shall be completed prior to placing any latex modified very early strength concrete. Areas from which unsound concrete and patches have been removed shall be kept free of slurry produced by wet sawing or wet scarifying by planning the work such that this slurry will drain away from the completed areas of preparation.

505.40.7.2 On both old and new decks within 24 hours before latex modified very early strength concrete placement begins, the entire surface shall be thoroughly cleaned by hydro blasting followed by an air blast in accordance with [Sec 505.10](#).

505.40.7.3 Containment and disposal of material shall be in accordance with Sec 202.2.

505.40.8.0 Finishing Equipment.

505.40.8.1 The finishing machine shall be self-propelled with one or more rollers, augers and vibratory pans capable of 1,500 to 2,500 vpm. It shall also be capable of forward and reverse movement under positive control, with a provision for raising all screeds to clear the screeded surface for traveling in reverse. A drag float may be necessary. Any modifications shall be subject to approval from the engineer.

milling process. Residue slurry from milling operations shall be removed in accordance with [Sec 622.30.3.8](#). If the top of dowel bars are exposed but not structurally damaged, the exposed section of the dowel bar shall be coated with an approved bond breaker.

613.20.3.1.1 Milling. Milling equipment shall be in accordance with [Sec 622.10](#), and shall be equipped with a device for stopping at a preset depth. Milling may be performed either across lanes or parallel to the pavement centerline. After milling, the bottom of the repair area shall be checked by sounding to ensure all unsound material has been removed. Any unsound material remaining shall be chipped free. All transverse sides of the removal shall be uniform and tapered 30° to 60° from vertical by milling or chipping. If excessive concrete is removed, or dowel bars are damaged to the extent to require full depth pavement repair, the cost for the repair shall be at the contractor's expense.

613.20.3.1.2 Full Depth Pavement Repair Required. If during the removal of material for partial depth pavement repair the pavement constituted full depth pavement repair in accordance with [Sec 613.20.1.2](#), removal operations shall cease at that location. The contractor may conduct full depth pavement repair at that time, or temporarily patch the area and perform full depth pavement repair at a later date. If the location is opened to traffic prior to the full depth pavement repair, all loose material shall be removed and either a bituminous material approved by the engineer or a concrete mixture in accordance with [Sec 613.20.2](#) shall be used to patch the location. Reestablishing joints or cracks in temporary repairs by sawing will not be required. Material provided for temporary patches shall be provided at the contractor's expense.

613.20.3.2 Cleaning. The exposed faces of the concrete shall be free of loose particles, oil, dust, traces of bituminous material and any other contaminants before repair material is placed. The procedure shall produce a clean, roughened surface, such as can be produced by sandblasting or, shotblasting. Containment and disposal of material from sandblasting or shotblasting shall be in accordance with Sec 202.2. All remaining loose material~~residue~~ shall be removed with air blasting equipment just prior to placement of material. The air from the air blasting equipment shall be free of contaminants.

613.20.3.3 Joint and Crack Preparation.

613.20.3.3.1 Transverse Joints and Cracks. When placing a partial depth pavement repair directly against a transverse joint or crack, a compressible insert shall be placed against the joint or crack to form a bond breaker between the patch material and joint or crack. A pliable material shall be used to reform cracks along the existing paths. The new joint or crack shall be formed to the same width as the existing joint or crack. The compressible insert shall be placed into the existing joint to a minimum depth of one inch below the bottom of the repair and shall extend a minimum of one inch beyond each end of the prepared repair boundaries.

613.20.3.3.2 Longitudinal and Centerline Joints. When placing a partial depth pavement repair directly against the centerline or an adjacent lane joint, a compressible insert, a thin polyethylene strip no less than 1/8 inch thick or asphalt impregnated roofing felt shall be placed along the joint prior to placing the patching material.

613.20.3.3.3 Shoulder Joints. When placing a partial depth pavement repair along a lane and shoulder joint, the repair edge shall be formed if the shoulder is either soil, aggregate or bituminous material. The form shall be placed even with the surface and slightly below the repair depth. If the shoulder is concrete, then the repair interface at the joint shall be in accordance with [Sec 613.20.3.3.2](#).

613.20.3.3.4 Reestablishment of Joint and Cracks. At locations where repairs include existing pavement joints, both longitudinal and transverse, the initial reestablishment of the

613.30.3.1.1 At areas shown on the plans or where unsuitable material is exposed during coldmilling operations and identified by the engineer to be repaired, all loose and unsuitable bituminous material shall be removed by milling or other approved methods. Concrete material shall be removed in accordance with [Sec 613.20.3.1](#). Around the perimeter of the repair, the sides shall be relatively vertical, and concrete surfaces shall have a roughened face, such as can be produced by milling or other means approved by the engineer. The minimum depth of the repair shall be 2 inches. The area shall be cleaned to remove loose material and shall have a relatively uniform depth. If the top of dowel bars are exposed but not structurally damaged, the exposed section of the dowel bar shall be coated with an approved bond breaker.

613.30.3.1.2 If during the removal of material for partial depth pavement repair, the pavement constitutes full depth pavement repair in accordance with [Sec 613.30.1.2](#), removal operations shall cease at that location. The contractor may conduct full depth pavement repair at that time, or the contractor may temporarily patch the exposed area in accordance with [Sec 613.20.3.1.2](#), and perform full depth pavement repair at a later date.

613.30.3.2 Cleaning. The exposed faces of the concrete shall be free of loose particles, dust and any other contaminants before repair material is placed. The procedure shall produce a clean, roughened surface, such as can be produced by sandblasting ~~or, shotblasting or high pressure water blasting.~~ Containment and disposal of material from sandblasting or shotblasting shall be in accordance with Sec 202.2. All ~~residue remaining loose material~~ shall be removed with air blasting equipment just prior to placement of material. The air from the air blasting equipment shall be free of contaminants.

613.30.3.3 Placement of Repair Material. The repair area shall be suitably tacked on the sides and bottom to ensure bonding of any remaining loose material, as well as bonding of the repair material. There shall be no ponding of the tack liquid at the time the area is filled. The repair area shall be filled with an approved bituminous surface mixture, and thoroughly compacted over the entire repair area to a density approved by the engineer. Areas greater than 3 inches in depth shall be filled in two lifts, each thoroughly compacted. Reestablishing of joints by sawing will not be required.

613.30.4 Method of Measurement.

613.30.4.1 Measurement of Class B partial depth pavement repairs for removing material will be made to the nearest 1/10 square yard. Any material removed beyond the repair area designated by the engineer due to the removal methods used by the contractor will not be included in the measurement for pavement repair. Measurement for furnishing and placing the bituminous material will be made to the nearest 0.1 ton.

613.30.4.2 If an area designated for partial depth pavement repair requires full depth pavement repair in accordance with [Sec 613.30.1.2](#), measurement for material removed as part of the partial depth pavement repair work at that location will be made to the nearest 1/10 square yard.

613.30.5 Basis of Payment. The accepted quantities for Class B partial depth pavement repair will be paid for at the contract unit price for each of the pay items included in the contract. Payment for tack liquid is incidental to the pay item for furnishing and placing bituminous material. Full depth pavement repairs required due to improper means and methods by the contractor will be at the contractor's expense. All other full depth pavement repairs will be paid for in accordance with [Sec 613.10](#).

SECTION 613.35 CLASS C PARTIAL DEPTH PAVEMENT REPAIR

mixed in accordance with the manufacturer's recommendations. The contractor shall supply a manufacturer's certification to the engineer for each lot of material furnished. Certification shall include the name of the manufacturer and a manufacturer's certification statement that the material supplied is the same as the material that was qualified.

613.40.2.2 Dowel Bars. Dowel bars shall be 1½ x 18 inches and in accordance with [Sec 1057](#), except the entire dowel bar shall be coated.

613.40.2.3 Expansion Caps for Dowel Bars. Caps shall be tight fitting and made of ¼ inch thick non-metallic material that will allow ¼ inch movement at each end of the dowel bar.

613.40.2.4 Joint Insert. To re-establish the crack, a compressible insert, in accordance with [Sec 613.20.2.4](#), shall be used. The material shall fit tight around the dowel bar and to the bottom and edges of the slot. The material shall be capable of remaining in a vertical position and tight to all edges during placement of the repair material to prevent the concrete backfill from flowing into the existing crack and pavement voids.

613.40.2.5 Bar Chairs. Bar chairs may be metal epoxy-coated chairs or a non-metallic material.

613.40.3 Construction Requirements.

613.40.3.1 Preparation of Slots. Two saw cuts shall be made in the pavement to outline the longitudinal sides of each dowel bar slot. The slots shall be sawed to a depth and length that allows the center of the dowel to be placed at mid-depth in the pavement slab. The slots shall be 2 ½ inches wide. The contractor shall provide a method, approved by the engineer, that will align the slots parallel to centerline of the roadway with a maximum variation of ¼ inch from a true parallel line. Slots in a wheel path shall be created by using saws with gang-mounted diamond blades, capable of simultaneously making six saw cuts for three dowel bar slots at the desired slot spacing. Equipment shall not cause damage to the existing pavement. All saw slurry shall be removed from the slot and pavement. No water residue or paste shall be allowed to flow onto lanes open to traffic or into closed drainage systems. If pneumatic hammers or other equipment used during concrete removal operations cause damage to pavement that is to remain, the concrete removal operations shall be discontinued and shall not resume until the contractor has taken corrective measures. The pneumatic hammer will not be permitted to break through the concrete, and if this occurs, a full depth pavement repair shall be conducted at the contractor's expense. The bottom of slots shall be flat. The edges of the slots shall be cleaned by sandblasting to produce a rough surface. Blasting operations shall not damage the surrounding pavement. Containment and disposal of material from sandblasting shall be in accordance with Sec 202.2. The newly exposed concrete surface shall be free of spalls, burrs, laitance and all contaminants detrimental to achieving an adequate bond. The maximum amount of spalling allowed on the edges of the slots will be ¾ inch. The point of curvature at the bottom of either end of the slot shall be ½ inch beyond the dowel bars end.

613.40.3.1.1 After the construction of a slot, the pavement shall not be opened to traffic until all six retrofit dowel bars are in place, cured, and the work is completed at that location. The tires of construction vehicles will not be permitted to travel on slots where concrete has been removed.

613.40.3.1.2 Multiple saw cuts parallel to the centerline within the slot removal boundaries may be sawed to allow removal of material from the dowel bar slots and to provide a level surface for the feet of the dowel bar chairs.

613.40.3.1.3 All slots shall be cleaned with moisture-free, oil-free, compressed air to remove any remaining dust, residue, debris and moisture. The contractor shall then seal the existing

623.30.3.3 Field Test. Prior to the start of the overlay operation, a test area of the complete overlay system shall be placed on the bridge deck in a contractor proposed location that is approved by the engineer. When multiple bridges are included in a project, a test area will be required on each bridge. The contractor may utilize one-half of the bridge deck or an area equal to one day's placement operation, whichever is smaller, as a field test. The degree of cleaning used on the test area shall be the minimum used on the remainder of the structure. The surface for the test overlay shall be prepared in accordance with the test method prescribed in ACI 503R - Appendix A of the ACI Manual of Concrete Practice to establish an approved cleaning practice. The approved cleaning practice shall remove all potentially detrimental material which may interfere with the bonding or curing of the overlay. Concrete shall be sound, with mortar soundly bonded to the coarse aggregate, with clean and open pores to be considered adequate for bond. All areas of asphalt and pavement markings shall be removed. Preparation of the surface shall produce a surface relief equal to International Concrete Repair Institute (ICRI) surface preparation level 6 or 7 or ASTM E 965 pavement macrotexture depth of 0.04 to 0.08 inch.

623.30.3.3.1 Visible moisture on the prepared deck at the time of placing the overlay will not be permitted. Moisture in the deck shall be checked by taping a plastic sheet to the deck for a minimum of 2 hours in accordance with ASTM D4263.

623.30.3.3.2 In addition to the above requirements, the cleaning practice shall provide an adhesion strength test result greater than 250 psi or a failure area into the base concrete that is greater than 50 percent of the test area. After the test area has cured for a minimum of 72 hours, adhesion shall be checked in accordance with ACI 503R. A test result will be the average of three tests on a sample area of the test patch. A minimum of three sample areas per test patch shall be tested. Successful test results will be required from each sample area.

623.30.3.3.3 If the test of a sample area fails to meet the above requirements due to a cohesive failure of the substrate concrete, the adhesive strength of the sample area will be considered acceptable.

623.30.3.3.4 Successful completion of the adhesion strength tests will be required before the full-scale overlay operation is to begin. All cleaning operations shall equal those used for the adhesion strength test areas, in both profile and cleanliness. If changes are made to the established cleaning practice, new adhesion strength testing shall be performed at the contractor's expense.

623.30.3.3.5 Test patches shall be installed with the same material, equipment, personnel, timing, sequence of operations and curing period that will be used for the installation of the overlay.

623.30.3.3.6 If the test fails, the contractor shall remove the material represented by the failed test patches and provide another test patch, at the contractor's expense, until satisfactory test results are obtained.

623.30.3.4 Surface Preparation. Before placement of the overlay, the entire deck surface shall be prepared by the cleaning practice established in the field adhesion strength tests in accordance with [Sec 623.30.3.3](#), except that sand blasting will not be permitted. [Containment and disposal of material shall be in accordance with Sec 202.2.](#)

623.30.3.4.1 If the engineer determines that the weather has changed significantly since the application of the field test patch, the contractor shall verify through adhesion strength tests that the practice is acceptable, at the contractor's expense.

623.40.3 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Polymer Concrete	1039

623.40.4 Construction Requirements.

623.40.4.1 Equipment. The contractor's equipment shall be in accordance with the manufacturer's recommendations.

623.40.4.2 Surface Preparation. Portland cement concrete shall be allowed to cure and dry for a minimum of seven dry days prior to installing the polymer concrete. Days with cold, wet or inclement weather which may be a detriment to curing of the Portland cement concrete will not count in this seven day minimum curing and drying time. The concrete surface shall be dry when placing the polymer concrete. The substrate shall be structurally sound and sandblasted to be free of all foreign matter, grease, dirt and laitance for all areas that will be in contact with the polymer concrete. Steel surfaces shall be cleaned in accordance with SSPC-SP 10 surface preparation requirements. Containment and disposal of material shall be in accordance with Sec 202.2. After sandblasting is completed, the joint shall be cleaned of debris by using oil and water free compressed air at a minimum of 90 psi or by vacuuming. These areas shall then be primed in accordance with the manufacturer's recommendations.

623.40.4.3 Placement. The polymer concrete shall be mixed, placed and cured in accordance with the manufacturer's recommendations and as shown on the plans. Before opening to traffic, the material shall be tack free and fully cured as determined by the engineer.

623.40.5 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, the volume of polymer concrete will be measured to the nearest 1.0 cubic feet of accepted, in-place polymer concrete. The revision or correction will be computed and added to or deducted from the contract quantity.

623.40.6 Basis of Payment. The accepted quantity of polymer concrete will be paid for at the contract unit price.

final position in still water and shall not be vibrated or disturbed after being deposited. Concrete placed under water for seal courses shall be Seal Concrete in accordance with [Sec 501](#).

703.3.3.7 Conveying, placing and pumping equipment shall have adequate capacity, be suitable for the intended work and shall be operated to produce a continuous stream of uniform concrete. Equipment shall be arranged to prevent transmission of vibration to freshly placed concrete. The system through which the concrete is pumped shall be manufactured such that no aluminum parts will come into contact with the concrete.

703.3.3.8 At the completion of concrete placement, the last concrete in the pipeline shall not be used.

703.3.3.9 Concrete used for filling cavities or crevices as directed by the engineer and as required in [Sec 206](#) shall be Class B concrete. This concrete shall be unformed mass concrete placed separately from and prior to the placing of footing concrete.

703.3.3.10 When a closure pour is specified on the bridge plans, or is necessary for other requirements, the closure pour between slabs poured independently shall be expansive Class B-2 concrete. Unpolished aluminum powder shall be added to the Class B-2 concrete as recommended by the powder manufacturer or as approved by the engineer for controlled expansion. A shrinkage compensating cement may be substituted for the unpolished aluminum powder and cement. If a shrinkage compensating cement is substituted, the type and amount shall be approved by the engineer.

703.3.3.10.1 Prior to placing the closure pour, the contractor shall release the falsework to allow the initial deflection in the slab extension. The contractor shall obtain approval from the engineer prior to placing the closure pour.

703.3.3.10.2 The slab area to be in contact with the closure pour shall be sandblasted to remove all foreign matter and shall be cleaned to remove all dirt and loose material. [Containment and disposal of material shall be in accordance with Sec 202.2.](#) After the slab area has been cleaned and any damaged epoxy coating on the reinforcing bars repaired, an epoxy-bonding compound shall be applied to the slab area to be in contact with the closure pour. The concrete bonding compound and application shall be in accordance with [Sec 623](#).

703.3.3.10.3 Immediately following application and before the concrete bonding compound has set, the closure pour shall be placed.

703.3.4 Joints in Concrete Masonry. Construction and expansion joints in concrete masonry shall be located where shown on the plans, except that in case of an unforeseen contingency, an emergency construction joint may be permitted.

703.3.4.1 Surfaces of construction joints shall be roughened or scored unless shear keys are shown on the plans. The face edges of all joints shall be carefully finished, and feathered edges shall be avoided. When the placing of concrete is temporarily discontinued, the concrete shall be cleaned of laitance and other objectionable material after becoming firm enough to retain form, and shall be thoroughly wetted before placing new concrete. Contraction joints in floor slabs of truss bridges may be sawed. Waterstops and flashings as shown on the plans shall be continuous if practical. Splices shall be watertight.

703.3.4.2 Preformed sponge rubber expansion joint material shall be of the dimensions shown on the plans. Splices shall be held to a practical minimum and shall be made by lacing with copper wire or soft-drawn galvanized steel wire. All joint material shall be securely stitched to one face of the concrete with No. 10 gage copper wire or No. 12 gage soft-drawn galvanized

Environmental protection shall be in accordance with [Sec 107](#). Hydro demolition shall not impede or interfere with maintaining traffic. Heavy equipment, such as vacuum trucks for removal of concrete debris, will not be permitted to place wheel loads on the deck areas where deteriorated concrete has been removed.

704.4.1.5 Concrete Removal. A boundary perimeter with one-inch vertical sides shall be established outside the deteriorated area. The deteriorated concrete shall be removed as required to provide good sound concrete on which new concrete can be placed and satisfactorily bonded to the reinforcing bars. The areas of repair shall be made approximately rectangular with the sides generally perpendicular to the surface being repaired. These areas shall be carefully removed such that reinforcement is not disturbed or damaged. For full depth repair, a saw cut outside the deteriorated area shall also be made on the bottom of the bridge deck, except on voided slab, solid slab and box girder bridges without entry access. Other acceptable methods for saw cutting the bottom of the deck may be used with approval from the engineer. No more than one-fourth of the column perimeter shall be removed at any one time, and no more than one-eighth of the column perimeter if the repair is completed under live load. Once the one-quarter or one-eighth limit has been reached, the column shall be repaired before any further column removal is done.

704.4.1.6 Reinforcing Bar Exposed. All exposed reinforcing bars shall be thoroughly cleaned by sand or hydro blasting to the satisfaction of the engineer.

704.4.1.6.1 Superstructure and Substructure Repair. The concrete within the boundary area for superstructure repair (unformed), substructure repair (formed) and substructure repair (unformed) shall be removed a minimum of one inch beyond the inside edge of any exposed reinforcing bars, including the main reinforcement.

704.4.1.6.2 Deck Repairs. The minimum depth of repair for repairing concrete deck (half-soling) or modified deck repair shall expose the upper layer of the top mat of reinforcing steel. When the bond between existing concrete and a reinforcing bar has been destroyed, or more than half the diameter of a reinforcing bar is exposed, the concrete adjacent to the reinforcing bar shall be removed to a depth that will permit the concrete to bond to the entire periphery of the bar. A minimum of one-inch clearance shall be maintained.

704.4.1.6.3 If a reinforcing bar is exposed during slab edge repair, the concrete adjacent to the bar shall be removed to a depth that will permit a qualified special mortar to bond to the entire periphery of the bar. A minimum of one-inch clearance shall be maintained.

704.4.1.7 Reinforcement Repair. Particular care shall be taken not to disturb or damage reinforcing bars. All exposed reinforcing bars shall be thoroughly cleaned by sand or hydro blasting. Cut or broken bars or bars with 25 percent or more cross sectional area lost shall be spliced 24 diameters on each side of the damage with new bars of the same size in accordance with [Sec 706](#). Damaged existing epoxy coated reinforcement shall be repaired in accordance with [Sec 710](#).

704.4.1.8 Material Disposal. All material removed shall be disposed of in accordance with [Sec 202](#).

704.4.2 Preparation of the Repair Area.

704.4.2.1 Patch Preparation Requirements. After removal of deteriorated concrete, the area to be repaired shall be sand or hydro blasted to remove all foreign matter, dirt, free standing water and loose material. Containment and disposal of material shall be in accordance with [Sec 202.2](#). The hydro demolition process will not require sand or additional hydro blasting unless the bonding surface of the repair area becomes contaminated or unsatisfactory prior to

placement of new concrete. The area to come in contact with new concrete shall be cleaned as stated above, saturated with water and painted with a concrete bonding compound or an epoxy mortar prior to the placement of new concrete. A concrete bonding compound shall be used for all structures with the following exception. An epoxy mortar shall be used on box girder, voided and solid slab structures and on structures where a cathodic protection system is to be installed.

704.4.2.2 Epoxy Sealing Preparation. The area to be sealed shall be cleaned by sand blasting. [Containment and disposal of material shall be in accordance with Sec 202.2.](#) Prior to sealing the concrete, all loose particles and foreign matter shall be removed using oil-free and water-free compressed air or a vacuum of at least 90 psi.

704.4.2.3 Concrete Crack Filler Preparation. The area to fill the cracks shall be cleaned by pressure washing with at least 2500 psi, 3 days minimum prior to the crack filler application and 2 days after any measurable precipitation.

704.4.3 Applying Epoxy. The area to be sealed shall be sealed with a qualified Type III epoxy or epoxy material for epoxy polymer concrete overlay. Sealing shall be completed before the application of any overlay. The cleaning, sealing and epoxy application shall proceed only as approved by the engineer, in accordance with the manufacturer's written recommendations. The epoxy application and rate of coverage shall be in accordance with manufacturer's recommendations, with a maximum coverage of 100 square feet per gallon.

704.4.3.1 Applying Concrete Crack Filler. The area to fill the cracks shall be filled with a low viscosity polymer crack filler. The concrete crack filler application and rate of coverage shall be in accordance with the manufacturer's recommendations, with a maximum coverage of 100 square feet per gallon. The broadcasting of dry blasting sand shall be applied only as approved by the engineer, in accordance with the manufacturer's written recommendations with a maximum coverage of 1 to 2 lbs/sq.yd. starting approximately 10 minutes after crack filling operation has started.

704.4.4 Placement of New Concrete.

704.4.4.1 Concrete Placement Requirements. Concrete shall be placed before the concrete bonding compound or epoxy mortar has begun to set. Deck repair concrete shall be placed in the repair area to match the top of the original deck surface. For bridges to be covered with concrete wearing surface, deck repair concrete shall be placed in the repair area up to the bottom of the proposed concrete wearing surface. The finished repair area shall have a light broom texture for bonding of the deck seal, except bridges to be covered with concrete wearing surface shall have a rough surface for bonding of the concrete wearing surface. All joints shall be formed to match any existing joint pattern.

704.4.4.2 Concrete Requirements. Concrete for concrete deck repair shall be Class B-2, except that solid slab, voided slab and box girder structures shall be the same class as the existing deck concrete and as specified in [Secs 704.3.4](#) and [704.4.4.3](#). The repair area shall not be opened to any traffic until the concrete has reached a compressive strength of 3,200 psi. Type III cement may be used to accelerate the set. The coarse aggregate shall be Gradation E in accordance with [Sec 1005](#). Accelerating additives containing chlorides will not be permitted.

704.4.4.3 Bridge Decks with Cathodic Protection System. Concrete for repairing the concrete deck shall be Class B-1. The repair area shall not be opened to any traffic until the concrete has reached a compressive strength of 3200 psi. Type III cement may be used to accelerate the set. The coarse aggregate shall be Gradation E in accordance with [Sec 1005](#). Accelerating additives containing chlorides will not be permitted. All half-sole repairs made



SECTION 717

FLEXIBLE JOINT SYSTEMS

SECTION 717.10 PREFORMED COMPRESSION SEAL.

717.10.1 Description. This work shall consist of furnishing and installing a preformed compression seal for joints as shown on the plans or as directed by the engineer. Structural steel for the joints shall be furnished and installed as shown on the plans.

717.10.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Preformed Compression Seals	1073

717.10.3 Construction Requirements.

717.10.3.1 Shop Drawings. Shop drawings for structural steel for expansion joint systems shall be prepared in accordance with [Sec 1080](#). The dimensions of the seal shall be shown on the shop drawings for the armored joint. Shop drawings will not be required when the seal is placed against concrete or existing steel armor.

717.10.3.2 Installation. The preformed compression seal shall be installed in joints in one continuous piece without field splices. Factory splicing will be permitted for joints in excess of 53 feet. The area of steel armor to come in contact with preformed compression seal lubricant adhesive shall be sand blasted prior to installing the seal. Sand blasting will be considered acceptable when the steel surfaces have been cleaned to an SSPC-SP10 degree of cleanliness. Containment and disposal of material shall be in accordance with Sec 202.2. The lubricant adhesive shall be applied in a continuous film to the sides of the seal and to the joint surfaces just prior to placing the seal in the joint. The seal shall be installed with an installation tool recommended by the manufacturer, in a manner that prevents the seal from being damaged and from being in tension. Twisting, curling and nicking the seal will be prohibited. Lubricant adhesive on top of the installed seal shall be removed before drying. Unless the installation tool is capable of installing the seal without elongation prior to placement, the seal shall be pre-cut to the exact length for the joint plus ends as shown in the contract documents. The pre-cut seal shall be installed and measured for stretch. The seal shall be removed and reinstalled if the seal stretch length exceeds five percent of the pre-cut length.

717.10.4 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where significant errors are found in the contract quantity. Where required, the preformed compression seal will be measured to the nearest linear foot based on measurement from roadway face of curb to roadway face of curb along the centerline of the joint. The revision or correction will be computed and added to or deducted from the contract quantity. No measurement will be made of portions of the joint that extend past the roadway face of curbs.

717.10.5. Basis of Payment. Preformed compression seals, including all material, coating, equipment, labor, fabrication, installation and any other incidental work necessary to complete this work, will be paid for at the contract unit price.

SECTION 717.20 STRIP SEAL.

717.20.1 Description. This work shall consist of furnishing and installing a watertight strip seal for joints as shown on the plans or as directed by the engineer. The structural steel for the joints shall be furnished and installed as shown on the plans.

717.20.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Strip Seal	1073

717.20.3 Construction Requirements.

717.20.3.1 Shop Drawings. Shop drawings for structural steel for expansion joint systems shall be prepared in accordance with [Sec 1080](#). The drawings shall show in detail the type, size, location of anchors, and sequence of installation. The dimensions of the seal shall be shown on the shop drawings for the armored joint. The cavity in the steel armor (also known as an extrusion) shall be of a dimensional tolerance that prevents the lug of the strip seal gland from slipping loose. The upper lip of the extrusion shall extend over the bottom lip to avoid pinching the gland when the expansion joint system is in a closed position. Shop drawings will not be required when the seal is placed in existing steel extrusions.

717.20.3.2 Installation. The area of steel armor to come in contact with strip seal lubricant adhesive shall be sand blasted prior to installing the seal. Sand blasting will be considered acceptable when the steel surfaces have been cleaned to an SSPC-SP10 degree of cleanliness. [Containment and disposal of material shall be in accordance with Sec 202.2.](#) The strip seal shall be made watertight with a lubricant adhesive for bonding the neoprene gland to the steel extrusion as recommended by the manufacturer. The contractor shall obtain the services of a qualified technical representative, approved by the manufacturer of the expansion system and acceptable to the engineer, to assist during the installation. The installation shall not occur without the technical representative being present.

717.20.4 Method of Measurement. Final measurement will not be made except for authorized changes during construction, or where appreciable errors are found in the contract quantity. Where required, the strip seal will be measured to the nearest linear foot, based on measurement from the roadway face of curb to roadway face of curb along the centerline of the joint. The revision or correction will be computed and added to or deducted from the contract quantity. Portions of the joint that extend past the roadway face of curbs will not be measured for payment.

717.20.5. Basis of Payment. Strip seals, including all material, coating, equipment, labor, fabrication, installation, technical assistance, and any other incidental work necessary to complete this work, will be paid for at the contract unit price.

SECTION 717.30 SILICONE EXPANSION JOINT SEALANT.

717.30.1 Description. This work shall consist of furnishing and installing the backer rod and silicone expansion joint sealant for joints as shown on the plans or as directed by the engineer. Structural steel for the joints shall be furnished and installed as shown on the plans.

717.30.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Silicone Expansion Joint Sealant	1057

717.30.3 Construction Requirements. The contractor shall furnish to the engineer the manufacturer's written product information, installation procedures and instructional information at least two weeks prior to installation. The contractor shall obtain the services of a qualified technical representative approved by the manufacturer of the expansion system and acceptable to the engineer, to assist during the installation. The contractor, the technical representative and the engineer shall meet to review and clarify installation procedures and requirements prior to starting the work. The start of surface preparations and sealant installation shall not occur without the technical representative being present. The technical representative shall be present for at least one day at the start of surface preparations and sealant installation.

717.30.3.1 Shop Drawings. Shop drawings for structural steel for expansion joint systems shall be prepared in accordance with [Sec 1080](#). The dimensions of the seal shall be shown on the drawings for the armored joint. Shop drawings will not be required when the sealant is placed against concrete or existing steel armor.

717.30.3.2 Surface Preparation. The concrete or steel surface shall be prepared for priming and sealant placement. New Portland cement concrete shall be fully cured and allowed to dry a minimum of seven days. The joint shall be cleaned of all gravel, loose material and other contaminants before sand blasting. Areas that will be in contact with the sealant shall be sand blasted with a clean, hard aggregate that will leave little to no dust residue. Sand blasted concrete surfaces will be considered acceptable when areas that will be in contact with the sealant have a roughened surface with clean, exposed aggregate. The surface shall be free of foreign matter or plastic residue. Sand blasted steel surfaces will be considered acceptable when the steel surfaces have been cleaned to an SSPC-SP10 degree of cleanliness. Containment and disposal of material shall be in accordance with Sec 202.2. After sand blasting is completed, the joint shall be cleaned of debris using oil-free and water-free compressed air or a vacuum, either being at least 90 psi.

717.30.3.3 Priming. Priming shall immediately follow sand blasting and cleaning and will only be permitted to proceed when the air and substrate temperatures are at least 40 F and rising. Sand blasting, priming and sealing shall be performed on the same day. The entire sand blasted surface shall be primed. Application and drying times for primers shall be in accordance with the manufacturer's recommendations. All leftover primer shall be properly disposed.

717.30.3.4 Joint Installation. The backer rod shall be installed as specified on the plans and in accordance with the manufacturer's recommendations. All voids in the installed backer rod shall be filled to prevent sealant leakage.

717.30.3.5 Sealant Placement. The sealant thickness and recess depth shall be as shown in the contract documents and shall be measured during installation at approximately 2 foot intervals. Adjustments to correct sealant thickness to within $\pm 1/8$ -inch tolerance shall be made before the sealant begins to set. Sealant placement will only be permitted when the air and substrate temperatures are above 40 F, below 90 F and 5 F above the dew point. The joint surfaces shall be kept clean and dry during sealing. The joint shall remain clean and dry during the sealing operation. Sealing shall be performed using a pneumatic gun in accordance with the manufacturer's recommendations. End of seal treatment at vertical faces of curbs, sidewalks or parapets shall be as recommended by the manufacturer and as shown in the contract documents. Sealant placed incorrectly shall be removed and replaced at the contractor's expense.

sealant shall be tooled to force the sealant against the joint face and to recess the bead approximately 1/8 inch.

717.40.3.5 Containment and disposal of material shall be in accordance with Sec 202.2.

717.40.4 Method of Measurement. No measurements will be made.

717.40.5 Basis of Payment. No direct payment will be made for this work.

SECTION 717.50 OPEN CELL FOAM JOINT.

717.50.1 Description. This work shall consist of furnishing and installing an open cell foam joint system as shown on the plans, as directed by the engineer and in accordance with the manufacturer's requirements.

717.50.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Open Cell Foam Joints	1073

717.50.3 Construction Requirements. The contractor shall have a manufacturer's representative on site for the joint installation. The representative shall be responsible for ensuring the surface preparation and joint installation are done in accordance with the manufacturer's requirements.

717.50.3.1 Field Splices. The Open Cell Foam shall be installed in one continuous piece without field splices, unless otherwise specified on the plans or directed to by the engineer. Open Cell Foam shall be spliced with silicone called for in Sec 1057 and in accordance with the manufacturers recommendations.

717.50.4 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where significant errors are found in the contract quantity. Where required, the open cell foam joint will be measured to the nearest linear foot based on measurement from roadway face of curb to roadway face of curb along the centerline of the joint. The revision or correction will be computed and added to or deducted from the contract quantity. No measurement will be made of portions of the joint that extend past the roadway face of curbs.

717.50.5. Basis of Payment. Open cell foam joint, including all material, coating, equipment, labor, fabrication, installation and any other incidental work necessary to complete this work, will be paid for at the contract unit price for Open Cell Foam Joint.

SECTION 717.60 PREFORMED SILICONE OR EPDM EXPANSION JOINTS.

717.60.1 Description. This work shall consist of furnishing and installing a preformed silicone or EPDM expansion joint seal for joints as shown on the plans or as directed by the engineer and in accordance with the manufacturer's requirements.

717.60.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Preformed Silicone or EPDM Expansion Joints	1073

717.60.3 Construction Requirements. The contractor shall furnish to the engineer the manufacturer's written product information, installation procedures and instructional information at least two weeks prior to installation. The contractor shall obtain the services of a qualified technical representative approved by the manufacturer of the expansion joint seal and acceptable to the engineer, to assist during the installation. The contractor, the technical representative and the engineer shall meet to review and clarify installation procedures and requirements prior to starting the work. The start of surface preparations and seal installation shall not occur without the technical representative being present. The technical representative shall be present for at least one day at the start of surface preparations and seal installation.

717.60.3.1 Surface Preparation. The concrete or steel surface shall be prepared for priming and seal placement. New Portland cement concrete shall be fully cured and allowed to dry a minimum of seven days. The joint shall be cleaned of all gravel, loose material and other contaminants before sand blasting. Areas that will be in contact with the sealant shall be sand blasted with a clean, hard aggregate that will leave little to no dust residue. Sand blasted concrete surfaces will be considered acceptable when areas that will be in contact with the sealant have a roughened surface with clean, exposed aggregate. The surface shall be free of foreign matter or plastic residue. Sand blasted steel surfaces will be considered acceptable when the steel surfaces have been cleaned to an SSPC-SP10 degree of cleanliness. Containment and disposal of material shall be in accordance with Sec 202.2 After sand blasting is completed, the joint shall be cleaned of debris using oil-free and water-free compressed air or a vacuum, either being at least 90 psi. Using a rag saturated in denatured alcohol, wipe clean both vertical faces of the expansion joint opening.

717.60.3.2 Priming. Priming shall immediately follow sand blasting and cleaning and will only be permitted to proceed when the air and substrate temperatures are at least 40° F and rising. Sand blasting, priming and installing the seal shall be performed on the same day. The entire sand blasted surface shall be primed. Application and drying times for primers shall be in accordance with the manufacturer's recommendations. All leftover primer shall be properly disposed.

717.60.3.3 Installation. The preformed silicone or EPDM expansion joint seal shall be installed in joints in one continuous piece without field splices. The locking adhesive and seal shall be applied in accordance with the manufacturer's recommendations, in a manner that prevents the seal from being damaged and from being in tension. Twisting, curling and nicking the seal will be prohibited. Unless the installation tool is capable of installing the seal without elongation prior to placement, the seal shall be pre-cut to the exact length for the joint plus ends as shown in the contract documents or as directed by the engineer. The pre-cut seal shall be installed and measured for stretch. The seal shall be removed and reinstalled if the seal stretch length exceeds five percent of the pre-cut length at the contractor's expense.

717.60.4 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where significant errors are found in the contract quantity. Where required, the preformed silicone or EPDM expansion joint will be measured to the nearest linear foot based on measurement from roadway face of curb to roadway face of curb along the centerline of the joint. The revision or correction will be computed and added to or deducted from the contract quantity. No measurement will be made of portions of the joint that extend past the roadway face of curbs.

717.60.5. Basis of Payment. Preformed silicone or EPDM expansion joint, including all material, coating, equipment, labor, fabrication, installation and any other incidental work necessary to complete this work, will be paid for at the contract unit price for Preformed Silicone or EPDM Expansion Joint.

231.2 Clear Zones

From Engineering Policy Guide

Jump to: [navigation](#), [search](#)



Contents

[\[hide\]](#)

- [231.2.1 Introduction](#)
- [231.2.2 ~~Clear Zone~~ Perception Issues](#)[Roadside Obstacles](#)
- [231.2.3 For Bridges and Culverts](#)
- [231.2.4 ~~On~~ Ramps](#)
- [231.2.5 ~~In~~ Unusual Conditions](#)

- [231.2.6 Clear Zone Perception Issues](#)
- [231.2.67 Maintenance](#)

231.2.1 Introduction

The [clear zone](#) concept is the ~~road~~[roadside](#) design principle of providing an unobstructed, traversable area beyond the edge of the through traveled way for the recovery of errant vehicles. The clear zone is always located adjacent to and measured from the edge of the through traveled way. The clear zone includes shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes (> 2 miles in length). The concept was developed in the 1960s and later incorporated into the *Roadside Design Guide* (RDG). The RDG suggests clear zone distances based on traffic volumes and speeds. These distances are neither absolute nor precise and, in some cases, it may be reasonable to leave a fixed object or non-traversable terrain within the clear zone area. Roadside design strategies ~~involve the following for providing clear zone are as follows, in order of preference:~~

1. Remove the obstacle
2. Redesign the obstacle for safe traversal
3. Relocate the obstacle further from the roadway (or move roadway further from obstacle)
4. Reduce obstacle [impact](#) severity (make it breakaway)
5. Shield the obstacle
6. Delineate the obstacle (when we must leave the obstacle)

The clear zone concept guidelines in the RDG may be most applicable to new construction and reconstruction/rehabilitation projects. Fixed objects and non-traversable terrain features may also be addressed on existing roads as part of resurfacing (1R) or resurfacing and restoration (2R) projects (see [EPG 128.2 Preventive Maintenance Projects \(1R and 2R\)](#)). Every roadside should be made as safe as practical. On [many](#) existing roads, primarily ~~those of an older or lower order nature~~[low volume minor routes](#), a clear [zone](#) area may be established through maintenance activities such as removal of trees, boulders or other obstacles, etc. While this practice is strongly encouraged, these areas should not be construed as providing the same safety benefit as clear zones.

Figures

[Roadway Typical Sections](#)

[RDG Table 3-1 "Suggested Clear-Zone Distances from Edge of Through Traveled Lane"](#)

[RDG Table 3-2 "Horizontal Curve Adjustment Factor"](#)

[RDG Figure 3-2 "Clear Zone for Non-](#)

Clear zones are reviewed and/or selected based on the RDG guidelines ~~after consulting in conjunction with the preparation of~~ the location/conceptual study report.

Recoverable Parallel Foreslope"

RDG Figure 3-6 "Preferred Cross Sections for Channels with Abrupt Slope Changes"

Clear zones are designed into a project when the anticipated posted speed of the roadway is 45 mph or more. When the anticipated posted speed is less than 45 mph, clear zones are still beneficial, but they are to be considered only if economically feasible. Non-traversable slopes or fixed objects are to be removed, redesigned, relocated or shielded by a barrier if they are within the indicated minimum clear zone width and it is cost effective to do so.

The clear zone ~~width is to~~ concept should be applied with good engineering judgment including a Safety Analysis (Highway Safety Manual) and ~~should~~ be balanced with project costs. Limited right of way or high construction costs may lead to the installation of a barrier or possibly no protection at all ~~if justified through a Safety Analysis. Documentation of decisions regarding Clear Zone strategies should be included in the project conceptual study report, project core team minutes or design exceptions forms. All project documents should be stored in eProjects.~~

231.2.2 Clear-Zone Perception IssuesRoadside Obstacles

~~In most cases, the use of the clear zone concept is preferable to the use of a shielding barrier. There is, however, a notable exception.~~ Roadside obstacles may be either man-made or natural. Barrier recommendations for roadside obstacles are a function of the nature of the obstacle itself and the likelihood that it will be hit. However, a barrier should be installed only if it is clear that the result of a vehicle striking the barrier will be less severe than the crash resulting from hitting the unshielded obstacle.

Roadside obstacles that are normally shielded are listed in Table 5-2 (Barrier Guidelines for Non-Traversable Terrain and Roadside Obstacles) of the RDG. While roadside obstacles immediately adjacent to the traveled way are normally removed, relocated, modified, or shielded, the optimal solution becomes less evident as the distance between the obstruction and the traveled way increases. Table 3-1 of the RDG, Clear-Zone Distances, is intended as a guide to aid the designer in determining whether the obstruction constitutes an obstacle to an errant motorist

~~Occasionally the public will poorly perceive the clear zone concept. In areas of very high fills, particularly those on the outside of a horizontal curve, the clear zone alone may give the impression of an unsafe situation. Even though the design may be completely safe within the guidance of the RDG the public will inevitably request the area be shielded, most often with guardrail.~~

~~In these cases, the best practice is to initially specify shielding. By doing so, MoDOT can avoid the needless expense of eventually using both treatments in the same location.~~

231.2.3 ~~For~~ Bridges and Culverts

Clear zones, when used, shall extend full-width to ~~the~~ bridge ~~endsend~~. Where the existing roadway is to be incorporated into the completed facility as part of the main roadway, the use of clear zones will be considered on individual projects.

The use of [clear zone typical sections](#) is not applicable to small culvert replacement projects where the intent is to continue the service of the road without upgrading it. In such cases, the typical sections used in the original construction are to be used except that the ~~roadbedroadway~~ width is not to be ~~more narrow~~[narrower](#) than 24 feet.

In shallow fills and in cuts where box or pipe culvert normally require a headwall to be located in the clear zone, the structure should be extended to place the headwall at the outside of the clear zone or a safety appurtenance (~~guardrailshield~~ or ~~barrier~~)[delineate \(903.18.4\)](#) should be provided. The slope of the clear zone will then require modification over the entire surface.

231.2.4 ~~On~~ Ramps

~~Flattened slopes or clear~~[Clear](#) zones are to be used on ramps ~~to eliminate the use of guardrail. Use guardrail only to protect bridge ends within the interchange area where applicable. Shielding may also be applicable with sound engineering judgment at these locations.~~

231.2.5 ~~In~~ Unusual Conditions

When a standard clear zone width and slope will not properly terminate on the existing ground surface because of hilly conditions, [additional grading](#), steeper slopes [\(4:1 in-lieu of 6:1\)](#) and [additional right of way](#), must be used. In this case, the clear zone may be omitted and guardrail used at the shoulder line.~~The desirable minimum length for to shield a non-recoverable slope. Reference to EPG 606.1 Guardrail – Length of Need as well as 5.6.4 Length of Need in the elimination of clear zone is 500 ft. but in no case less than 250 feet.~~

[Roadside Design Guide will](#) For long fill sections through a reservoir project, clear zones can be eliminated and guardrail used at the shoulder lines.

Speed change lanes ([Auxiliary Lanes](#)) adjacent to ~~main roadway~~[the through traveled way](#) ([Through Lanes](#)) are to be placed within main roadway's clear zone with no widening of clear zone. The clear zone is always located adjacent to and measured from the ~~normal edge of the pavement of the main roadway including climbing or continuous auxiliary lanes.~~[edge of the Through Traveled Way.](#)

231.2.6 Clear Zone Perception Issues

In most cases, the use of the clear zone concept is preferable to the use of a shielding barrier.

Occasionally the public will poorly perceive the clear zone concept. In locations of very high fills particularly those on the outside of a horizontal curve, the clear zone alone may not provide the public with a sense of enough security. Even though the design may be completely safe within the guidance of the RDG the public may request the area be shielded, most often with guardrail, possibly with guard cable. In addition to very high fills, bodies of water, steep cliffs are other locations that may be considered for special emphasis.

In these locations sound engineering judgment, including a Safety Analysis (HSM) comparing various alternatives (clear zone widths, guardrail in-lieu of clear zone, and/or a combination of clear zone and shielding) should be employed to determine the most effective solution. Additional guidance can be found in the RDG, paragraphs 5.2 Barrier Recommendations and 5.2.1 Roadside Geometry and Terrain Features.

231.2.6 Maintenance

District Maintenance personnel shall be responsible for maintaining clear zones on highways.

626.1 Edgeline Rumble Strips

From Engineering Policy Guide

Jump to: [navigation](#), [search](#)



Edgeline Rumble Strips

Edgeline rumble strips are used to enhance [safety](#) on every paved [shoulder](#) at least 2 ft. wide, unless the shoulder has a curbed section or is intended to be used as a future travel lane. Rumble strips are omitted where the posted speed is less than 50 mph. All [major roads](#) will have edgeline rumble strips unless the posted speed is less than 50 mph.

In most situations, edgeline [pavement marking](#) material is sprayed over the milled rumble strip, creating what is referred to as a “rumble stripe.” (See [Standard Plan 620.00](#).) Any deviation from this typical application shall be submitted as a design exception.

Where full depth pavement extends beyond the travel lane and into the shoulder area at least 12 inches (e.g., pavement widths 13 ft. or greater), the rumble stripe should be placed in the full depth section of widened pavement (see [Standard Plan 626.00](#)).

When resurfacing and milling rumbles, the roadway surface course asphalt mix used for the travel lanes should extend a minimum of 18 inches beyond the edge of the travel lane and onto the shoulder so that the rumble strip is milled into the roadway surface course mix ([See Shoulder Surface for additional monolithic shoulder paving guidance](#)). Edgeline rumbles should not be milled into existing asphalt shoulder pavement due to oxidization and potential raveling.

Where the width of full depth pavement does not extend at least one (1) foot onto the shoulder, and the rumble strip must be placed on, or partially on, a shoulder with less than full depth pavement, as indicated on Std. Plan 626.00 ($\leq 12'$ Pavement Structure), the condition and depth of the shoulder structure should be evaluated prior to determining the location of the edgeline. If the shoulder condition and depth is deemed adequate to support routine off-tracking of traffic onto the rumble strip, the edgeline stripe should be placed over the rumble strip as shown in the standard plans (i.e., rumble stripe). If evidence suggests the shoulder condition or depth is inadequate to support routine off-tracking of traffic onto the rumble strip, placement of the edgeline stripe and rumble strip may be considered as follows:

- For major roads, the edgeline stripe should be placed in the travel lane with the rumble strip placed 4 inches beyond the edgeline stripe. The rumble strip should not be moved further out from the centerline. A design exception shall be submitted when separating the edgeline stripe from the rumble strip. See [EPG 231.4 Shoulder Width](#) for recommended shoulder widths.
- For minor roads, a mini rumble strip (6 inches wide) should be placed along the edge of the travel lane structure provided sufficient driving width remains. If sufficient driving width cannot be achieved, rumble strips should not be used. When a centerline rumble is not used, sufficient driving width is defined as having a minimum of 10 ft. between the centerline joint and the inside edge of the edgeline rumble. When a centerline rumble is used, sufficient driving width is defined as having a minimum of 10 ft. between the edge of the centerline rumble and the inside edge of the edgeline rumble. The edgeline stripe (4 inches) should be placed over the inside edge of the mini rumble strip (i.e., mini rumble stripe).

Shoulder Surface



Paved shoulders and aggregate stabilized shoulders provide a secure surface to accommodate vehicles for emergencies and other uses. Paved shoulders are an integral part of the pavement structure and are considered as part of the pavement design configuration. See [Shoulder Width](#) for additional information

Additional Information

[EPG 350 Design for Bases and Aggregate Surfaces](#)

Shoulders on urban roadways with access control (major or minor) are to be paved. In no case will a paved or aggregate surface be used directly behind a mountable curb along the outer edge of a roadway. A curb and gutter will only be used with an anticipated posted speed less than 50 mph.

Currently shoulder designs are categorized as A1, A2 and A3.

Type A1 shoulder design is comprised of asphalt or concrete on a prepared aggregate subgrade placed the same thickness as the mainline pavement. This shoulder type ~~is~~^{are} to be used sparingly, in instances that can be justified such as where there is an imminent need for use of the shoulder as a lane.

Type A2 shoulder design consists of asphalt, concrete or roller compacted concrete on a prepared aggregate subgrade with the final surface placed 5 ¾ in. thick. Type A2 shoulders are used on all interstate routes and for major roadways with significant traffic.

Type A3 shoulder design consists of asphalt, concrete, or roller compacted concrete on a prepared aggregate subgrade with the final surface placed either 3 ¾ in. thick (asphalt) or 4 in. thick (concrete or roller compacted concrete). This shoulder ~~type is~~^{are} used on major routes

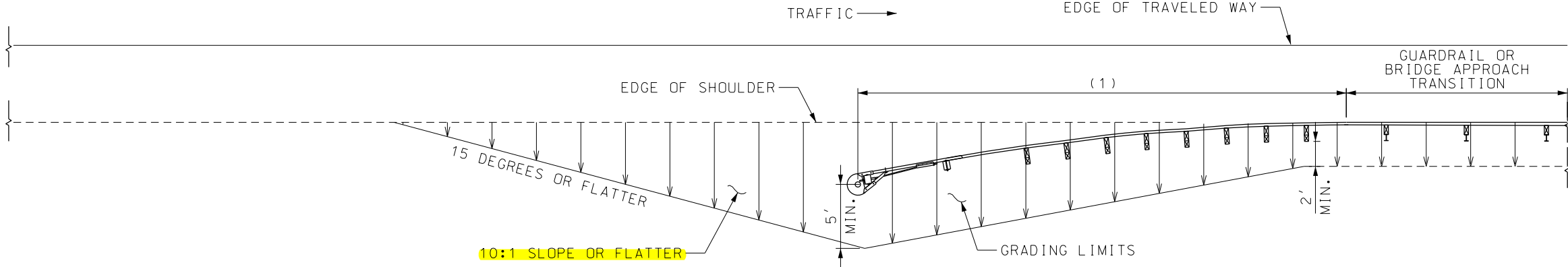
(non-interstate only) with relatively lower traffic volumes and on minor routes where a paved shoulder will be provided.

For new construction, ~~Where~~ a paved shoulder is provided on major routes, the full thickness of the travel way pavement should be extended laterally to a longitudinal joint either 1 ft. or 2 ft. outside the travel way. This widening is to extend 2 ft. for interstate and 1 ft. for all other locations. In instances where short segments of pavement are placed, butted at each end by pavement that is not widened, approval may be obtained to omit the widening.

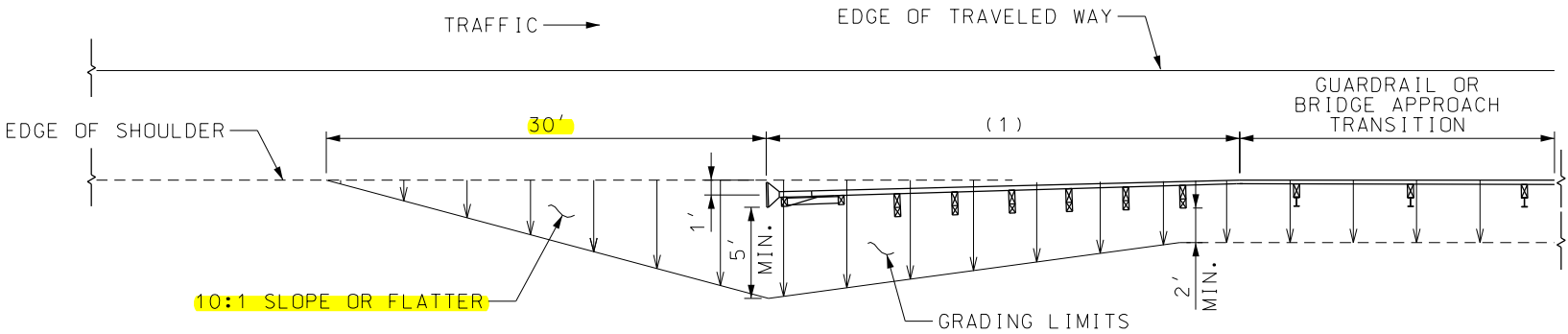
For resurfacing projects on roadways with shoulders 4 feet or less, the same asphalt surface mix used on the travelway should be extended the entire shoulder width. This will allow for a single monolithic pavement operation for the shoulder, reducing additional lane drops and construction time. All shoulders greater than 4 feet wide, should have the same asphalt surface mix used on the travelway extended onto the shoulder a minimum of 18 inches. This will provide a continuous surface mix for placing rumble strips/strips (see EPG 626 Rumble Strips).

Ramp shoulders should be consistent with the mainline. For ramps with integral curbs, the shoulder material and thickness will be specified in the pavement thickness determination.

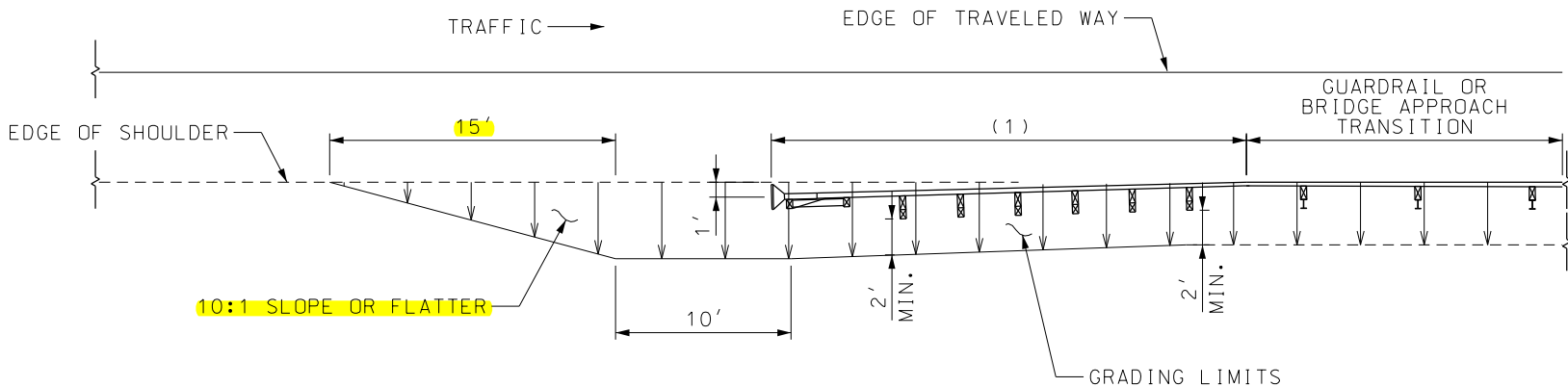
Minor road shoulders should be aggregate stabilized except when maintenance or safety concerns (e.g., edge drop off, high run-off road occurrence) justify an alternate treatment. When conditions warrant, a 1 or 2 ft. lateral extension of the mainline pavement should be considered as an initial option. If paving the remaining width of shoulder is justified, the shoulder should consist of the Type A3 shoulder design.



GRADING LIMITS FOR FLARED CRASHWORTHY END TERMINALS



PREFERRED GRADING LIMITS FOR CRASHWORTHY END TERMINALS



ALTERNATE GRADING LIMITS FOR CRASHWORTHY END TERMINALS

GENERAL NOTES:

THE PREFERRED GRADING LIMITS SHALL BE USED WHEN INDICATED ON THE PLANS.

THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH APPROVED SHOP DRAWINGS OF THE APPROVED CRASHWORTHY END TERMINAL.

END ANCHORS SHALL BE INSTALLED ON ENDS OF GUARDRAIL RUNS WHERE CRASHWORTHY END TERMINALS ARE NOT REQUIRED.



MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

CRASHWORTHY END TERMINALS
TYPE A
GRADING LIMITS

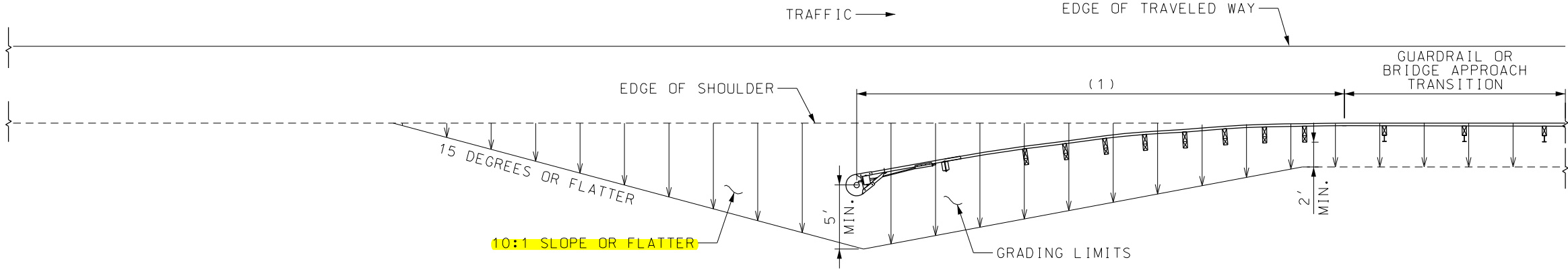
(1) APPROVED CRASHWORTHY END TERMINAL

DATE EFFECTIVE: 04/01/2019
DATE PREPARED: 12/12/2018

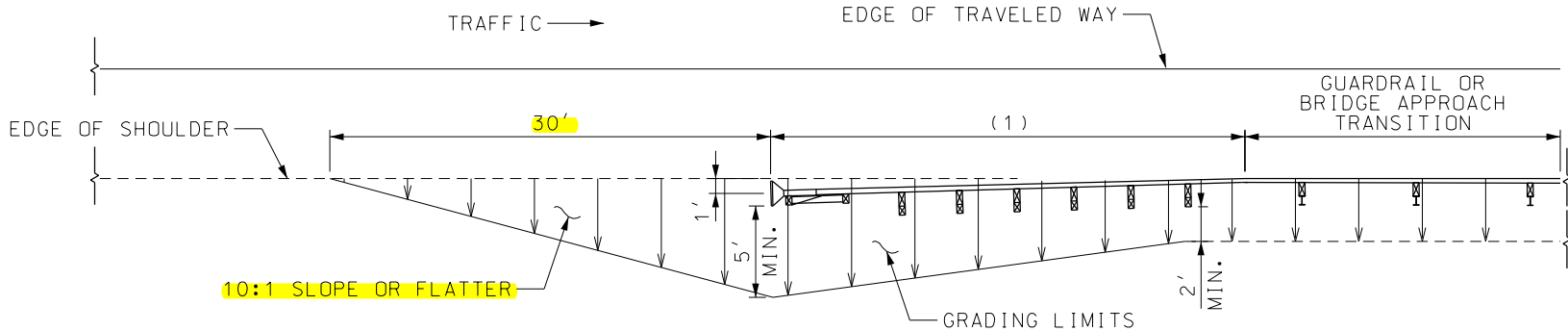
606.31A

SHEET NO.
1 OF 1

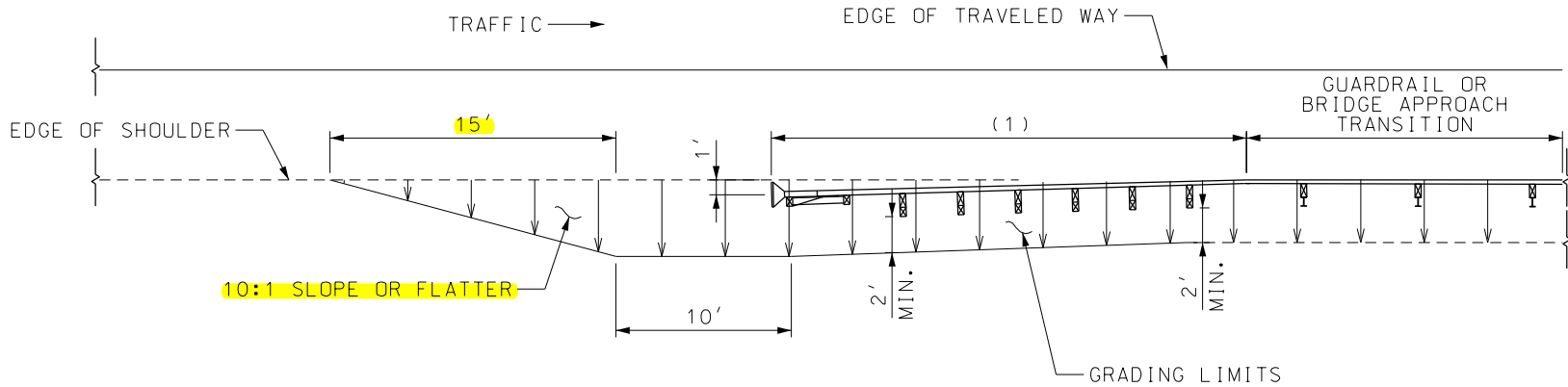
IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



GRADING LIMITS FOR FLARED CRASHWORTHY END TERMINALS



PREFERRED GRADING LIMITS FOR CRASHWORTHY END TERMINALS



ALTERNATE GRADING LIMITS FOR CRASHWORTHY END TERMINALS

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END ANCHORS SHALL BE INSTALLED ON ENDS OF GUARDRAIL RUNS WHERE CRASHWORTHY END TERMINALS ARE NOT REQUIRED.



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MASH
CRASHWORTHY END TERMINALS
TYPE A
GRADING LIMITS

(1) APPROVED CRASHWORTHY END TERMINAL

DATE EFFECTIVE: 04/01/2019
DATE PREPARED: 12/12/2018

606.81A

SHEET NO.
1 OF 1