EXHIBIT A

Project Special Provisions

The following specifications modify and take precedence over the CDOT Standard Specifications for Road and Bridge Construction.

Mechanically Stabilized Panel Walls

Sections 504 of the Standard Specifications are hereby revised for this project to include the following:

DESCRIPTION

This work consists of constructing a concrete panel facing Mechanically Stabilized Earth (MSE) retaining wall system at the locations and to the lines and grades shown in the Contract or plans as finalized by the Contractor's structural design engineer. Either metallic or geo-grid reinforcements specified in this specification can be used as soil inclusion in the reinforced structure backfill zone. The design chart(s) in the plans define the strength(s) required for the zone of mechanical reinforcement of soil. Based on the total summed Long-term Design Strength (LTDS), the reinforcements proposed by the shop drawings for a specific wall height allowing a maximum ±15% variation for individual layer shall meet or exceed the values (Total) shown in the plan.

The following MSE wall system suppliers have successfully completed the CDOT product approval process, and have been pre-approved. The Contractor shall be responsible for adapting the design and construction of the MSE wall system to the site condition. The Contractor shall design the wall system(s) chosen to meet all external and internal stability requirements of the Contract, including the global stability and long-term foundation settlement limitation of the Contract. This list is provided for information only, and does not limit the Contractor in any way to the use of only these suppliers. However, the Contractor shall be responsible to ensure that the supplier in the pre-approved list or any other selected supplier(s) is in conformance with the requirements of the Contract and this specification.

System Names	Supplier's Phone Numbers
Reinforced Earth	314-4746979
VSL	214-6470200
Hilfiker	707-4435093
Isogrid	703-9226778
Transwall	801-7450902
Strengthened Earth	214-7545500
ARES	800-2924457
MSE Plus	408-4309300
Strengthened Soil	817-4270997

MATERIAL

(a) Shop Drawings. The Contractor shall review and approve shop drawings and certified material test reports prior to construction of wall. Use of a firm to prepare these drawings and reports shall be limited to a specialty firm regularly engaged in the design and construction of permanent MSE walls. The Contractor's structural design engineer shall reject shop drawings prepared by a non-specialty firm. Shop drawings shall be reviewed in accordance with the Contract.

The shop drawings shall provide the details necessary to demonstrate compliance with the requirements in the Contract or the plans as finalized by the Contractor and these specifications, including:

1. Wall layouts shall be closely conformed to line and grades in the plans including start, corner, and end stations, leveling pad step breaks, top and bottom of wall elevations. For walls with rail anchoring slab, the top of panel elevations shall be within 8" (200 mm) measured from the bottom of anchoring slab. If temporary wall(s) are required for the construction of permanent wall, the permanent wall vendors shall supply the shops and material for temporary wall(s).

2. Unless shown otherwise on the plans, the facial panels shall be connected to each layer of soil reinforcement.

   Panel to panel, panel to reinforcement connection detail, or limits of special panels at curved wall corner shall be shown. The back of each panel shall be logically numbered with its placing sequence.

3. The actual panel and reinforcement elevations shall be marked on the shop drawings by taking into account the supplied regular panel as well as special panel height(s) for matching the front and top finished grade.

4. The soil reinforcement types, Minimum Average Roll Value (MARV) or yield strength, spacing, lengths, elevations, and the corresponding wall design height shall be shown on the wall layout. Each reinforcement layer shall be composed of a single grade of reinforcement material and shall be placed at same elevation from end to end of wall. Sprayed on or taped on consistent color code for material grade identification shall be used in each roll or grade of reinforcement. Elevations of the reinforcement layers shall be specified on the plan except when the reinforcement spacing is a constant from the top to the bottom of the wall.

5. Soil Reinforcement Length (RL). The soil reinforcement length shall be measured from the back face of the concrete panel to end of reinforcement as measured to the last cross member. Except for tail (secondary) reinforcements, soil reinforcement lengths shall not be less than the specified lengths given in the plans.

   The soil reinforcement shall be the same length from top to bottom at all layers of wall segment. The minimum soil reinforcement length shall be as follows:

Design Height (DH)	Minimum RL
DH > 11' (3.35 M)	0.7(DH)
11' (3.35 M) ≥ DH ≥ 8' (2.43 M)	8' (2.43 M)

DH < 8' (2.43 M)	Minimum of 1.0(DH) or 6' (1.83 M)
Top Layer	≥ 8' (2.43 M)

6. Panel Size and Reinforcement Spacing:

   A. Except for full height panel, the maximum panel size is 75 square foot (4.65 square meter).

   B. Unless demonstrated by the vendor that panel concrete crack size can be controlled during shipment and erection, that panels will be accepted by Contractor's QA manager, and joint width due to differential settlement limit is within acceptable limits full height panels are not allowed. For full height panels, the maximum panel width and panel height shall be 10 feet (3 m) and 30 feet (9 m) accordingly, however the limiting differential settlement shall be restricted within 1/500.

   C. The maximum vertical spacing between layers of adjacent soil reinforcement shall not exceed 36 inches (914 mm). Except the half height panel used at the bottom of wall, including all partial height panels at the top of wall there shall be at least two layers of reinforcement per panel.

   D. The first and bottom layers of reinforcement shall be within 18 inches (457 mm) measured from the top of panel and from the top of leveling pad accordingly.

7. LTDS of Reinforcements.

   A. Metallic (In-extensible) Soil Reinforcement. For Structure Backfill (Class 1), with an impervious membrane installed on the top of wall to intercept the roadway de-icing chemicals, the following minimum sacrificial thickness for reinforcement shall be applied to the 75 years LTDS calculations:

Galvanization Loss	15 µm/year for first 2 years 4 µm/year for subsequent years
Carbon steel loss	12 µm/year after zinc depletion

   B. Geosynthetic (Extensible) Soil Reinforcement. For roadway support walls with geosynthetic reinforcement, to keep the surface runoff out the wall, the same membrane shall be installed as specified in item 1 above. Geosynthetic soil reinforcement shall be a geogrid or woven geotextile. For polyester (PET), polypropylene (PP) and high-density polyethylene (HDPE) reinforcement, the LTDS of material shall be determined using the following factors of safety to ensure the required design life. The LTDS may not exceed the following K percent of its ultimate tensile strength, MARV, i.e.

   LTDS = K * MARV,

   Where K = CRC / (FS * FC * FD)

CRC = Creep Reduction Coefficient, Factor of Safety (FS) = 1.5,

FC = Construction Damage Factor, FD = Durability Factor.

(1) Geogrid reinforcements (HDPE, PET) pre-approved by CDOT:

Products with weight ≥ 8 oz/Yd^2 (270 g/m^2)	K
Tensar	20%
Fortrac, Miragrid, Strata, Synteen and Raugrid	24%

(2) All products not pre-approved by CDOT including geogrid pre-approved by CDOT:

Products with weight < 8 oz/Yd^2(270 g/m^2)	K
All geogrid or woven geotextile products meet AASHTO Table 5.8.6.1.2A requirements	10%
Products not meet AASHTO Table 5.8.6.1.2A requirements including Non-woven geotextile products	5%

8. Design Heights and Supplied Reinforcing Material. The wall design height shall be measured vertically from the top of the leveling pad to the top of concrete rail anchoring slab for walls with railing, or to the top of concrete coping for walls without railing. For both geosynthetic and metallic reinforcement, the required reinforcement LTDS and the supplied LTDS (determined in accordance with the K factors or depletion of material as defined above) with corresponding brand and grade of material shall be marked clearly on the elevation view. The LTDS of the supplied reinforcement grade shall meet or exceed the required LTDS corresponding to the reinforcement spacing provided.

9. For the reinforcement layouts of tiered walls, the overall geometry, the reinforcement length and the sum of the LTDS provided from all layers in all tiers shall be in close conformity to the retaining wall system shown in the plans in order to ensure that both local and global stability requirement have been met.

10. For reinforcements interfered with obstructions such as steel pile, concrete pier, concrete box and pipes, details of their connections shall be provided. Details shall be provided according to the design computation that demonstrates that the structure meets the required safety factors in the obstruction area.

    A. Backfill. The wall backfill material in the reinforced zone and the associated trapezoidal retained zone shall conform to the requirements Structure Backfill (Class 1) of Section 206. For pullout, a friction angle of 34 degrees shall be assumed for Structure Backfill (Class 1), and shall be considered non-aggressive soil for corrosion and durability computations. CDOT may require chemical and organic content tests if the source is questionable. All reinforcing elements shall be designed to ensure a minimum design life of 75 years for permanent structures.

    B. Leveling Pad. Concrete for the leveling pad shall be Concrete Class B, f'c = 3000

psi (25 MPa), conforming to the requirements of Section 601. The maximum vertical step shall be no greater than 36 inches (430 mm). The leveling pad shall be reinforced only at the steps. To avoid panel cracking from high contact points, a 1/4 inch (6 mm) thick expansion joint material with the same thickness as the panels may be installed between the first layer of panels and the leveling pad. Cure the leveling pad concrete a minimum of twelve (12) hours before placement of concrete panels. For the toe of wall founded on slope steeper than 1.5 (H) to 1 (V), leveling pad shall be constructed with reinforced concrete with same reinforcing schedule as at its step. Leveling pad concrete shall be cured for at least twelve (12) hours before placement of the concrete blocks.

C. Impervious Membrane and Joint. The impervious membrane shall meet the requirements of subsection 712.08 for geomembrane, and shall have a minimum thickness of 30 mills (0.76 mm). It shall be spliced either with a dual track field seamed joint or with an 8 inches (203 mm) minimum overlap and folded to shed water. For all roadway-supporting walls an impervious membrane shall be installed at the top of the reinforced zone to intercept surface runoff and prevent salt penetration. This membrane shall have a minimum coverage length measured perpendicular to the wall face of at least the wall design height plus 3 feet, 4 inches (1 m). It shall be installed with a perforated and corrugated HDPE drainage collection pipe, with a geotextile sock filter, and shall extend either to the drainage system or drain out of the wall at every 100' (30 m) along the wall alignment. The membrane shall slope 20 maximum (H) to 1 (V) towards the drainage collection pipe. To avoid the obstruction of the pipe in the middle of the fill, as an alternate, for walls with temporary cut slope or pre-installed roadway fill slope, the water collector system (sock filter, perforated pipes and joints) may be moved to the back. The membrane can be installed with a 20:1 slope from the facing block all way to the cut or pre-filled slope. However, a minimum of 18 inches by 18 inches geo-fabric filter material rapped 6 inches perforated HDPE pipe collector in conjunction with the geo-composite down drains shall be installed at the toe of the slope. The geo-composed drain board shall be one continuous piece and nail secured along the slope. The geo-composite drains that collect the water from the membrane to the water collector system shall be a minimum 12 inches in width at 10 foot maximum spacing. The Contractor shall provide a detailed layout of this equivalent water collection system.

D. Concrete Panel Facing Unit and Panel Joint Material**.** The pre-cast concrete panels shall conform to the requirements of the Contract, plans (which shall include the color, texture, dimensions and pattern shown on the plans), and these specifications. These facing units shall be factories made from Portland cement, which shall conform, to the requirements of Section 601 and the following:

Minimum Field Compressive Strength (28 Days): 4000 psi.

Minimum Cement Content: 610 pounds/cubic yard

Maximum Water/Cement Ratio: 0.45 with an approved water-reducing admixture.

Air Content (total): 4-9%

No more than 50% fine aggregate (AASHTO M6) by volume of total aggregate.

Ambient temperature: shall be a minimum of 40° F and rising when casting panels.

Pre-cast panels shall be cured in accordance with AASHTO M170.

Reinforcing steel shall conform to the requirements of Section 602 of the specifications. Reinforcement shall be provided as required for shrinkage and temperature in accordance with AASHTO Standard Specifications for Bridge Design and as required for soil reinforcement anchorage. The concrete in the pre-cast units shall be compacted using a vibrating table, grid vibrator, or vibrating screen. All panels shall be cast faces down on flat level surface.

Panel dimensions and facing treatment shall conform to the architectural requirements of the Contract. Width of panel from center to center of joint shall be an even whole increment of the pattern dimensions selected to match the architectural treatment. Thickness shall be a minimum of 4 inches plus the depth of rustication. Panel shall be cast to the dimension that accommodates the architectural treatment.

Panels may be longer than 5 feet provided their section strength could be shown to accommodate handling and erection without cracking. Soil reinforcement attachment devices shall be within 1 inch of panel location. All unit dimensions shall be within 1/4 inch of plan. Concrete surface for the front face of the wall shall match the architectural treatment requirements and structural concrete stain, as shown on the plans. Squareness determined by the difference between two diagonals, shall not exceed 1/2 inch. Surface defects on the front face textured surface, shall not exceed 1/8 inch when measured with a 5 feet straight edge, except when intentionally roughened.

CDOT shall be allowed access to the manufacturer's facilities to inspect and sample units from lots prior to delivery. The CDOT reserves the right to reject any concrete panels, which do not meet the requirements of these specifications. The Contractor shall notify the CDOT in writing at least seventy-two (72) hours before beginning the shipment of any panels for this project.

Cover on the back face of the wall for vertical joint is required between panels and shall be a drainage geotextile conforming to Subsection 712.08, a minimum of 12 inch wide, nailed or glued in place prior to placing backfill.

At horizontal joints, a cellular type or molded expansion joint material shall be placed and shall be of a size suggested by the supplier and as Approved.

E. Certifications, Calculations and Testing Reports. The Contractor shall provide the following required reports, certificates and calculations if needed with the shop drawing submittal. All engineering calculations shall be certified and stamped by a professional engineer licensed in the State of Colorado.

(1) Certification of MARV. For geo-synthetic reinforced system only, a certification letter from the manufacture which provides the MARV (S) and

certifies the MARV (S) of the supplied materials have been determined in accordance with ASTM D-4595 or ASTM D-6637 as appropriate.

(2) Mill report for metallic reinforcements and connectors. This includes but shall not be limited to mill certifications on weld ability, ultimate tensile and/or yield strength.

(3) Report of the panel/reinforcement connection test. The test report shall be prepared and certified by an independent laboratory. The panel to reinforcement connection test method shall conform to the industrial standards and providing report on the ultimate as well as service limit state.

(4) Report for soil to reinforcement interface pullout test. Tests shall include the full range of overburden pressures defined by wall design heights.

(5) Certification of facial panel to reinforcement long-term connection strength. Certification shall include calculations to demonstrate that the facial panel to reinforcement connection meets or exceeds current AASHTO 75 years design life requirements.

(6) Certification of reinforcement pullout. Certification shall be provided with detail calculations to demonstrate that reinforcement pullouts meet or exceed current AASHTO requirements. For metal reinforcement breakage and pullout, calculations shall include a combination of 75 years material depletion of carbon steel and galvanization loss.

(7) Report and certification for the initial concrete compression strength, shipping and handling stress. Cylinder compressive test is acceptable to verify the initial concrete strength of panel at time of shipping. Concrete tensile stress shall not exceed the modulus of rupture. Report shall include calculations of panel cracking stress according to the proposed method of lifting and shipping. Before panel shipping from precast yard to wall site, the Contractor's structural design engineer shall approve the time of shipping, method of lifting and supporting condition during shipping as well as storage condition at the site before panel installation.

Efflorescence, Freeze and Thaw Test. Panel shall be visually efflorescence free. Efflorescence control agent shall be used in concrete mix design. Test results for freeze and thaw durability shall be supplied with test data up to 300 freeze and thaw cycles to confirm that panels with concrete additives alone can survive 150 cycles with weight loss for each of 4 of the five samples not exceeding 1% initial weight. Per CDOT's approval, project specific freeze and thaw durability tests may be substituted by the tests of units made with the same material, concrete mix design, manufacturing process, and curing method, conducted not more than 18 months prior to delivery. An independent laboratory shall provide reports and certifications of the above tests as per ASTM C666, ASTM C 1262 and C 1372 as appropriate. Test results will be subject to a 20% price reduction.

(8) Calculations. Calculation of the LTDS of reinforcement shall conform to the 16th Edition of Standard Specifications for Highway Bridges.

CONSTRUCTION REQUIREMENTS

(a) Approval and Qualifications of MSE Wall Installer. The job site wall foreman shall have experience in construction of at least five successfully completed MSE walls within the last three years. The foreman must have prior experience or adequate training of the products that the Contractor elects to use in the project. The resume and credentials of the foreman shall be reviewed and documented by the Contractor prior to constructing any portion of the wall. He shall be on the site for 100% of time during which the work is being done.

(b) Technical Representative of Wall Product Supplier. The Contractor shall require a technical representative (Tech Rep) of the selected wall product to be present at all times during the first three weeks of the wall construction. The total time of Tech Rep on the project site shall be no less than 5% of the time during which the wall is being constructed. This Tech Rep shall be available to:

(1) Provide technical instructions to the Contractor as required in the construction of the earth retaining wall system.

(2) Supply the Contractor with product specific specifications in the placement of the soil reinforcement and backfill in accordance with the wall system.

(3) Give guidelines to the Contractor in placing the facing units and attaching them to the soil reinforcement in accordance with the system requirements.

(4) Provide technical assistance to the facing unit fabricator.

(5) The wall system tech rep shall certify in writing that the wall(s) were constructed in accordance with the product specific specifications.

(6) The tech rep shall also be available whenever there is a crisis or any special field condition such as change of geological condition, equipment or personnel changes or at the request of CDOT.

(c) Facial Panel Placing Plan and Daily Placement Logs. Before the start of wall construction, the Contractor shall provide a panel-placing plan and shall keep the placement logs, which shall be submitted, to the quality program manager for approval and acceptance. The panel Quality Control shall contain multiple submittals to CDOT if required for Item 7 and 8 in subsection (f) certifications under Material. Panels shall be labeled with serial number for each panel and corresponding certification with random sample testing for each every 220 panels or 5500 square foot of wall face. Minimum one certification with supporting test results is required for each wall. Test result shall be reviewed and pre-approved by the Contractor's structural design engineer before shipment. The Constructor shall coordinate and mark the panel and backfill placing sequence on the logs. The log serves as evidence and basis for making decisions on payment or payment reductions.

(d) Wall Test Segment. Before moving into full production mode, CDOT has the option to utilize a segment of actual wall as a test wall. The Acceptance of the test segment shall be based on the requirements of the Contract. On this specification, product specific requirements and product supplier's deliberation. The Contractor can use this test segment to establish a

benchmark for workmanship as well as to verify the adequacy for equipment operations. CDOT and the Contractor may use the test segment to identify Quality Assurance and Quality Control measures as early as possible.

(e) For Wall with Curved Alignments or Tight Corners with Angle Points. The Contractor shall provide a placement plan that show curved or angle layouts, special corner panel, sequence of panel placement and construction off-sets as recommended by the manufacture.

(f) Excavation and Backfill. The base of leveling pad shall receive the same compaction as Cut Area required by 203.07 of Standard Specification. The Contractor shall report to the Contractor's Geotechnical Engineer with density test results for any unsatisfactory bearing material that not meeting the minimum 90% compaction for wall less than 16' and 95% of T-180 for wall higher than 16'. Should the excavation for the placement of the leveling pad expose an unsatisfactory bearing material, the Contractor's Geotechnical Engineer may require removal and replacement of that material. The removed material shall be replaced with Structure Backfill (Class 1) compacted in conformance with Subsection 206.03. The Contractor's Geotechnical Engineer shall provide the limits including the depth of removal. As directed by the Contractor's Geotechnical Engineer, if required, Structure Backfill (Class 1) material shall be reinforced with soil reinforcements in conjunction with wick drains and outlet pipes.

Grade the foundation for the bottom of wall for a width equal to or exceeding the limits of the RL plus 1 foot, 6 inches (450 mm) as shown in the plans. This graded area shall be compacted with an appropriate vibratory roller weighting a minimum of 8 tons (7 metric tons) for at least five passes. For cut wall with continuous seepage, phasing of foundation construction or different drainage and foundation improvement plan may be necessary. The Contractor's Geotechnical Engineer should be contacted for support as needed.

The reinforced fill and the retained fill portion immediately behind it as defined on the plans shall be Structure Backfill (Class 1). Unless otherwise noted on the plans, recycled asphalt and flow-fill material shall not allow substituting for Structure Backfill. The backfill shall be placed with a distance equal to the reinforcement spacing away from the back of panel. The triangular portion behind the concrete panels and above the spill of backfill shall be filled with $3/8^{+}$ inch (10^{+} mm) crashed rock or filter aggregates as approved by the Contractor's structural design engineer. Before compacting to the required density and before successive layers are placed; each lift of backfill shall not exceed 6 inches (152 mm). The fill and compaction operation shall start 3 feet (1 m) from the wall face toward the reinforcement end. All the Structure Backfill (Class 1) shall compact to a density of no less than 95% of maximum density in accordance with AASHTO T 180 (or 100% T 99).

At least 6 inches (152 mm) of material shall be in place prior to operation of tracked vehicles over soil with reinforcement. Only power operated roller or plate compaction equipment weighting less than 1,000 lbs (450 kg) is allowed within 3 feet (914 mm) of the front of the wall face. Fill, compaction and density test behind and parallel to the panels of the top triangular portion above the backfill spill zone can only begin after the compacted fills are at or are slightly above the next layer of reinforcement. The reinforcement should not be connected to the wall until the compacted fill is at or slightly higher than the location of connector. The compaction of this triangular zone can be relaxed from 95% down to 90% T 180 (95% T 99).

The Contractor shall place additional concrete panel coping and properly compacted fill material, to return the finished grade to plan elevations if settlement has occurred. A final inspection before the installation of rail anchoring slab shall be made 30 to 45 Days after the completion of the top panels. The Contractor shall provide temporary storm water and wind erosion control during the construction for the backfill placed. The Contractor is responsible for make-up and backfill loses due to wind and water erosion. If the settlement is determined to be the result of the non-conforming backfill or the backfill does not meet compaction requirements; the Contractor shall bring the elevation to the finished grade at no extra cost to the project.

To avoid the washout by rain, the area in front of the wall and around the leveling pad shall be backfilled as soon as practically possible.

(g) Reinforcement. The Steel reinforcement shall be slack free and polymer reinforcement shall be slightly pre-tensioned. The minimum coverage ratio for geogrid reinforcement shall be 67%. Do not cut soil reinforcement to avoid obstruction without the designer's approval.

(h) Leveling Pad. The leveling pad shall be level within the tolerance of 1/8 inch (3 mm) for any two points, and within 1/4 inch (6 mm) for any two points 10' (3 m) apart. If the wall is not level, the panels will bind against each other causing spall of the edges and corners.

Cushion or shimming material (expansion joint material, concrete mortar grout, roofing felt or geosynthetic reinforcement) shall be applied to panels directly founded on a leveling pad. Before starting a new course of panels, the Contractor shall take steps to ensure that elevations are matched at the neighboring panels. Neoprene cushion or shimming spacers shall be used to obtain necessary panel elevations at next leveling pad step. No more than 2 shims (each 3/16" thick) should be required to level the panels on the leveling pad.

(i) Wooden Wedges. Wooden wedges are used to help to hold the panels at the correct batter during the filling operation. The wooden wedges should be made from hard wood (such as oak, maple or ask). Wooden wedges shall be removed as soon as the precast panels above the wedged panels are completely erected and backfilled. In no case should there be more than three rows wooden wedges in place. Failure to remove the wooden wedges can cause the panel to crack or spall.

(j) Panel Facing. For wall with roadway on its top, the top of wall shall meet the wall layout line shown on the plans. For wall with roadway on its side, the bottom of wall shall meet the wall layout line shown on the plans. An overall negative batter (wall face leaning outward) between the bottom and the top of the wall is not allowed. Unless otherwise noted on the plans for battered walls, the final wall face shall be vertical, or have a positive batter of 5% maximum for construction control purpose. The surface of the wall face shall be tested with a 10 feet (3 m) straightedge laid along the surface in all directions. Except as necessary for horizontal alignment of the wall, convex deviation of the wall face from the straightedge (belly wall) shall not be allowed, and concave deviation from the straightedge shall be less than 1/2 inch (12 mm).

Unless otherwise noted, except for full height panel, all panels shall be stacked and placed with each panel spanning the joint in the row below (running bond). For walls without a rail-anchoring slab, cast-in-place reinforced concrete coping with uniform exposed height is required to catch the required finished elevations as well as to retain the panels' lateral deformation.

For walls with rail anchoring slabs, the top of panel elevations shall be within 8 inches (200 mm) of the bottom of the anchoring slab. Cast-in-place coping or sawcut partial height panels may be used to accomplish this without extra cost to the project.

Where the impervious membrane for drainage interferes with the placing of reinforcement, the panels beyond the termination shall be reinforced with the same grade of additional soil reinforcing material to maintain the total amount of reinforcement per panel. To avoid the leaking or soil erosion through the joint, a minimum of 12 inches (300 mm) wide glued on filter fabric shall be used behind all vertical joints.

If specified in the plan, facing panels directly exposed to spray from deiced pavements and indirect windborne spray zone shall have three layers of water resistant or repellant concrete sealer applied to the exposed panels at front and back face including concrete coping before the wall is opening to traffic.

For completed wall or parts of completed wall, before final payment any damages including blemish and discoloring of panel shall be replaced or repaired or even sand blasting cleaned as accepted by the Quality Program Manager.

(k) Fill under Leveling Pad. For walls requiring fill under the planned elevation of the leveling pad, the Contractor may elect to lower the elevation of the leveling pad as approved by the Contractor's structural design engineer except that the finished elevation at the top of the wall shall not be altered. The higher wall shall be redesigned with longer reinforcement length and revised reinforcement schedule. Because modifications to the leveling pad elevations are for the Contractor's convenience, the cost for additional facing blocks, reinforcements and fill material including installation shall be at the Contractor's expanses. Lowering the planned elevation of leveling pads and replacing the original design with a higher wall with the original reinforcement schedule specified in the plan is not permitted.

504 Panel Facing Payment Reductions.

1. Dislocated Panel - A dislocated panel is an individual panel or its corner located outward more than 1/4 inch (6 mm) from the adjacent panels.

2. Cracked Panel - A cracked panel is an individual panel with any visible crack where viewed from a distance of wall height in natural light.

3. Corner Knock Off - A corner knock-off is a panel with any missing facial corners.

4. Substandard Panel - Substandard panels are concrete panels installed in any wall segments that do not meet the certified values for compressive strength.

5. Oversize Joints - Panels with oversize joints are two adjacent panels with more than 2/3 of a lip exposed or a joint in which the filter fabric is visible from the front view.

6. Panels Failing the 10 Foot Straightedge Test - Straightedge test failures are joints that that deviate from even by more than ¼ inch when measured by placing a 10 foot straightedge across the joint.

Defects shared by two adjacent panels such as oversized joint, dislocated panel and panels not passing 10 foot straight edge test will be counted as two defects.

In the completed wall, or completed portion of the wall the number of defects, as described above, in each 40 foot section (horizontal or arc length) will be counted. If there are defects, the number of defects in the 40 foot section will be considered for price reduction according to the table below. For panels subjected to price reduction, if the defects are repairable or the overall quality of wall can be improved, with the consent from the Engineer, the Contractor may elect to repair and reduce the percent of price reduction. A walkthrough inspection shall be made as requested by the Contractor before final payment.

No. of Defects in 40 Foot Section	2	3	4	5	>5
% Of Price Reduction	3	9	15	21	Rejection

When the number of defects exceeds 5, the Engineer will reject the entire wall or portions thereof.

Concrete Block Facing MSE Walls

Sections 504 of the Standard Specifications are hereby revised for this project to include the following:

DESCRIPTION

This work consists of constructing a concrete block facing MSE retaining wall system at the locations and to the lines and grades shown in the Contract or plans as finalized by the Contractor. Metallic or geo-synthetic reinforcement (woven fabrics or geo-grids) specified in this specification may be used as MSE reinforcement in the reinforced structure backfill zone. The design chart(s) in the plans for this project define the strength required for the mechanical reinforcement of soil. Based on the total summed Long-term Design Strength (LTDS), the reinforcement proposed by the shop drawings for a specific wall height allowing a maximum of ± 15% variation for individual layer shall meet or exceed the total quantities shown in the plan.

The following MSE Wall System suppliers have successfully completed the CDOT product approval process, and have been pre-approved. The Contractor shall be responsible for adapting the design and construction of the MSE Wall System to the site condition. The Contractor shall design the wall system(s) chosen to meet all external and internal stability requirements of the Contract, including the global stability and long-term foundation settlement limitation of the Contract. This list is provided for information only, and does not limit the Contractor in any way to the use of only these suppliers. However, the Contractor shall be responsible to ensure that the supplier in the pre-approved list or any other selected supplier(s) is in conformance with the requirements of the Contract and this specification.

System Names	Reinforcement Types	Supplier's Phone Numbers
Pyramid/RECO	Steel Grid	703-821-1175
Diamond/Mirafi	PET Geogrid	303-696-8960
Amastone/Mirafi	PET Geogrid	303-761-0883
Versa-Lok/Mirafi	PET Geogrid	970-667-4480
Venture/Strata	PET Geogrid	303-254-8846
Anchor/Mirafi	PET Geogrid	303-292-2345
Allan/Huesker	PET Geogrid	303-292-2345
Mesa/Tensar	HDPE Geogrid	303-429-9511
Key System	Steel Grid	800-747-8971

MATERIAL

(a) Shop Drawings. The Contractor shall review and approve shop drawings and certified material test reports prior to construction of any walls. Use of a firm to prepare these drawings and reports shall be limited to a specialty firm regularly engaged in the design and construction of permanent MSE walls. The Contractor shall reject shop drawings prepared by a non-specialty firm. Shop drawings shall be reviewed in accordance with the Contract.

The shop drawings shall provide the details necessary to demonstrate compliance with the requirements in the Contract or the plans as finalized by the Contractor and these specifications, including:

1. Wall layouts shall conform to the lines and grades in the plans including starting, corner, and ending stations, leveling pad step breaks, total number of blocks and associated top of block elevations. For walls with rail anchoring slabs, the top of block elevations or the CIP leveling course shall be within 2 inches (50 mm) measured from the bottom of the anchoring slab. If temporary wall(s) are required for the construction of permanent walls, the permanent wall vendor shall provide the shop drawings and material for temporary wall(s).

2. Unless shown otherwise on the plans, the facial blocks shall be connected to each layer of soil reinforcement and the block placement sequence shall be shown. Additionally, the block to reinforcement connections and the cut block limits at curved wall corners shall be shown.

3. The actual reinforcement elevations shall be marked on the shop drawings by taking into account the supplied block height, number of reinforced layers, thickness of soil reinforcing and shimming material, and, for curved corners, the interposing layers of reinforcement.

4. The soil reinforcement types, Minimum Average Roll Value (MARV), spacing, lengths, elevations, and the corresponding wall design height segments shall be shown on the wall layout. Each reinforcement layer shall be composed of a single grade of reinforcement material and shall be placed contiguously at a constant spacing and at the same elevation from end to end of wall. Sprayed on or taped on consistent color code for material grade identification shall be used in each roll or

grade of reinforcement. Elevations of the reinforcement layers shall be specified in the plans except when the reinforcement spacing is a constant from the top to the bottom of the wall.

5. Soil Reinforcement Length (RL). The soil reinforcement length shall be measured from the front face of the concrete block face to the end of the soil reinforcement as measured to the last cross member. Except for tail (secondary) reinforcement, Soil reinforcement lengths shall not be less than the specified lengths given in the plans.

   The soil reinforcement shall be the same length from top to bottom at all layers in a wall segment. The minimum soil reinforcement length shall be as follows:

Design Height (DH)	Minimum RL
DH > 11' (3.35 M)	0.7(DH)
11' (3.35 M) ≥ DH ≥ 8' (2.43 M)	8' (2.43 M)
DH < 8' (2.43 M)	Minimum of 1.0(DH) or 6' (1.83 M)
Top Layer	≥ 8' (2.43 M)

6. Soil Reinforcement Spacing:

   A. The first (bottom) layer of soil reinforcement shall be no further than 16 inches (406 mm) above the top of the leveling pad.

   B. The last (top) layer of soil reinforcement shall be no further than 20 inches (508 mm) on the average below the top of the uppermost concrete block.

   C. The maximum vertical spacing between layers of adjacent soil reinforcement shall not exceed 32 inches (813 mm). For walls deriving their connection capacity by friction the maximum vertical spacing of the reinforcement should be limited to two times the block depth (front face to back face) to assure construction and long-term stability. The top row of reinforcement should be one-half the vertical spacing.

7. Long Term Design Strength (LTDS) of Reinforcement.

   A. Metallic (Inextensible) Soil Reinforcement. For Structure Backfill (Class 1), with an impervious membrane installed on the top of wall to intercept the de-icing chemicals, the following minimum sacrificial thickness for reinforcement shall be applied to the 75 years LTDS calculations:

Galvanization Loss	15 µm/year for first 2 years 4 µm/year for subsequent years
Carbon steel loss	12 µm/year after zinc depletion

   (1) Geosynthetic (Extensible) Soil Reinforcement. For roadway support walls with geosynthetic reinforcement, to keep the surface runoff from entering the wall backfill, the same membrane shall be installed as specified in item 1

above. Geosynthetic soil reinforcement shall be a geogrid or woven geotextile. For polyester (PET), polypropylene (PP) and high-densitypolyethylene (HDPE) reinforcement, the LTDS of material shall be determined using the following factors of safety to ensure the required design life. The LTDS may not exceed the following K percent of its ultimate tensile strength, MARV, i.e.

LTDS = K * MARV,

Where K = CRC / (FS * FC * FD)

CRC = Creep Reduction Coefficient Factor of Safety (FS) = 1.5

FC = Construction Damage Factor FD = Durability Factor

B. Geogrid reinforcement (HDPE, PET) pre-approved by CDOT:

Products with weight $\geq$ 8 oz/Yd^2 (270 g/m^2)	K
Tensar	20%
Fortrac, Miragrid, Strata, Synteen and Raugrid	24%

C. All products including geogrid reinforcement not pre-approved by CDOT:

Products with weight < 8 oz/Yd^2(270 g/m^2)	K
All geogrid or woven geotextile products meet AASHTO Table 5.8.6.1.2A requirements	10%
Products not meet AASHTO Table 5.8.6.1.2A requirements including Non-woven geotextile products	5%

8. Design Heights and Supplied Reinforcing Material. The wall design height shall be measured vertically from the top of the leveling pad to the top of the concrete rail-anchoring slab for walls with railing, or to the top of the concrete block for walls without railing. For both geosynthetic and metallic reinforcement, the required reinforcement LTDS and the supplied LTDS (determined in accordance with the K factors or depletion of material as defined above) with corresponding brand and grade of material shall be marked clearly on the elevation view.

   The LTDS of the supplied reinforcement grade shall meet or exceed the required LTDS corresponding to the reinforcement spacing provided.

9. For the reinforcement layouts of tiered walls, the overall geometry, the reinforcement length and the sum of the LTDS provided from all layers in all tiers shall be in close conformity with the retaining wall system shown in the plans in order to ensure that both local and global stability requirement have been met.

10. For reinforcements that interfere with obstructions such as steel piles, concrete piers, concrete boxes and pipes, details of the connections shall be provided. Details shall be provided according to the design computation that demonstrates that the structure meets the required safety factors in the obstruction area.

(b) Backfill. The wall backfill material in the reinforced zone and the associated trapezoidal retained zone shall conform to the requirements for Structure Backfill (Class 1) of Section 206. For pullout, a friction angle of 34 degrees shall be assumed for Structure Backfill (Class 1) and the backfill material shall be considered to be non-aggressive soil for corrosion and durability computations. CDOT may require chemical and organic content tests if the source is questionable. All reinforcing elements shall be designed to ensure a minimum design life of 75 years for permanent structures.

(c) Leveling Pad. Concrete for the leveling pad shall be Concrete Class B, f'c = 3000 psi (25 MPa), conforming to the requirements of Section 601. The maximum vertical step shall be no greater than either 24 inches (610 mm) or three blocks. The leveling pad shall be reinforced only at the steps. For the toe of wall founded on slope steeper than 1.5 (H) to 1 (V), leveling pad shall be constructed with reinforced concrete with same reinforcing schedule as at its step. Leveling pad concrete shall be cured for at least twelve (12) hours before placement of the concrete blocks.

(d) Impervious Membrane and Joint. The impervious membrane shall meet the requirements of Subsection 712.08 for geomembrane, and shall have a minimum thickness of 30 mills (0.76 mm). It shall be spliced either with a dual track field seamed joint or with an 8 inch (203 mm) minimum overlap and folded to shed water. For all roadway-supporting walls, an impervious membrane shall be installed at the top of the reinforced zone to intercept surface runoff and prevent salt penetration. This membrane shall have a minimum coverage length measured perpendicular to the wall face of at least the wall design height plus 3 feet, 4 inches (1 m). It shall be installed with a perforated and corrugated HDPE drainage collection pipe, with a geotextile sock filter, and shall extend either to the drainage system or drain out of the wall at every 100 feet (30 m) along the wall alignment. The membrane shall slope 20 maximum (H) to 1 (V) towards the drainage collection pipe. To avoid the obstruction of the pipe in the middle of the fill, as an alternate, for walls with temporary cut slope or pre-installed roadway fill slope, the water collector system (sock filter, perforated pipes and joints) may be moved to the back. The membrane can be installed with a 20:1 slope from the facing block all way to the cut or pre-filled slope. However a minimum 18 inch by 18 inch geo-fabric filter material rapped 6 inch perforated HDPE pipe collector in conjunction with the geo-composite down drains shall be installed at the toe of the slope. The geo-composed drain board shall be one continuous piece and nail secured along the slope. The geo-composite drains that collect the water from the membrane to the water collector system shall be a minimum 12 inches in width at 10 feet maximum spacing. The Contractor's structural design engineer shall provide a detailed layout of this equivalent water collection system.

(e) Pre-cast Concrete Facing Blocks. Concrete blocks including cap blocks shall conform to the requirements in the Contract, plans, and these specifications including the color, texture, and pattern. The Contractor shall provide certification to CDOT Region 2 that the tests indicated in this subsection meet the requirements of the appropriate specification.

1. Cementations material shall be Portland cement conforming to the requirements of ASTM C 150. If fly ash is used it shall not exceed 20% by weight of the total cement content and shall conform to ASTM C 618.

2. Aggregates used in concrete blocks shall conform to ASTM C 33 for normal weight concrete aggregate.

3. The 28 Days compression strength for concrete blocks shall be equal to or greater than 4500 psi (32 MPa). The quality of blocks shall be maintained that the variations of the compression strengths are within 10 %. The minimum oven dry unit weight shall be 125 pcf (2000 Kg/M^3) with a maximum water absorption rate by weight of 6%. Test shall meet the ASTM C 140.

4. All units shall be sound and free from cracks or other defects that would interfere with proper placement of the unit, or impair the strength or permanence of the construction. Minor cracks incidental to the usual method of manufacture or minor chipping resulting from shipment and delivery are recognized and exempt from payment reduction. Cracks, chips, color, any blemishes, and/or other imperfections will be cause for rejection.

   Any architectural treatments shall meet the requirements shown in the plans. If architectural coating is used and water repellant sealer is required by the Contract, prior to beginning wall construction, CDOT shall be provided with four sample blocks for each different color and texture for Approval. Water-resistant or repellant coatings shall conform to ASTM C 1262.

   The permissible variations in the exterior dimensions of the concrete blocks shall not differ more than ± 1/8 inches (3 mm), except the height of the block shall be within ± 1/16 inches (1.5 mm) from the specified dimensions for an individual block. The minimum thickness of any walls or webs within the block shall be on average 2.5 inches (51 mm) at the face and 1.5 inches (38 mm) 2 inches (50 mm) at stem and back. The vertical edges, if applicable, shall be chamfered for splitting and precise dimensioning.

5. CDOT shall be allowed access to the manufacturer's facilities to inspect and sample units from lots prior to delivery with a minimum 24 hours advance notice.

6. CDOT the right to reject any concrete blocks, which do not meet the requirements of this specification. The Contractor shall notify the CDOT writing at least 72 hours before beginning the shipment of any blocks for this project.

(f) Certifications, Calculations and Testing Reports. The Contractor shall provide the following reports, certifications and calculations to CDOT. All engineering calculations shall be certified and stamped by a Professional Engineer licensed in the State of Colorado.

1. Certification of MARV or Ultimate Tensile Strength. For geo-synthetic reinforced systems only, a certification letter from the manufacture which provides the MARV (S) and certifies that the MARV (S) of the supplied materials have been determined in accordance with ASTM D-4595 or ASTM D-6637 as appropriate. For metallic wall reinforcement, a mill test report containing the ultimate tensile strength for the soil reinforcement shall be included in the certification.

2. Report of the Block/Reinforcement Connection Test. The test report shall be prepared and certified by an independent laboratory. The block to reinforcement

connection test method shall conform to the requirements of NCMA Methods SRWU-1. The service limit state connection strength shall be reported and determined with the 0.75 inch (19 mm) performance limit.

3. Report for Block/Block Connection Test. An independent laboratory shall prepare the test report. The block-to-block connection test method shall conform to the requirements of NCMA Methods SRWU-2. The service state connection strength shall be determined with the 0.75 inch (19 mm) performance limit.

4. Report for Soil to Reinforcement Interface Pullout Test. Tests shall include the full range of overburden pressures as defined by the wall design heights.

5. Certification of Facial Block to Reinforcement Long-Term Connection Strength. A certification shall be provided with detailed calculations according to the latest AASHTO Standard Specification including Interim and laboratory test results performed in accordance with FHWA NHI-00-043, Appendix A3 to demonstrate that the facial block to reinforcement connection meets or exceeds the current AASHTO 75 year design life requirements.

6. Certification of Reinforcement Pullout. A certification shall be provided with detail calculations to demonstrate that reinforcement pullouts meet or exceed the current AASHTO requirements. The metal reinforcement breakage and pullout calculations shall include a combination of 75 years of material depletion for carbon steel and galvanization loss.

7. Report and Certification for Concrete Block 28 Days Compression Strength and Water Absorption Rate. Either a full block or a saw cut coupon compressive test is acceptable to verify the 28 day concrete strength provided the sample allows the test to conform to ASTM C90. The sampling shall be done at manufacture's casting yard and testing results shall be pre-approved before shipment. The Contractor's structural design engineer shall approve the sample selections for the coupon tests. Coupons shall be cut from the two sides or the back of block (not the front split face) with maximum two original concrete surfaces. The average compressive strength of three tests from randomly selected three blocks, with load applied in the bearing direction shall be equal to or greater than 4500 psi (32 MPa) with the minimum of 4000 psi (28 MPa) for individual tests in accordance with ASTM C 90 and C 140. A minimum of two coupons shall be prepared and marked per each block, minimum one coupon for successfully conducting the supplier's tests and minimum one spared for a future test. The spared coupons from the three tests shall be labeled and delivered to the CDOT with the certification. The minimum oven dry weight of concrete coupons shall be 125 pcf (2000 Kg/M^3) with a maximum water absorption rate by weight of 6% as determined by ASTM C 140. Coupons shall be cut from relatively the same location of each block and prepared with uniform workmanship. Any individual sample shall test within 12% of the average of the three. If any two samples of the three are not within the 15% requirement then the test is to be considered void and must be rerun with either different set of samples or conduct full block test.

(g) Efflorescence, Freeze and Thaw Test. Block shall be visually efflorescence free. Efflorescence control agent shall be used in concrete mix design. Test results for freeze and thaw durability shall be supplied with test data up to 150 cycles to confirm that blocks with concrete additives alone can survive 150 cycles with weight loss for each of four of the five samples not exceeding 1% initial weight. Per CDOT's approval, project specific freeze and thaw durability tests may be substituted by the tests of units made with the same material, concrete mix design, manufacturing process, and curing method, conducted not more than 18 months prior to delivery. An independent laboratory shall provide reports and certifications of the above tests as per ASTM C 1262 and C 1372 as appropriate. Test results will be subject to a 20% price reduction.

(h) Conditions to Waive the Block/Reinforcement Connection Testing Reports. For walls designed with low strength geo-grid or woven geo-fabric, except for the top layer of blocks, every block shall be connected by friction with either a main or a tail reinforcement starting at or 2 inches (50 mm) maximum from the front face of block. The spacing for main reinforcement is two blocks maximum or 16 inches (406 mm). The tail or secondary reinforcement shall be applied in between the main reinforcement. The same grade of material as used for main reinforcement shall be used for the tail or secondary reinforcement, however, only a minimum of 36 inches (910 mm) total length measured from the face of block is required. Aggregate filled cells shall be filled with 1/4 inch (6 mm) aggregate. In lieu of aggregate filled cells, the cells in the top four blocks of the wall shall be doweled with steel or fiberglass bars and grouted with cement.

Punched or poked holes through fabric reinforcement are allowed to accommodate grout and dowel bars.

CONSTRUCTION REQUIREMENTS

(a) Approval and Qualifications of MSE Wall Installer. The job site wall foreman shall have experience in construction of at least five successfully completed MSE walls within the last three years. The foreman must have prior experience or adequate training of the products that the Contractor elects to use in the project. The resume and credentials of the foreman shall be verified and documented by the Contractor before beginning wall construction.

(b) Facial Block Quality Control, Placing Plan and Daily Placement Logs. Before the start of each wall construction, the Contractor shall prepare a block-placing plan and shall keep the placement logs. Blocks shall be labeled with manufacturer's lot number for each pallet and corresponding certification with one set of random sample testing for each every 6000 blocks. Minimum one certification with supporting test results is required for each wall. Test result shall be reviewed and pre-approved by the Contractor's structural design engineer before shipment. CDOT may conduct separate tests with the spared coupons from the original samples. Block testing shall be increased to one set of sampling for every 3000 blocks if the CDOT identifies substandard blocks or when block color or concrete mix changes. Per the Contractor's structural design engineer's approval, block sampling may be reduced to one set of sampling for every 12000 blocks after the first acceptable sampling results. For each project, at no additional cost, the blocks used for CDOT's verification purpose shall be kept within a maximum of 1/2% of the total number of blocks. The Contractor shall conduct block sampling as early as possible and acquiring blocks regularly, however without conducting any tests within 90 Days of the sampling date, the blocks shall be returned. The Contractor shall coordinate

and mark the block and backfill placing sequence on the logs. The log serves as means to identify where each lot of blocks was placed in any particular wall, and it will be used in questionable blocks and as evidence for the basis of making decisions on payment or payment reductions.

(c) Wall Test Segment. Before moving into the full production mode, CDOT has the option to utilize a segment of the actual wall as a test wall. The Accepted wall segment shall establish a benchmark for workmanship as well as to verify the adequacy for equipment operations. The Contractor may use the test segment to identify Quality Assurance and Quality Control problems.

(d) Wall with curved alignments, tight curved corners and adjacent to bridge abutment. The Contractor shall provide a placement plan that shows curved layouts, special block or saw cut block dimensions, sequence of block placement and construction off-sets as recommended by the manufacture. For tight curved corners and dissimilar foundations such as bridge abutment, to avoid blocks with random cracks, the Contractor shall install stack bond blocks with vertical through joints, however, reinforcement spacing shall be reduced to one block height or other properly designed methods of block stabilization as approved by the Contractor's structural design engineer. Short tail reinforcements used to tie-back cut blocks in between main reinforcements are acceptable. A stack bond for stress relief may be built either with pre-cut or partial pre-cut individual blocks or by saw cutting block face of breaking running bond vertically right after installation.

(e) Excavation and backfill. The base of leveling pad shall receive the same compaction as Cut Area required by 203.07 of Standard Specification. The Contractor shall report to the CDOT with density test results for any unsatisfactory bearing material not meeting the minimum 90% compaction for walls less than 16 feet and 95% of T-180 for wall higher than 16 feet. Should the excavation for the placement of the leveling pad expose an unsatisfactory bearing material, the Contractor shall remove and replacement of that material. Any removed material shall be replaced with Structure Backfill (Class 1) compacted in conformance with Subsection 206.03. The Contractor, with the geotechnical engineer, shall jointly provide the limits, including the depth of removal. As directed by the Contractor's structural design engineer, if required, Structure Backfill (Class 1) material shall be reinforced with soil reinforcements in conjunction with wick drains and outlet pipes.

Grade the foundation for the bottom of the wall for a width equal to or exceeding the limits of the Reinforcement Length (RL) plus 1 foot, 6 inches (457 mm), as shown in the plans. This graded area shall be compacted with an appropriate vibratory roller weighing a minimum of 8 tons (7 metric tons) for at least five passes, or as directed by the Contractor's structural design engineer. For cut wall with continuous seepage, phasing of foundation construction or different drainage and foundation improvement plan may be necessary. The geotechnical engineer should be contacted for support as needed.

The reinforced fill and the retained fill portion immediately behind it, as defined on the plans, shall be Structure Backfill (Class 1). Recycled asphalt and flow-fill material shall not be substituted for Structure Backfill. The backfill within a distance equal to the reinforcement spacing away from the back of the blocks shall be placed with reduced lift. The triangular portion behind the concrete blocks and above the spill of backfill shall be filled with $3/8^{+}$ inch (10^{+} mm) crushed rock or filter aggregates or Class 1 backfill with filter fabrics. Each compacted lift of backfill must not exceed 8 inches (200 mm) and

shall be roughly leveled with the targeted block top elevation. The fill and compaction operation shall start 3 foot (1 m) from the wall face toward the reinforcement end. All the Structure Backfill (Class 1), including fill material under wall and on-site material as allowed under Section (b) of Material, shall be compacted to a density of no less than 95% of the maximum density as determined by AASHTO T 180 (or 100% T 99). For on-site foundation material containing more than 30% retained on 3/4 inch sieve (19mm), a method of measure compacting consisting of a conventional heavy vibratory roller starting with minimum 5 passes shall be used to establish the number of passes required that exceeds the 95% T180.

At least 6 inches (152 mm) of material shall be in place prior to operation of tracked vehicles over soil with reinforcement. Only power operated roller or plate compaction equipment weighing less than 1,000 lbs (450 kg) is allowed within 3 feet (914 mm) of the front face of the wall. Density tests behind and parallel to the blocks in the top triangular portion above the backfill spill zone can only begin after the fill material for the entire layer has been placed and compacted. The compaction of this triangular zone can be relaxed from 95% down to 90% T 180 (95% T 99) as directed by the Contractor's structural design engineer.

The Contractor shall place additional blocks and properly compacted fill material to return the finished grade to the planned elevations if settlement has occurred. A final inspection before the installation of rail anchoring slabs shall be made thirty (30) to forth-five (45) Days after the completion of the top layer of blocks. The Contractor shall provide temporary storm water protection and wind erosion control during construction. The Contractor is responsible for making up for any backfill loses due to wind and water erosion. If the settlement is determined to be the result of the non-conforming backfill or the backfill does not meet compaction requirements, the Contractor shall bring the elevation to the finished grade.

(f) Reinforcement. The Steel reinforcement shall be slack free and polymer reinforcement shall be slightly pre-tensioned. The geosynthetic reinforcement shall be preferably with 100% coverage and an overlap between rolls is not required. However, the minimum coverage for geogrid reinforcement shall be 67% and the spaces between rolls shall be staggered between layers.

Geosynthetic sheet reinforcement shall be laid to within 1 inch (25 mm) from the front face of block.

(g) Leveling Pad. The base of leveling pads shall meet the requirement of Item (e) of this section. The concrete leveling pad shall be level within the tolerance of 1/16 inch (1.5 mm) for any two block lengths, and within 1/4 inch (6 mm) for any two points that are 10 feet (3 m) or more apart.

To avoid a washout by rain during construction, the area in front of the wall and around the leveling pad shall be backfilled as soon as it is practical to do so.

A layer of thin cushion or shimming material shall be used to support the blocks that are to be directly founded on a leveling pad. Before starting a new course of blocks, the Contractor shall take steps to ensure that the wall elevations will be matched at the next leveling pad step and layers of cushion or shimming material or grinding as necessary shall be used to obtain the necessary block elevations at the next leveling pad step.

(h) Block Facing. For walls that support a roadway, the alignment at the top of the wall shall meet the wall layout lines shown on the plans; for walls adjacent to a roadway, the alignment at the bottom of the wall shall match the wall layout line shown on the plans. An overall negative batter (wall face leaning outward) between the bottom and the top of the wall is not allowed. For vertical walls, unless otherwise noted on the plans, the final wall face shall be vertical or shall have a positive batter that is not greater than 5% for construction control purposes. For walls higher than 16 feet (5 m), the 5% batter requirement may be relaxed to a maximum of 8% as required by the special block products. The surface of the wall face shall be tested with a 10 foot (3 m) straightedge laid along the surface in all directions. Except as necessary for horizontal alignment of the wall, a convex deviation (wall belly) of the wall face from the straightedge shall not be allowed, and a concave deviation (wall depression) from the straightedge shall be less than 3/4 inches (19 mm).

Unless otherwise noted, all blocks shall be dry-stacked and placed with each block spanning the joint in the row below (running bond). Shimming or grinding shall control the elevations of any two adjacent blocks within 1/24 inch (1.0 mm). The top of blocks shall be tested with a minimum length of 3 foot (0.9 m) long straight edge level (bubbles). Any high points identified by the straight edge shall be ground flat. Block front to back tilting shall be checked frequently, however correction by shimming shall be done no later than three completed courses. For walls without a rail-anchoring slab, the top two courses, or a cast-in-place reinforced concrete cap course and the two courses directly below it, shall be pinned and internally grouted together with a minimum of two No. 4 (13M) bars or equivalent fiberglass bars per block. The concrete block shall have cells to accommodate grouted pins and modifications must be made for blocks that do not have such cells. Grout is limited to penetrate a maximum depth of three blocks measured from the top of fill for each operation. For grout more than three blocks in height, multiple grout operations are required. A layer of fabric shall retain the grout in the lowest grouted block layer. The aggregate for grout shall be modified according to cell size and geogrid aperture. Grout operation in any 20 foot (6 m) long wall segment shall be placed and consolidated by a minimum of two simultaneously working concrete vibrators. In lieu of a cast-in-place reinforced concrete cap, precast cap blocks may be used but must be secured to the supporting blocks with approved adhesive or mortar to prevent vandalism. Cap blocks must meet the same freeze and thaw specifications as the normal blocks. All concretes for CIP cap and grout shall meet a minimum 3000-psi (21 Mpa) for 28 Days compression strength.

For walls with rail anchoring slabs, the top of block elevations shall be within 2 inches (50 mm) of the bottom of the anchoring slab. Cast-in-place concrete or sawcut partial height blocks may be used to accomplish this without extra cost to the project.

Where the impervious membrane for drainage interferes with the continuation of reinforcement, the blocks beyond the termination shall be reinforced or shimmed with the same grade of soil reinforcing material to maintain the reinforcing at the constant block elevation.

If specified in the plan, facing blocks directly exposed to spray from deiced pavements and indirect windborne spray zone shall have three layers of water resistant or repellant concrete sealer applied to the exposed blocks at front and back face including cap blocks before the wall is opened to traffic.

To avoid vandalism and to retain the fill, cracked blocks, loose partial blocks or blocks with oversize joints shall be bound or sealed by grout. Before final payment, any damaged blocks including blocks with blemishes such as cement residue, mud stain and discoloration shall be replaced or repaired or even sand blasted at no additional cost.

(i) Fill under Leveling Pad. For walls requiring fill under the planned elevation of the leveling pad, the Contractor may elect to lower the elevation of the leveling pad, except that the finished elevation at the top of the wall shall not be altered. The higher wall shall be redesigned with longer reinforcement length and revised reinforcement schedule. Because modifications to the leveling pad elevations are for the Contractor's convenience, the cost for additional facing blocks, reinforcements and fill material including installation shall be at the Contractor's expanses. Lowering the planned elevation of leveling pads and replacing the original design with a higher wall with the original reinforcement schedule specified in the plan is not permitted.

(j) 504 Blocking Facing Payment Reductions. A dislocated block is an individual block that is offset outward more than 1/4 inch (6mm) or placed with a vertical joint more than 1/4 inch (6mm) from the adjacent blocks. A cracked block is an individual block with any visible crack where viewed from a distance of wall height in natural light. A corner knock-off is a block with any missing facial corners or any side longer than 1/2 inches (13mm) at corner. Substandard blocks are concrete blocks installed in any wall segments that do not met the certified values of compression strength, water absorption rate and freeze/thaw cycles.

In the completed wall, or completed portion of the wall, if the number of defective blocks (cracked blocks, corner knock-off blocks, dislocated blocks, efflorescence or cement blemished blocks and substandard blocks including rejected blocks) and blocks failing the straightedge test exceeds 3% of the total number of blocks in any wall segment of 40 feet (12 m) horizontal or arc length, a 3% price reduction per each percent of exceeding for the block facing in this portion of the wall will be applied and this percentage shall accumulate thereafter to a maximum reduction of 21%. For blocks subjected to price reduction, if the defects are repairable or the overall quality of wall can be improved, with the consent from the CDOT Region 2, the Contractor may elect to repair and reduce the percentage of price reduction. A walk-through inspection shall be made with the CDOT as requested by the Contractor before final payment. The CDOT shall determine the overall payment reduction.

% Of Defect Blocks	≤ 3	≤ 4	≤ 5	≤ 6	≤ 7	≤ 8	≤ 9	≤ 10	>10
% Of Price Reduction	N/A	3	6	9	12	15	18	21	Rejection

1. The overall payment reduction percentage shall be calculated by dividing the sum of all non-freeze-thaw deflective blocks by the total number of blocks in portion(s) of the wall. When this percentage exceeds 10%, CDOT shall reject the entire wall or portions thereof. The 20% reduction due to failure of the freeze-thaw requirements shall be applied to the total cost of all the elements comprising the wall. The elements comprising the wall for this price reduction shall be Excavation, Structure Backfill (Class 1), Mechanical Reinforcing of Soil, Concrete Class B, and Reinforcing Steel or Reinforcing Steel (Epoxy Coated) in the leveling pad.

Painting of Aluminum Access Doors for Steel Structures

Sections 509 and 708 of the Standard Specifications are hereby revised for this Project as follows:

Subsection 509.24 shall include the following:

Aluminum access doors shall receive a solvent cleaning to remove grease, oil, etc. (SSPC-SPI) followed by a brush blast to provide a profile similar to the structural steel. The access doors shall receive one coat of primer as described in the Revision of Section 708.03.

Subsection 708.03 shall include the following:

If Alternate 1, Alkyd System, is to be used on the structural steel, the aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following the application of this primer, the doors shall be painted the same as the structural steel (one field coat of primer followed by the topcoat). Coating thicknesses shall be the same as specified for the structural steel.

If Alternate 2, Inorganic Zinc-Rich Polyurethane System, is used on the structural steel, the aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following application of the vinyl wash primer, the same polyurethane topcoat as used on the structural steel shall be applied to the access doors (minimum 3.0 mils dry film thickness).

The manufacturer of the primer shall certify in writing that the primer used is compatible with the cleaned aluminum access doors and the polyurethane topcoat to be used on the structural steel.

Welding – Existing Steel

Section 509 of the Standard Specification is hereby revised for this Project as follows:

Subsection 509.20 shall include the following:

For field welding A7 steel, electrodes used shall be E7015, 16, 18 or 28.

For welding A7 steel with low-hydrogen electrodes by any process, the minimum preheat and interpass temperature shall be 150°F for thicknesses of metal up to 1-1/2 inches.

Subsection 509.26 shall include the following:

The Contractor shall not commence any field welding on the girders until CDOT has been notified and their representative is on the site.

Subsection 509.20(h) shall include the following:

Base metal shall be preheated to 150°F on the surface prior to welding studs.

Bridge Drain

Section 513 is hereby added to the Standard Specifications for this project as follows:

DESCRIPTION

This Work shall consist of furnishing and placing bridge drains in accordance with the Contract.

MATERIALS

Pipe for bridge drains shall meet the requirements of ASTM A53 and shall be standard weight and minimum 10-inch nominal diameter.

Down spout pipe shall be hot dipped galvanized after fabrication. Galvanizing shall meet the requirements of AASHTO M111.

Metal used in the manufacture of castings shall meet the requirements of ASTM A48 Class 35B.

CONSTRUCTION REQUIREMENTS

Bridge drains shall be placed and secured at the locations shown on the plans prior to placement of concrete. The bridge drain and grate assembly shipped to the site shall not be disassembled for installation unless specifically called for by the manufacturers installation directions.

Prior to fabrication of this item, two sets of working drawings that comply with the Contract shall be submitted to CDOT for information only.

Painting of Aluminum Access Doors for Concrete Structures

Section 601 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 601.14(b)4 shall include the following:

Aluminum access doors shall receive a solvent cleaning to remove grease and oil (SSPC-SPI) followed by a brush blast.

The aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following the application of this primer, the doors will be coated with Structural Concrete Stain conforming to Revision of Section 708 Painting of Aluminum Access Doors for Steel Structures.

The manufacturer of the primer shall certify in writing that the primer used is compatible with the cleaned aluminum access doors and the Structural Concrete Stain to be used on the Structural Concrete.

Structural Concrete (Grooved Pattern Finish)

Section 601 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 601.09 shall include the following:

An Approved elastomeric form liner that will produce a grooved pattern finish shall be used in the designated portions of retaining walls. The form liner shall be furnished with a coating of an approved, non-petroleum base, factory-applied form release agent. After fastening the form liner to the form, an additional coat of manufacturer's recommended (only Approved non-petroleum base may be used) form release agent shall be applied to the liner prior to and for each pour of concrete. Adjacent sections of the form liner shall be butted together to produce a good mortar tight joint. All grooves shall line up in the vertical direction. The form liner shall be securely fastened to the forms with staples or nails.

Form ties shall be inserted through the form liner by cutting a cross-shaped slit in the liner. Prior to reuse of the form liner on adjacent wall sections, slits in the form liner that do not coincide with new tie spacing shall be sealed with a plastic tape which will adhere securely to the surface of the form liner.

The Contractor will be responsible to assure that whenever any discontinuities of the grooved pattern, or whenever any lines interrupting or intersecting the grooved pattern, are called for on the plans, that the resulting lines, horizontal, diagonal, vertical or otherwise, are neat and true, and that the form liner is not unduly deflected in any direction, including the form liner at the interface between the form liner and any other interrupting or intersecting line.

Subsection 601.09(f) shall include the following:

Forms to which a form liner is to be attached shall not be treated with oil.

Section 601.14(a) shall include the following:

A grooved pattern surface finish as required by the Contract shall be used on the designated portions of concrete walls.

For all walls or panels requiring a grooved pattern on the exposed surface, which are less than 10 feet in height, the form liner producing the pattern shall be one continuous piece extending the full height of the wall or panel. For all other walls, no section of the form liner may be less than 10 feet in height except for one section which may be required to extend the form liner to full height.

Horizontal joints in adjacent form liner sections shall be offset by no less than 1 foot vertically. The form liners shall be properly aligned to limit visible horizontal and vertical joints in the concrete.

The required groove pattern finish shall extend from the bottom of wall or top of wall footing to the top of wall or bottom of wall coping or cap, or as otherwise required in the Contract. Grooves shall be continuous with no apparent curves or discontinuites. Variation of the groove from true vertical shall not exceed 1/4 inch for each 10 feet of wall height.

Concrete for such walls shall be poured monolithically vertically. Concrete finish shall be in accordance with Revision of Section Structural Concrete Stain and shall be required for the full height of the grooved pattern finish to one foot below ground line.

Concrete Class DT (Deck Topping)

Section 601 of the Standard Specification is hereby revised for this Project as follows:

Subsection 601.17 shall include the following:

In the event that plastic shrinkage cracking has occurred, any cracks greater than 0.010 inch in width that develop within the first 5 Days of overlay placement shall be assumed plastic shrinkage cracks. The Contractor's structural design engineer will measure the cracks by the insertion of a wire gage at any time or temperature at five Days. The Contractor shall make repairs by filling the cracks, concrete removal and replacement or other Approved methods at no additional cost to the Project.

A low viscosity two-part methacrylate or Approved equal shall be used to fill cracks in accordance with the recommendations of the manufacturer of the crack filling material.

Those portions of the structure that have been overlaid with the Concrete Class DT shall not be opened to traffic, including construction traffic, for at least five Days after overlay placement and until the concrete has reached a compressive strength of 0.8 f 'c.

Concrete Class D (Bridge)(Special)(Deck Rehabilitation)

Section 601 of the Standard Specifications is hereby revised for this project as follows:

Subsection 601.02 shall include the following:

Concrete Class D (Bridge) (Special) shall conform to the following:

Concrete Class	Required 28 Day Field Compressive Strength (psi)	Required 6 Hour Field Compressive Strength (psi)	Minimum Cement (lb/yd^3)	Air Content % Range	Maximum Water Cement Ratio	Additional Requirement
D (Bridge) (Special)	4500	2500	615	5 - 8	0.44	3, 7, 10, 11

(2) Approved fly ash may be substituted for portland cement up to a maximum of 20% by weight.

(3) Of the total aggregate a minimum of 50% AASHTO M 43 size No. 8 coarse aggregate is required.

Subsection 601.03 shall include the following:

Type III cement will be permitted for Concrete Class D (Bridge) (Special).

Subsection 601.05 shall include the following:

Calcium chloride will not be allowed for Concrete Class D (Bridge) (Special). Approved admixtures which conform to AASHTO M 194 Type F (water reducing, high range) and Type G (water reducing, high range and retarding) will be permitted for Concrete Class D (Bridge) (Special).

The laboratory trial mix must produce an average 6 hour compressive strength of at least 2750 psi.

For Concrete Class D (Bridge) (Special) the Contractor shall develop maturity relationships in accordance with ASTM C 1074 with the following additions or modifications:

(1) The cylinders used to establish the compressive strength vs. maturity relationship shall be cast and cured in the field in conditions similar to the project.

(2) These cylinders shall be tested in pairs at times, which yield compressive strengths three sets of which are at or below 2500 psi and one of which is above 2500 psi.

(3) Testing to determine datum temperature or activation energy will not be required.

(4) A test slab shall be cast at the same time and location as the cylinders. The test slab shall have a length and width of 6 feet x 6 feet and a thickness of 3 inches. The maturity of the test slab, when used in the compressive strength vs. maturity relationship from the cylinders, shall indicate that a compressive strength of 2500 psi is achieved in the required time. Slab maturity will be determined with two probes located in the slab approximately 1 and 2 feet from the edge. The test slab shall be covered with a blanket similar to the one to be used on the bridge deck.

The development of the maturity relationship and maturity determination of the test slab is part of the trial mix and shall thus be documented in the Concrete Mix Design Report.

The Contractor shall provide a multi-channel maturity meter and all necessary wire and connectors. The Contractor shall be responsible for the placement and maintenance of the maturity meter and wire. Placement shall be as directed by the Contractor's structural design engineer.

Delete Subsection 601.12(m) and replace with the following:

Portions of bridge decks patched with Concrete Class D (Bridge) (Special) shall not be opened to traffic until the maturity value of the concrete, determined by the Contractor in accordance with ASTM C 1074 as modified in subsection 601.05, indicates that a compressive strength of at least 2500 psi has been achieved.

Delete Subsection 601.16 and replace with the following:

Concrete Class D (Bridge) (Special) shall be cured until the maturity value of the concrete, determined by the Contractor in accordance with ASTM C 1074 as modified in subsection 601.05, indicates that a compressive strength of at least 2500 psi has been achieved.

Portions of bridge decks patched with Concrete Class D (Bridge) (Special) shall be cured by a membrane forming curing compound that conforms to AASHTO M 148, Type 2 applied at a rate of 1 gallon per 100 square feet. The curing compound shall be applied as a fine spray within 10 minutes of discontinuing the finishing operation. Before and during application the curing compound shall be kept thoroughly mixed. Curing blankets with a minimum R-value of 0.5 shall be provided, in addition to the curing compound, and shall be placed as soon as they can be placed without marring the surface.

When the ambient temperature is below 50°F, the Contractor shall maintain the concrete temperature above 50°F during the curing period. It shall be the Contractor's responsibility to determine the necessity for undertaking protective measures.

Structural Concrete Stain

Sections 601 and 708 of the Standard Specifications are hereby revised for this project as follows:

Subsection 601.01 shall include the following:

This work consists of: (1) Class 2 surface finish of concrete to receive Concrete Stain; (2) providing and applying an opaque structural concrete stain to all concrete surfaces previously designated in the Contract to receive a structure concrete stain; and (3) provide up to 5-gallons of pre-mixed touch-up paint in aerosol spray cans.

The color of the structural concrete stain shall be as noted on the plans, and shall be Approved from test panels provided by the Contractor.

The structural concrete stain shall be one of the following products or Approved equals:

1. RAINSTOPPER RS400 – Semi Transparent Stain

   Textured Coatings of America
   Pro-Coat Systems, Inc.
   5775 Stapleton Drive North
   Denver, Colorado 80216

   303-322-9009

2. "Acrylic" Structural Concrete Stain

   Anchor Paint Co. of Denver, Inc.
   641 South Jason
   Denver, Colorado 80223-2305
   303-744-2361

3. Bridge and Highway Concrete Sealer, B97-Series

   The Sherwin-Williams Company
   543A Santa Fe Drive
   Denver, Colorado 80204
   303-893-1303

Subsection 601.03 shall include the following:

Structural Concrete Stain 708.08.

Subsection 601.09(f) shall include the following:

All concrete forms shall be treated with a water based concrete form release agent prior to placing reinforcement for surfaces to which structural concrete stain is to be applied.

In Subsection 601.14 (a) delete the third paragraph and replace with the following:

Structural concrete stain shall be the final finish for all concrete surfaces designated on the plans and in these specifications.

Delete Subsection 601.14(b)4 and replace with the following:

Unless otherwise shown in the Contract, the structural concrete stain shall be applied to all exposed concrete elements of the structure above the ground line, and shall extend 1-foot below the finished ground line. Bridge bearing devices, curb and barrier cover plates, fence, and steel bridge rail shall be masked or otherwise protected to prevent structural concrete stain from coming into contact with them.

The color of the Structural Concrete Stain shall have the written approval of CDOT prior to final batching and application on the project. The final color of the Approved, structural concrete stain, shall be determined as follows:

1. 2 foot by 2 foot samples of the colors required by the Contract, shall be submitted to CDOT for Approval. The Stain samples shall be applied to a surface similar in texture to the concrete surface on which the stain will be applied on the project. The Stain samples shall be applied by the same methods to be used in field application.

2. At least three weeks prior to beginning of the application of the structural concrete stain, 100 sf test panels shall be prepared for final color Approval by CDOT. The test panels shall be produced on the actual concrete surface on which the final product will be placed, at a location designated by CDOT. The stain shall be applied to the test panels by the same methods to be used in the final field application. CDOT will be allowed one week for Approval after stain application to the test panels.

Concrete finishing and curing shall be completed in accordance with the specification prior to the application of the Stain. The concrete finish to which the structural concrete stain is to be applied shall be a Class 2 Finish, except as modified below:

1. Following curing of the concrete in accordance with Subsection 601.13, all projections and bulges shall be removed and the surface sandblasted. Sandblasting shall profile the concrete surface, remove all form release agents, and all other deleterious materials that would inhibit the bond of the Structural Concrete Stain. The profile of the sandblasted concrete surface shall be equivalent to Concrete Surface Profile Three (CSP 3) as defined in Technical Guideline No. 03732, " Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays" by the International Concrete Repair Institute. The Contractor shall provide a CSP 3 chip for use on the project.

2. A mortar mix, proportioned by volume, consisting of one part portland cement, two to three parts sand (conforming to the requirements of ASTM C 144), and an approved bonding agent shall be used to patch all holes produced by form ties, honeycombing, voids 1/2 inch or larger in any dimension, broken corners and edges, and other defects. The mortar mix shall include an approved bonding agent. The quantity and

application procedure of the bonding agent shall be in accordance with the recommendations of the manufacturer of the bonding agent. Areas to be patched shall be moistened with water before the mortar is applied, and the patched area shall be float finished and left flush with the concrete surface without checking or cracking of patches. Patching shall be done when the ambient temperature is at least 40°F. Holes deeper than 3/4 inch shall be filled in layers that does not exceed 1/2 inch in thickness.

3. Within 24 hours prior to applying structural concrete stain, the concrete surface to be coated shall be cleaned by water blasting at a minimum pressure of 3,000 psi and at a rate of 4 to 14 gallons/minute, to remove dust, dirt, and other materials that would inhibit bonding of the coating. If the surface is contaminated before application of the coating, it shall be re-cleaned as required prior to application of the coating.

New concrete shall be at least 28 Days old or as approved in writing by the coating manufacturer before the stain is applied.

Two coats of stain shall be applied. Each coat shall be applied at a rate of 200 to 250 square feet per gallon. (Approximately 3 mils dry film thickness.) The second coat shall not be applied until at least 12 hours after the application of the first coat.

If the surface is contaminated between coats it shall be re-cleaned as stated above prior to application of the next coat.

The stain shall be mixed mechanically and applied by spraying. Workmanship shall be such that the final stained surface is colored uniformly and presents a pleasing appearance. Any areas determined by CDOT to be insufficiently stained shall be re-stained.

The stain shall be applied only when the ambient temperature is between 40°F and 90°F, and is anticipated to remain above 40°F for a minimum of twenty-four hours. The surface to be stained shall be dry and free of frost.

Subsection 708.08 shall include the following:

708.08 Structural Concrete Stain: The Stain shall be a one-component, non-vapor barrier, solvent based acrylic resin. No sand or other texturing agents will be permitted.

PHYSICAL PROPERTIES

Solid by Weight:	51%, plus or minus 2%
Solids by Volume:	34%, plus or minus 2%

A material safety data sheet (MSDS) prepared in accordance with Federal Standard 313 and a complete set of manufacturers mixing and application instructions shall be submitted to CDOT before the Contractor begins applying the Stain.

Fence Chain Link Special

Section 607 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 607.02 shall include the following:

All materials shall meet the requirements specified in AASHTO M181 except as otherwise noted in the Contract. The Contractor shall provide certification from the manufacturer that all materials used are in compliance with the requirements of the Contract.

All material shall be galvanized. When required by the plans, the fence shall also be vinyl coated. The color shall be as noted in the Contract. All exposed materials shall have a uniform coloration. Temporary members and attachments that are to be removed need not be vinyl coated. The inside of pipes shall not be vinyl coated. When the fence is vinyl coated, the bolts and nuts shall be either vinyl coated or painted to match fence coating.

Anchor bolts, threaded rods, anchor studs, post dowels and other unexposed portions of anchorage assemblies shall be galvanized and not vinyl coated or painted.

The Contractor shall furnish to the CDOT for Approval a 12 inch by 12 inch sample of the fabric (showing the exact coating and fabric construction to be used) and manufacturer's literature covering all aspects of the system before ordering or fabricating any parts.

The fabric shall be AASHTO M181 Class C or, when vinyl coating is specified in the plans, Class B. The mesh and wire sizes shall be as specified in the Contract. When 3/8 inches mesh with 12-gauge wire is specified in the Contract the following properties shall apply.

For other mesh and wire sizes the properties shall be as specified by AASHTO M181.

Mesh	3/8 inch
Core wire-breaking strength	650 pounds
Core wire diameter	0.105 inch +/-0.005 inch
Galvanizing, Class C fabric	1.2 ounces/square foot
Galvanizing, Class B fabric	0.30 ounces/square foot
Vinyl Coating Class B Fabric	0.008 inch +/-0.002 inch

Tension wires shall be AASHTO M181 Type 1 Class 2 or, when vinyl coating is specified, Type 4.

Tension wires and their fittings shall have a minimum breaking strength of 1920 pounds.

Truss rods and their fittings shall have a minimum breaking strength of 3840 pounds for fences without horizontal members and with a minimum prestress force given by the plans.

Posts and horizontal members shall be standard or extra strong steel pipe, satisfying ASTM A53 Type E or S, Grade B 35,000 psi or, at the Contractor's option, ASTM A466 Grade D pipe 50,000 psi minimum yield strength conforming to the following table may be substituted for both the standard and extra strong pipe of the same outside diameter called for in the plans. All fittings and connections dependent on the pipe's inside diameter shall be modified as necessary for proper fit-up.

ALTERNATIVE PIPE

Nominal Diameter Inches	Outside Diameter Inches	Pounds per Feet	Wall Thickness Inches
1.25	1.660	1.836	0.111
1.50	1.900	2.281	0.120
2.00	2.375	3.117	0.130
2.50	2.875	4.640	0.160

Stretcher bars, truss rods, tension wires, post tops and other required fittings and hardware shall be commercial quality steel, or better, or cast or malleable iron as appropriate to the article. A pair of two tension wires with appropriate turnbuckles or other adjustment devices may be substituted for each truss rod.

Post clips, wire ties or hog rings shall be galvanized 9 gauge or 14 gauge (before galvanizing) steel wire, and vinyl coated when specified by the Contract. Wire ties shall be given at least one complete turn. Ends of wire ties shall be directed away from traffic.

Subsection 607.03 shall include the following:

For fences without permanent horizontal members and with a minimum prestress force given by the Contract, the following shall apply:

The total pretension force in the tension wires and the mesh combined shall not be less than the value shown in the plans. Each tension wire, truss rod and the mesh should have some pretension and shall not be slack. This is to assure the strength and stiffness of the fence system under the anticipated loads.

The Contractor shall control the quality of the fence tensioning by checking that the deflection of the fence does not exceed the value shown in the Contract when the test load is applied. The CDOT may choose to assure this quality by observing these tests, or by performing audit tests. If the deflection is excessive, the Contractor shall retension the fence components.

The temporary horizontal members shall be removed after the tensioning of the fence is accepted.

Concrete Sound Barrier Fence

Section 607 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 607.01 shall include the following:

This work shall consist of design and construction of a precast concrete panel and steel or concrete post sound barrier in accordance with the terms of the Contract.

Subsection 607.02 shall include the following:

The concrete sound barrier panels shall be a hard, durable, precast cementitious construction which is incombustible, vermin-proof, corrosion-resistant, impact resistant and capable of withstanding exposure to the natural elements of weather and to road deicing chemicals and fungicides, without significant deterioration.

The fabrication plant for the precast concrete panel shall be currently certified by PCI as A1.

The concrete sound barrier panels shall be manufactured with a grooved pattern finish with structural concrete stain or exposed aggregate on the sides of the panel and of the dimensions defined in the Contract.

Panels - Precast Concrete - Modular panels shall be precast concrete, minimum 4,500 psi compressive strength at twenty-eight (28) Days, with vertical receiver edges which permit retention of the modular panel in the wide flange steel beam or concrete post.

Panels - Reinforcement - Reinforcement shall be one layer of the size and spacing shown in the shop drawings supported by design calculations, placed mid-depth in the panel.

Panels - Lifting Inserts - Shall have a rated capacity greater than the weight of the panel. The number and location of inserts is to be determined by the precaster.

Panels - Steel Post - Posts shall be wide flange structural steel column, in accordance with shapes, sizes, details and method of panel connection as shown on the drawings. Posts shall be installed plumb. The posts shall be galvanized in accordance with Sections 509 and 708, and any revisions thereto.

Subsection 607.03 shall include the following:

Prior to starting Work, the Contractor shall submit to CDOT for review and general comment, shop drawings showing his proposed details and method of constructing the walls together with complete engineering calculations and test reports. The drawings shall include lists of materials to be used, sequence of operations and a sufficient number of detailed sections to clearly illustrate the scope of work.

The barrier shall be designed to withstand wind loads indicated in the American Association of State Highway and Transportation Officials Guide Specifications of Structural Design of Sound Barriers, 1989. Wind pressure shall be applied perpendicular to the barrier, in each direction, at a minimum of 27 pounds per square foot for structure-mounted barriers less than 14 feet in height, or within 10 feet of traffic.

Sound Transmission - The Contractor shall submit to CDOT copies of an independent testing laboratory test report, which shows that the barrier system was tested in accordance with ASTM E90-75 and achieves a minimum sound transmission coefficient of 32.

Freeze-Thaw - If concrete weighing 110 pounds per cubic foot or less is used the Contractor shall submit to the CDOT copies of an independent testing laboratory test report which shows that the barrier system was subjected to a minimum of 250 freeze-thaw cycles according to ASTM C666-84 and AASHTO T161-86, without apparent deterioration. The barrier system must be able to pass this test using a 10% saline solution water spray.

The Contractor shall use plan elevations to develop the layout and fabrication drawings including a complete elevation view of each wall indicating top and bottom elevations as well as the ground line.

The barrier shall be installed in accordance with the Contract and the manufacturer recommendations, and in accordance with drawings submitted by the Contractor and approved by the Contractor's structural design engineer. Joints and connections shall be secured in such a manner as to be structurally sound and prevent the panel from moving under wind loading with no visible openings for sound transmission and light leaks through or under the noise barrier system

The lifting inserts in the top edge of the panel shall be partially filled with sand and sealed with non-shrink, waterproof grout to allow later access to the inserts in the event of relocation of the barrier.

Damaged areas of the panels shall be repaired or replaced at the Contractor's expense at no additional cost to the Project and in accordance with the manufacturer's recommendations. All panels showing evidence of being cracked must be replaced at the Contractor's expense at no additional cost to the Project.

A manufacturer representative shall be present during the installation or be available within twenty-four (24) hours to insure that the concrete barrier system is properly constructed, installed and repaired, as necessary.

Pre-Cast Concrete Panels

Reinforcing steel shall conform to the requirements of Section 602.

Pre-cast concrete panel construction shall conform to the requirements of Section 601 and the following:

(1) Concrete Class D is required and the 28-day strength shall be 4,500 psi.

(2) Form release agents shall be of a non-petroleum base that will not discolor the concrete panels and are compatible with the Structural Concrete Stain used on the Project.

(3) Panels shall be cast with the grooved pattern finish shown in the Contract Documents and a Structural Concrete Stain finish shall be applied to both sides of the panel. Surface preparation, patching and Structural Concrete Stain application shall conform to the requirements of the Revision of Section 601 and 708. Steel posts shall be protected while the surfaces of the panels are prepared, patched and coating applied. The color of the Structural Concrete Stain shall be as defined in the Contract.

(4) Panels shall be cured in accordance with the requirements of Section 601.13 (The Membrane Forming Curing Compound Method shall not be used).

Subsection 607.03 shall include the following:

The Contractor shall perform such clearing and grubbing, and/or excavation and backfill as may be necessary to construct the sound barrier to the required grade and alignment.

Clearing and grubbing shall conform to the requirements of Section 201.

Backfill shall conform to the requirements of Section 203.08.

Prior to setting pre-cast panels, the material below the bottom panels shall be graded smooth to the elevations shown in the roadway plans.

Steel posts shall be set plumb.

The grout placed between the post base plate and the top of the drilled caisson shall be a mortar mix, proportioned by volume, consisting of:

(1) One part Portland cement.

(2) Two to three parts fine aggregate, conforming to the requirements of ASTM C 144.

(3) A latex admixture that conforms to the requirements of ASTM C 1059, Type II (Non-redispersable). A minimum of 12% latex solids by weight of cement shall be added to the mortar mix and with enough water to provide a plastic workable mix.

QC/QA for Prestressed Precast Concrete Girders (Members)

Section 618 of the Standard Specification is hereby revised for this project as follows:

Delete the first paragraph of subsection 618.01 and replace with the following:

This Work consists of fabrication, Quality Control and Quality Assurance inspection, testing, furnishing and installing prestressed precast concrete girders (members) in accordance with the requirements of the Contract.

In Subsection 618.03, delete the second paragraph, and replace with the following:

Minimum concrete cover to the outside diameter of prestressing steel shall be 1-1/2 inches. Minimum concrete cover to the outside diameter of reinforcing steel shall be 1 inch.

Prestressed precast concrete girders shall be cast to the tolerances of Table 618-1. Those members that meet the tolerances of Table 618-1 are acceptable. The Contractor shall evaluate and submit a written report to the QA Representative for all members that do not meet the tolerances of Table 618-1. The Contractor's report shall address the deficient member's structural adequacy, potential reduction of corrosion resistance, how the member will fit into the overall construction and its relationship to adjacent members. Prestressed precast concrete girders that do not meet the required tolerances shall not be moved from the casting yard or erected in their intended permanent position until they have been accepted in writing by the Contractor's QA Manager according to the requirements of the QPM.

TABLE 618-1

Prestressed Precast Concrete Member Tolerances

Prestressed Concrete I Girders

Length	±0.25 inch/25ft, ±1 inch maximum
Width (overall)	+0.38 inch, -0.25 inch
Depth (overall)	+0.50 inch, -0.25 inch
Depth (flanges)	±0.25 inch
Width (web)	+0.38 inch, -0.25 inch
Sweep (Variation from a straight line parallel to centerline of the member)	0.13 inch/10ft.
Variation from end squareness or skew	±0.19 inch/ft, ±1 inch maximum
Camber variation from design camber	±0.13 inch/10 ft ±0.50 inch, max. ≤ 80 ft length 1 inch, max. Over 80 ft length
Position of strands:	
Individual	±0.25 inch
Bundled	±0.50 inch
Position of design location of deflection points for deflected strands	±20 inch
Position of plates other than bearing plates	±1 inch
Position of bearing plates	±0.63 inch
Tipping and flushness of plates	±0.25 inch
Tipping and flushness of bearing plates	±0.13 inch
Position of inserts for structural Connections	±0.50 inch
Position of handling devices:	
Parallel to length	±6 inch
Transverse to length	±1 inch
Position of stirrups:	
Longitudinal spacing	±2 inch
Projection above the top	±0 .75
Local smoothness (Does not apply to top surfaces covered with a concrete topping)	±0.25 inch in 10 ft any surface
Concrete cover:	
All steel reinforcement	+0 .50 inch -0 inch
Position of post tensioning ducts	±0.25 inch
Position of tendon anchorage plates	±0.25 inch

Prestressed Concrete Box Girders

Length	±0 .75 inch
Width (overall)	±0 .25 inch
Depth (overall)	±0 .25 inch
Depth (top flange)	±0 .50 inch
Depth (bottom flange)	+0.50 inch, -0.13 inch
Width (web)	±0 .38 inch
Sweep (Variation from a straight line parallel to centerline of the member)	0.13 inch /10 ft.
Up to 40-ft member length	±0.25 inch
40-60 ft member length	±0 .38 inch
Greater than 60 ft member length	±0 .50 inch
Variation from end squareness or skew	±0.13 inch /10 feet
Horizontal	±0.50 inch maximum
Vertical	±0.50 inch

Camber variation from design camber	±0.13 inch/10 ft.
	±0.50 inch, maximum
Differential camber between adjacent members of the same design	0.25 inch/10 ft, 0.75 inch max.
Position of strands:	
Individual	±0.25 inch
Bundled	±0.25 inch
Position of design location of Deflection points for deflected strands	±20 inch
Position of plates other than Bearing plates	±1 inch
Position of bearing plates	±0.63 inch
Tipping and flushness of plates	±0.25 inch
Tipping and flushness of bearing plates	±0.13 inch
Position of inserts for structural Connections	±0.50 inch
Position of handling devices:	
Parallel to length	±6 inch
Transverse to length	±1 inch
Position of stirrups:	
Longitudinal spacing	±1 inch
Projection above the top	+0.25 inch, -0.75 inch
Tipping of beam seat bearing area	±0.13 inch
Position of transverse tie rod holes:	
Parallel to length	±0.50 inch
Vertical	±0.38 inch
Position of void adjacent to end Block	±1 inch
Local smoothness (Does not apply to top of beam surface covered with a concrete topping)	±0.25 inch in 10 ft, any surface
Concrete cover to all steel reinforcement (Both exterior and adjacent to void)	+0.50 inch, -0 inch
Position of post tensioning ducts	±0.25 inch
Position of tendon anchorage plates	±0.25 inch

In Subsection 618.04 (b) add the following:

(10) Unit dimensions and fabrication tolerances of all members. Location and dimension, including tolerances, of all void forms in box girders.

In Subsection 618.05 (c), add the following:

All inspection reports, compressive strength test results, reinforcing steel cover measurements and box girder web, top flange, and bottom flange measurements shall be submitted to CDOT two Working Days prior to shipment.

In Subsection 618.05 (d), add the following:

Members not accepted by the Contractor's QA Manager shall be rejected according to the requirements of the QPM.

In Subsection 618.06 (b) add the following:

(1) The depth of the top slab of box girders shall be measured after placing all concrete and while the concrete is still plastic. Probes shall be inserted within 18 inches from the end of each form void and every 5 feet longitudinally down the girder centerline to determine the top slab thickness.

The concrete cover of every steel reinforcing bar in the top mat of all girders (including Prestressed Concrete I Girders) shall be measured after concrete placement and while the concrete is still plastic. Rebar shall be located and concrete cover determined with a probe at the centerline of girder for 10 feet from each end and midspan.

Each measurement shall be recorded and documented by the Contractor in the Post Pour Inspection Records. Girders with deviations from the specified tolerances shall be evaluated by the Contractor in accordance with the requirements of Subsection 618.03.

(2) After a box girder has been removed from the forms, testing shall be performed to determine the thickness of the webs and the top and bottom slabs. Holes shall be drilled in the webs and top flange of box girders as indicated in Figure 1. The top flange, both webs and bottom flange dimensions shall be determined and recorded and documented by the Contractor in the Post Pour Inspection Records. After completion of thickness measurements, holes shall be filled as approved by the Contractor's structural design engineer. Members with deviations from the tolerances specified in Table 618-1 shall be evaluated by the Contractor in accordance with the requirements of Subsection 618.03.

Steel reinforcement cover meter tests shall be performed on box girders after removal from the casting bed. The test pattern shall be as indicated in Figure 1. Concrete cover meter tests shall be performed on all Concrete I Girders at the girder centerline, both sides of the web and bottom flange, centerline of the exterior edge of each flange and centerline of each sloping surface adjacent to the webs for 10 feet from both ends and at midspan. The concrete cover for each reinforcing bar shall be recorded and documented by the Contractor in the Post Pour Inspection Report. Members showing any test result deviating from the specified minimum cover to the outside of the reinforcing steel or strand shall be evaluated by the Contractor in accordance with the requirements of subsection 618.03.

(3) Soundness of the bottom flange shall be inspected by sounding. The surface shall be struck with a hammer to determine the possibility of entrapped air voids in the bottom flange. The longitudinal centerline of the bottom flange shall be tested once every two linear feet. Areas that indicate possible air voids shall be recorded and submitted to the Contractor's QA Manager within one Working Day. The results of the sounding tests shall be recorded and documented by the Contractor in the Post Pour Inspection Reports. The extent of air voids shall be determined. Members with any void greater than twenty-five square inches shall be rejected. Voids of twenty-five square inches or less shall be repaired as approved by the Contractor's structural design engineer.

Delete Subsections 618.13 and 618.14(b).

In Subsection 618.14 (c) replace the first paragraph with the following:

The Contractor shall handle the product in such a manner as to prevent cracking or damage. Cracked or damaged products shall be replaced at the Contractor's expense. See Construction Figure 1.