

**COLORADO DEPARTMENT OF TRANSPORTATION**  
**SPECIAL PROVISIONS**  
**I-25: BRIDGES OVER SANTA FE**

The 2005 Standard Specifications for Road and Bridge Construction controls construction of this project. The following special provisions supplement or modify the Standard Specifications and take precedence over the Standard Specifications and plans.

**PROJECT SPECIAL PROVISIONS**

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**COLORADO**  
**DEPARTMENT OF TRANSPORTATION**  
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## NOTICE TO BIDDERS

The proposal guaranty shall be a certified check, cashier's check, or bid bond in the amount of 5 percent of the Contractor's total bid.

Pursuant to subsections 102.04 and 102.05, it is recommended that bidders on this project review the work site and plan details with an authorized Department representative. Prospective bidders shall contact one of the following listed authorized Department representatives at least 12 hours in advance of the time they wish to go over the project.

Program Engineer	Paul Jesaitis
Office Phone:	303-757-9919
Resident Engineer	Ron Buck
Office Phone:	303-972-9112
Project Engineer	Daniel Housand
Office Phone:	303-972-9112

The above referenced individuals are the only representatives of the Department with authority to provide any information, clarification, or interpretation regarding the plans, specifications, and any other contract documents or requirements.

A mandatory pre-bid conference will be held for this project on November 19, 2010 at 9:00 a.m. in CDOT's Offices located at 1197 W. Alameda Avenue, Denver Colorado. Bids will be accepted only from pre-qualified bidders who attend the mandatory pre-bid conference. **Special notice is hereby given that pre-qualified bidders electing to provide a design and construction alternate for either or both bridges will not be allowed to also provide a base or default bid for the same bridge or bridges.**

Questions received from bidders along with CDOT responses will be posted on the CDOT web site listed below as they become available. [http://www.dot.state.co.us/Bidding/ads\\_and\\_ebs.htm](http://www.dot.state.co.us/Bidding/ads_and_ebs.htm)

If the bidder has a question or requests clarification that involves the bidder's innovative or proprietary means and methods, phasing, scheduling, or other aspects of construction of the project, the Project Engineer will direct the bidder to contact the Resident Engineer directly to address the question or clarification. The Resident Engineer will keep the bidder's innovation confidential and will not share this information with other bidders.

The Resident Engineer will determine whether questions are innovative or proprietary in nature. If the Resident Engineer determines that a question does not warrant confidentiality, the bidder may withdraw the question. If the bidder withdraws the question, the Resident Engineer will not answer the question and the question will not be documented on the CDOT web site. If the bidder does not withdraw the question, the question will be answered, and both the question and CDOT answer will be posted on the web site. If the Resident Engineer agrees that a question warrants confidentiality, the Resident Engineer will answer the question, and keep both question and answer confidential. CDOT will keep a record of both question and answer in their confidential file.

All questions shall be directed to the CDOT contacts listed above no later than 7:00 A.M. Monday of the week of bid opening. Final questions and answers will be posted no later than Tuesday morning of bid opening week.

Questions and answers shall be used for reference only and shall not be considered part of the Contract.

**CONTRACT GOAL (COMBINED)**

The Department has determined that Underutilized Disadvantaged Business Enterprises (UDBEs) will participate by contracting for a part of the work of this Contract. The contract goal for participation in this Contract by certified DBEs who have been determined to be underutilized has been established as follows:

UDBE\* **14 Percent**

The percentage will be calculated from proposals received for this project according to the following formula:

$$\text{Percentage} = 100 \times \frac{\text{**Dollar amount of work to be contracted to underutilized DBEs (UDBEs)}}{\text{Total dollar amount of the original Contract}}$$

\* All DBEs will be considered to be UDBEs.

\*\* Based on DBE contract unit prices rather than prime contract unit prices.

NOTE: Specific Good Faith Efforts required to meet the Contract Goal specified above are defined in the Standard Special Provisions. In addition, the Transportation Commission has determined an overall 12.69 percent annual goal for the participation of all DBEs.



**COMMENCEMENT AND COMPLETION OF WORK**  
**BASIC COST PLUS TIME BIDDING**

The Contractor shall commence work under the Contract between July 11 and July 23, 2011, unless such time for beginning the work is changed by the Chief Engineer in the "Notice to Proceed." The Contractor shall complete all work within the contract time specified in subsection 102.11(a), second paragraph, in accordance with the "Notice to Proceed."

Section 108 of the Standard Specifications is hereby revised for this project as follows:

Subsection 108.03 shall include the following:

The Contractor's progress schedule may be a Critical Path Method (CPM) Schedule; submittals to CDOT will be in both hard copy and electronic format.

The first sentence of the second paragraph of Subsection 108.07 shall be replaced with the following:

It is anticipated that construction operations may be necessary to take place on Saturdays and Sundays. The Contractor shall arrange such operations with the Engineer at least two weeks prior to beginning the work. The Contractor shall not carry on construction operations on holidays unless previously arranged and approved.

Salient features to be shown on the Contractor's Progress Schedule are:

- (1) Traffic Control
- (2) Mobilization
- (3) Detour(s)
- (4) Construction Surveying
- (5) Clearing and Grubbing
- (6) Dewatering
- (7) Earthwork
- (8) Erosion Control
- (9) Relocate Utilities (water and sanitary sewer)
- (10) Removal of Asphalt
- (11) Removal of Bridge (Deck, Piers, Abutments, Foundations)
- (12) Removal of Portions of Present Structure (bridge rail, rail slab and precast concrete wall panels)
- (13) Removal of Guardrail
- (14) Possible Removal of Contaminated Soil and Water
- (15) Temporary Bridge (Includes removal)
- (16) I-25 over Santa Fe Bridge (Caissons, Abutments, Piers, Precast Concrete Tub Girders, Bridge Rail)
- (17) Ramp 1 Bridge (Caissons, Abutments, Piers, Precast Concrete Tub Girders, Bridge Rail)
- (18) Mechanically Stabilized Earth Retaining Walls (With Pre-Cast Facing)
- (19) Mechanically Stabilized Earth Retaining Walls (Precast Concrete Facing and Welded-Wire Fabric Facing)
- (20) Shoring (5 areas)
- (21) Sign Structures
- (22) Lighting
- (23) Traffic Signals
- (24) Water Quality Ponds

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**COMMENCEMENT AND COMPLETION OF WORK**  
**BASIC COST PLUS TIME BIDDING**

- (25) Concrete Paving
- (26) Asphalt Paving
- (27) Storm Drainage
- (28) Permanent Pavement Marking
- (29) Final Signing
- (30) Soil Conditioning, Seeding, Mulching and Cleanup

### **ON THE JOB TRAINING CONTRACT GOAL**

The Department has determined that On the Job Training shall be provided to trainees with the goal of developing full journey workers in the types of trade or classification involved. The contract goal for On the Job Trainees working in an approved training plan in this Contract has been established as follows:

Minimum number of total On the Job Training required: **6,500** hours

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**REVISION OF SECTIONS 101, 102, AND 108  
BASIC COST PLUS TIME BIDDING**

Sections 101, 102, and 108 of the Standard Specifications are hereby revised for this project as follows:

Delete subsection 101.21 and replace with the following:

**101.21 Contract Time.** The maximum number of calendar days allowed for completion of the Contract specified in subsection 102.11(a), second paragraph.

Add subsection 102.11 as follows:

**102.11 Cost Plus Time Bidding.** A special bidding procedure will be used to determine the successful bidder for this project. This procedure takes into account the price offerings from the bidder and the time the bidder intends to take to complete the work.

The work will be considered completed when it conforms to the Contract and has been accepted in accordance with subsection 105.20(b).

- (a) *Preparation of Proposal.* The bidder shall establish the number of calendar days that will be required to complete the work. The calendar day number shall be included in the bid proposal. This calendar day number multiplied by the daily cost shall be added to the total amount bid for the work items. The sum of these two amounts will be used to determine the lowest successful bidder according to the following formula:

$$A + B \bullet (\text{the daily cost}) = \text{Contractor's bid for evaluation of the lowest successful bidder}$$

Where:

A = Contractor's total bid for the work items

B = Number of calendar days required to complete the work.

Daily cost for this project = \$ 5,000

The total number of calendar days established by the bidder to complete the work shall not exceed **1208** calendar days. Bids showing time for completion in excess of this amount will be considered non-responsive.

The above formula will be used solely for the purpose of determining the lowest successful bidder and will have no effect on the actual total bid cost for completing the work.

- (b) *Early Completion of the Work Incentive.* If the Contractor completes the work in less than the total number of days bid, an incentive will be paid to the Contractor. This incentive (I) will equal the number of calendar days bid (B) minus the actual number of calendar days required to complete the work (C) multiplied by the daily cost.

$$I = (B - C) \bullet (\text{the daily cost})$$

The maximum incentive is limited to **2 percent** of the Contractor's total bid for the work items (**0.02 • A**).

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**REVISION OF SECTIONS 101, 102, AND 108  
BASIC COST PLUS TIME BIDDING**

- (c) *Late Completion of the Work Disincentive.* If the number of calendar days required to complete the work is in excess of the total number of calendar days bid, a disincentive will be deducted from payments made to the Contractor. This disincentive (D) will equal the actual number of calendar days required to complete the work (C) minus the number of calendar days bid (B) multiplied by the daily cost.

$$D = (C - B) \bullet (\text{the daily cost})$$

Subsection 108.08, first paragraph, shall include the following:

These liquidated damages will be assessed in addition to disincentives for failure to complete the work in the time bid by the Contractor in accordance with subsection 102.11(c).

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**REVISION OF SECTION 102  
PROJECT PLANS AND OTHER DATA**

Section 102 of the Standard Specifications is hereby revised for this project as follows:

Subsection 102.05 shall include the following:

After the proposals have been opened, the low responsible bidder may obtain from CDOT's Printing and Visual Communications Center, 4201 East Arkansas Avenue, Denver, Colorado 80222, at no cost: 15 sets of plans and special provisions; and if available for the project, one set of full-size cross sections, one set of full-size major structure plan sheets, and one set of computer output data. If the low bidder has not picked up the plans and other available data by 4:30 p.m. on the second Friday after bid opening, they will be sent to the Resident Engineer in charge of the project. Additional sets of plans and other available data may be purchased on a cash sale basis from CDOT's Visual Communication Center at current reproduction prices. Subcontractors and suppliers may obtain plans and other data from the successful bidder or they may purchase copies on a cash sale basis from the Visual Communication Center at current reproduction prices.

Copies of the following information will be available for Prime Contractors at the mandatory pre-bid conference and at [www.coloradodot.info/projects/I25SantaFe](http://www.coloradodot.info/projects/I25SantaFe):

- (1) Survey information.
- (2) As-Constructed Bridge Plans for Structures F-16-DT and F-16-DW.
- (3) Cross Sections
- (4) Earthwork Calculations
- (5) Preliminary Geotechnical Study, I-25 Santa Fe – Alameda Interchange prepared by Ground Engineering, dated March 17, 2008.
- (6) Subsurface Exploration and Geotechnical Recommendations prepared by Ground Engineering, dated July 3, 2009.
- (7) Limited Phase I Environmental Subsurface Investigation, prepared by Ground Engineering, dated March 9, 2009.
- (8) Limited Phase I Environmental Subsurface Investigation, prepared by Ground Engineering, dated July 15, 2009.
- (9) Limited Phase I Environmental Subsurface Investigation, prepared by Ground Engineering, dated October 2010.
- (10) Modified Phase 1 Environmental Site Assessment, prepared by Felsburg Holt & Ullevig, dated April 2005.
- (11) City and County of Denver Construction Activities Stormwater Discharge Permit from the City and County of Denver for land disturbances equal or greater to one (1) acres.
- (12) **Materials Management Recommendations Report, prepared by Felsburg Holt & Ullevig, dated November 2010.**
- (13) **O-Cell Load Test Memorandum, prepared by Ground Engineering, dated November 3, 2010.**

**REVISION OF SECTION 104**  
**LANE RENTAL FEE**

Section 104 of the Standard Specifications is hereby revised for this project as follows:

Subsection 104.04 shall include the following:

- (e) *Lane Rental Fee.* The Contractor shall pay lane rental fees for lane closures on I-25 that run over the allowed closure times listed in the Traffic Control Plan – General Project Special Provision.
- This fee will be assessed for each hour, or portion thereof, that lane closures are in place on I-25 outside of closure times allowed in the Traffic Control Plan.
  - The Engineer will not charge fees for delays due to conditions beyond the control and fault of the Contractor, or when the Engineer suspends the work for periods of unsuitable weather or extenuating circumstances in accordance with Subsection 105.01.

The lane rental fee will be deducted from any monies due the Contractor for work performed. The deduction will be based on the applicable rate for any and all closures, whether work is performed or not. This deduction will be reflected in each progress payment. This deduction is not a penalty, but is a rental fee based upon road user costs to occupy lanes on I-25.

The lane rental fee for closures on I-25 shall be \$5,000 per hour per lane.

**REVISION OF SECTION 105  
CONTROL OF WORK**

Section 105 of the Standard Specifications is hereby revised for this project as follows:

Subsection 105.02 shall include the following:

Table 105-1 shall include:

<b>Section No.</b>	<b>Description</b>	<b>Type</b>	<b>Contractor Colorado PE Seal Required</b>
206	Shoring	Working Drawings	Yes
504	*MSE Walls (Default Design) Wire Mesh Facing	Shop Drawings	Yes
504	*MSE Walls (Default Design) Precast Concrete Panel Facing	Shop Drawings	Yes
508	Provide Temporary Support	Working Drawings	Yes
518	Expansion Devices: 0-4 Inch	Shop Drawings	No
613	Light Standards (Mid Mast)	Working Drawings	Yes

\* Design calculations are required as part of the Shop Drawing submittal.

Subsection 105.11 shall include the following:

The Contractor shall coordinate and cooperate fully with the contractor constructing the project immediately north of this project at I-25 and Alameda and for the City and County of Denver Project located at I-25 and Broadway (expected to start construction in 2011). The Contractor shall coordinate construction activities, detours, traffic control and lane closures so as to not adversely impact that contractor’s operations or the traveling public.



**REVISION OF SECTION 106  
CONFORMITY TO THE CONTRACT OF HOT MIX ASPHALT**

Section 106 of the Standard Special Provisions is hereby revised for this project as follows:

Subsection 106.05 shall include the following:

For this project, Contractor process control testing of hot mix asphalt is mandatory.

**REVISION OF SECTION 107**  
**PROTECTION OF EXISTING VEGETATION**

Section 107 of the Standard Specifications is hereby revised for this project as follows:

Subsection 107.12 shall include the following:

The Contractor shall save all existing vegetation (including trees, shrubs, ground covers, grasses, wetlands & riparian) in this area, except for that vegetation, which must be removed to accommodate construction of the project, per the plans. Specific areas of vegetation to be protected shall be as directed by the Engineer and shall be protected by using orange construction fencing, wire fencing with metal posts or silt fence. Fencing for trees shall be installed at the drip line of the tree or as approved by the Engineer. Equipment shall not be installed or stockpile material within 15 feet of existing trees to remain.

The Contractor shall perform all the work in such a manner that the least environmental damage will result. All questionable areas or items shall be brought to the attention of the Engineer for approval prior to removal or any damaging activity.

The Contractor shall promptly report any vegetation damaged or scarred during construction to the Engineer for assessment of damages. Damaged or destroyed fenced vegetation, shall be replaced at the expense of the Contractor. Vegetation of replaceable size shall be replaced at the Contractor's expense. When trees, shrubs beyond replaceable size or wetlands have been damaged or destroyed, the Contractor shall be liable for the appraised value based upon the official current publications. For trees and shrubs use the International Society of Arboriculture, Guide for Plant Appraisals. The Contractor shall pay any fines or jail time should a wetland be damaged, at no cost to the project. The value of disturbed vegetation shall be calculated according to the following formula:

$$\text{(Vegetation size) x (Species) x (Location) x (Condition) x (Arborist or Wetland Specialist) = Vegetation value}$$

A consulting Arborist retained by CDOT will determine the value of the trees and shrubs. A consulting Wetland Specialist shall determine the value of the wetland or wetland species. This value will be deducted from any money due to the Contractor.

The determination as to whether a plant is of replacement size or beyond will be made by CDOT's Landscape Architect or Wetland Specialist.

If the fence is knocked down or destroyed by the Contractor, the Engineer will suspend the work, wholly or in part, until the fence is repaired to the Engineer's satisfaction at the Contractor's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

Protective fencing will not be measured or paid for separately but included in the work.

**REVISION OF SECTION 107**  
**ARCHAEOLOGICAL/PALEONTOLOGICAL**

Section 107 of the Standard Specifications is hereby revised for this project as follows:

Subsection 107.23 shall include the following:

There are areas of paleontological concern within the limits of this project, within which project excavations could uncover fossils. CDOT will furnish a paleontologist to monitor project excavations at the following locations:

- (a) Caisson drilling for Structure F-16-XS
- (b) Caisson drilling for Structure F-16-XR

Steve Wallace, CDOT paleontologist, shall be notified a minimum of two (2) weeks prior to any excavations in the above listed locations. The paleontologist can be contacted at (303) 757-9632 (office) or (303) 562-4201 (cell).

Construction monitoring will likely be intermittent, with actual locations and duration of monitoring determined on site by the CDOT paleontologist as construction progresses.

The staff paleontologist shall be invited to the preconstruction conference for this project.

Any work by the Contractor associated with coordinating with CDOT's paleontologist will not be paid for separately but included in the work.

**REVISION OF SECTION 107  
PERFORMANCE OF SAFETY CRITICAL WORK**

Section 107 of the Standard Specifications is hereby revised as follows:

Add subsection 107.061 immediately following subsection 107.06 as follows:

**107.061 Performance of Safety Critical Work.** The following work elements are considered safety critical work for this project:

- (1) Overhead girder erection.
- (2) Overhead structure construction.
- (3) Removal of bridge structure.
- (4) Removal of temporary bridge.
- (5) Temporary works: temporary bridge, falsework, shoring that exceeds 5 feet in height.
- (6) Work requiring the use of cranes or other lifting equipment
- (7) Excavation and embankment adjacent to the roadway.
- (8) Work operations such as pile driving and jack hammering which may create vibration and cause debris to fall into traffic.

The Contractor shall submit, for record purposes only, an initial detailed construction plan that addresses safe construction of each of the safety critical elements. When the specifications already require an erection plan or a bridge removal plan, it shall be included as a part of this plan. The detailed construction plan shall be submitted two weeks prior to the safety critical element conference described below. The construction plan shall be stamped "Approved for Construction" and signed by the Contractor. The construction plan will not be approved by the Engineer.

The Construction Plan shall include the following:

- (1) Safety Critical Element for which the plan is being prepared and submitted.
- (2) Contractor or subcontractor responsible for the plan preparation and the work.
- (3) Schedule, procedures, equipment, and sequence of operations, that comply with the working hour limitations.
- (4) Temporary works required: falsework, bracing, shoring, etc.
- (5) Additional actions that will be taken to ensure that the work will be performed safely.
- (6) Names and qualifications of workers who will be in responsible charge of the work:
  - A. Years of experience performing similar work.
  - B. Training taken in performing similar work.
  - C. Certifications earned in performing similar work.
- (7) Names and qualifications of workers operating cranes or other lifting equipment:
  - A. Years of experience performing similar work.
  - B. Training taken in performing similar work.
  - C. Certifications earned in performing similar work.
- (8) The construction plan shall address how the Contractor will handle contingencies such as:
  - A. Unplanned events (storms, traffic accidents, etc.).
  - B. Structural elements that don't fit or lineup.
  - C. Work that cannot be completed in time for the roadway to be reopened to traffic.

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**REVISION OF SECTION 107  
PERFORMANCE OF SAFETY CRITICAL WORK**

- D. Replacement of workers who don't perform the work safely.
  - E. Equipment failure.
  - F. Other potential difficulties inherent in the type of work being performed.
- (9) Name and qualifications of Contractor's person designated to determine and notify the Engineer in writing when it is safe to open a route to traffic after it has been closed for safety critical work.
- (10) Erection plan or bridge removal plan when submitted as required elsewhere by the specifications. Plan requirements that overlap with above requirements may be submitted only once.

A safety critical element conference shall be held two weeks prior to beginning construction on each safety critical element. The Engineer, the Contractor, the safety critical element subcontractors, and the Contractor's Engineer shall attend the conference. Required pre-erection conferences or bridge removal conferences may be included as a part of this conference.

After the safety critical element conference, and prior to beginning work on the safety critical element, the Contractor shall submit a final construction plan to the Engineer for record purposes only. The Contractor's Engineer shall sign and seal temporary works related to construction plans for safety critical elements. The final construction plan shall be stamped "Approved for Construction" and signed by the Contractor.

The Contractor shall perform safety critical work only when the Engineer is on the project site. The Contractor's Engineer shall be on site to inspect and provide written approval of safety critical work for which he provided stamped construction details. Unless otherwise directed or approved, the Contractor's Engineer need not be on site during the actual performance of safety critical work, but shall be present to conduct inspection for written approval of the safety critical work.

When ordered by the Engineer, the Contractor shall immediately stop safety critical work that is being performed in an unsafe manner or will result in an unsafe situation for the public. Prior to stopping work, the Contractor shall make the situation safe for work stoppage. The Contractor shall submit an acceptable plan to correct the unsafe process before the Engineer will authorize resumption of the work.

When ordered by the Engineer, the Contractor shall remove workers from the project that are performing the safety critical work in a manner that creates an unsafe situation for the public in accordance with subsection 108.05.

Should an unplanned event occur or the safety critical operation deviate from the submitted plan, the Contractor shall immediately cease operations on the safety critical element, except for performing any work necessary to ensure worksite safety, and provide proper protection of the work and the public. If the Contractor intends to modify the submitted plan, he shall submit a revised plan to the Engineer prior to resuming operations.

All costs associated with the preparation and implementation of each safety critical element construction plan will not be measured and paid for separately, but shall be included in the work.

Nothing in the section shall be construed to relieve the Contractor from ultimate liability for unsafe or negligent acts or to be a waiver of the Colorado Governmental Immunity Act on behalf of the Department.

**REVISION OF SECTION 201  
CLEARING AND GRUBBING**

Section 201 of the Standard Specifications is hereby revised for this project as follows:

In Subsection 201.02 delete the second paragraph and replace with the following:

Clearing and grubbing shall be within the toe limits of the project, as identified in the plans. All other areas of clearing and grubbing shall be as directed by the Engineer.

In Subsection 201.02 delete the sixth paragraph and replace with the following:

No material or debris shall be disposed of within the project limits; and, shall be legally disposed of off-site or preferably to a recycling center. The Contractor shall make all arrangements to obtain written permission from property owners for disposal locations outside the limits of the project. Copies of this written agreement shall be furnished to the Engineer before the disposal area is used.

The Contractor is advised that several species of noxious weeds were identified within the project area. Noxious weed areas are identified in the Environmental Plans and referenced in the Revision of Section 217 Herbicide Treatments.

Any equipment used in a noxious weed area shall be thoroughly cleaned prior to moving to another site or leaving the project. Wash water shall be contained in a bermed contained site and shall not be allowed to enter into a storm drain. Failure to do so will be deemed a violation of the Management Plan.

## **REVISION OF SECTION 202 REMOVAL AND TRIMMING OF TREES**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

### **DESCRIPTION**

Subsection 202.01 shall include the following:

This work includes the removal and disposal & trimming of trees 4 inches or greater in diameter, as measured 24 inches above the existing ground as shown on the plan. This work also includes the removal and the trimming and the disposal of the waste of the trees as shown on the plans and directed by the Engineer. This work includes the preservation from injury or defacement of all vegetation and objects designated to remain.

The Engineer will establish environmental limits. All trees, shrubs, plants, grasses, and other vegetative materials shall remain, except as designated by the Engineer. If it appears that the completion of construction may cause damage to the branches of any tree, the Contractor shall prune trees to facilitate construction.

### **CONSTRUCTION REQUIREMENTS**

Subsection 202.02 shall include the following:

Prior to beginning any wall, bridge or roadway construction, removal, trimming, and pruning of encroaching vegetation, the Contractor shall be responsible to schedule and participate in a walk-through of the site with the Contractor, the Engineer and the CDOT Landscape Architect to mark/tag trees, to be removed and or trimmed. Trees to be transplanted and vegetation to be protected will also be marked during this walk through.

The Contractor shall submit for approval, a proposal including methods, materials, and construction pruning and schedule, to the Engineer.

After all directed clearing, trimming, and pruning is completed and accepted, no additional clearing, trimming, cutting, or pruning will be allowed unless approved, in writing, by the Engineer.

All trimming, pruning and removal work is to be accomplished using the American National Standard Institute standards (ANSI a 300-1995 section 5.3.3.2). This work shall be done by a Contractor or subcontractor who is a qualified tree surgeon and who is a member of the National Arborist Association. The firm's or individual's name and qualifications shall be submitted at the pre-construction conference for the Engineer's approval. A list of references and other clients shall be included with the qualifications statement. The Contractor shall provide a written description of work methods and time schedules to be approved in writing by the Engineer prior to work commencing.

Access for the removal or pruning of trees will be extremely limited. The Contractor shall obtain any local permits necessary for pruning or removal of all trees not in the right-of-way. Trees shall be felled at the risk of the Contractor. Strict limits of disturbance are defined in the plans and shall be adhered to. If damage or destruction occurs outside of the pre-established limits, the provisions of "Revision of Section 107-Protection of Existing Vegetation" will be enforced.

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**REVISION OF SECTION 202  
REMOVAL AND TRIMMING OF TREES**

Where construction brings about a need to sever roots, roots shall be pruned. If tree roots larger than two (2) inches in diameter of trees scheduled only for trimming are encountered with digging or trenching, they should be tunneled. The Contractor shall physically inspect and hand excavate around root zones to determine damage and health of tree. The Contractor shall not tear the roots out. Removal of two (2) inches or larger diameter roots encountered during construction will not be allowed. If damage or destruction occurs on trees scheduled only for trimming, the provisions of "Revision of Section 107-Protection of Existing Vegetation" will be enforced.

Branches on trees or shrubs shall be removed as directed by the Engineer. All trimming shall be done by skilled workmen. All work shall be done according to the following requirements:

1. Trimming and pruning shall be done with proper, sharp, clean tools in such a manner as to preserve the natural character of the tree.
2. All final cuts shall leave no projections on or off the branch and shall not be cut so close as to eliminate the branch collar.
3. To avoid bark stripping, all branches 2 inches in diameter and larger shall be cut using the 3-cut method. These branches shall be lowered to the ground by proper ropes.
4. Tools used on trees known or found to be diseased shall be disinfected with alcohol before they are used on other trees.
5. Branches which are weak or dead shall be removed. Structural weaknesses, decayed trunk or branches, or split crotches shall be reported to the Engineer.
6. When trimming, cutting back or topping trees, the Contractor shall use the drop-crotch method and avoid trimming or cutting back to small suckers. Smaller limbs and twigs shall be removed in such a manner so as to leave the foliage pattern evenly distributed.
7. When reducing size (cut back or topping) not more than one third of the total area shall be reduced at a single operation.
8. Climbing spikes will not be allowed when a tree is not scheduled for removal.
9. Remove manmade structures including wires and cables from existing trees.
10. Make smooth cuts on any severed tree roots greater than 2 inches diameter. Do not rip or tear, by excavation equipment, roots of trees to remain.
11. Fertilizers, insect sprays, or other chemicals shall not be applied before or during root or branch pruning processes.
12. Time limits for tree trimming shall be as stated in Revision of Section 240 Protection of Migratory Birds.



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**REVISION OF SECTION 202  
REMOVAL AND TRIMMING OF TREES**

All brush, branches, limbs, and foliage smaller than 3 inches in diameter shall be chipped into mulch and removed/hailed away from the site or stockpiled at a designated site. The trunks and limbs 3 inches and larger shall be cut into less than 6 foot lengths and hauled away or stockpiled at a designated site. Stumps shall be left no higher than 1 foot above the ground surface and shall not be removed when within the areas to be excavated. In lawn areas, stumps shall be left at a depth of 12 inches below the proposed finished grade surface. In paved areas, stumps shall be left at a depth of 36 inches below finish grade. Tree stumps designated on the plans for removal, shall be cut so that they are 1 foot below the ground surface and the majority of the stump removed. When trees being cut off are outside the excavation limits, the stumps shall be removed by grinding to 1 foot below the surface cut so that no more than 3 inches remains above the ground surface. Stump removal areas shall be filled with existing soil. Chemicals which will harm future landscapes, above stumps, may not be applied to aid in stump removal. Removals or mulch shall become the property of the Contractor.

**METHOD OF MEASUREMENT**

Subsection 202.11 shall include the following:

Removal of trees will be measured by the actual number of trees 4 inches greater in diameter, as measured 24 inches above the existing ground, removed and disposed of. Removal of trees smaller than 4 inches in diameter shall be included under the clearing and grubbing item.

**BASIS OF PAYMENT**

Subsection 202.12 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal of Tree	Each
Tree Trimming	Each

Chipping and hauling chipping, stockpiling mulch, and hauling and stockpiling trunks and limbs will not be paid for separately but shall be included in the work. Removal of trees less than 4 inches in diameter (at DBH) will not be paid for separately but shall be paid for as clearing and grubbing.

All clearing and grubbing directed by the Engineer will be paid for as lump sum under the clearing and grubbing item.

**REVISION OF SECTION 202  
REMOVAL OF PORTIONS OF PRESENT STRUCTURE**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work includes removal of a portion of existing wall, bridge rail and rail slab. Removal may include, but not be limited to removal of concrete type 7 bridge rail, reinforced concrete rail slab, and portions of the concrete panel facing wall along existing structure Wall-F-16-BL. The existing concrete panel faced MSE wall is located south of Stor-All Storage, and is connected to the west end of the Broadway Viaduct. Removals are required for construction of the proposed wall, which will be built in close proximity.

Subsection 202.02 shall include the following:

Removal operations shall be conducted in a manner such that there is minimal interference with vehicular traffic on I-25 or traffic adjacent to or below the structure.

Subsection 202.11 shall include the following:

The completed and accepted work for the Removal of Portions of Present Structure will not be measured, but will be paid for on a lump sum basis.

Subsection 202.12 shall include the following:

Payment will be made under:

<b>Pay Item</b>	<b>Unit</b>
Removal of Portions of Present Structure	Lump Sum

Payment for Removal of Portions of Present Structure will be full compensation for all labor and materials required to complete the work; and hauling and disposal of removed materials outside of CDOT ROW.

**REVISION OF SECTION 202**  
**REMOVAL OF ASPHALT MAT**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work includes removal and disposal of existing asphalt mat within the project limits as shown on the plans or at locations directed by the Engineer.

In subsection 202.02 delete the seventh paragraph and replace with the following:

The existing asphalt mat which varies in thickness from 6 to 19 inches shall be removed in a manner that minimizes contamination of the removed mat with underlying material. The removed mat shall become the property of the Contractor and shall be either disposed of outside the project site, or used in one or more of the following ways:

1. Used in embankment construction in accordance with subsection 203.06.
2. Placed in bottom of fills as approved by the Engineer.
3. Placed in the subgrade soft spots as directed by the Engineer.

The removed mat shall not be utilized in the backfilling of mechanically stabilized earth retaining walls.

Subsection 202.11 shall include the following:

The removal of the existing asphalt mat will be measured by the square yard of mat removed to the required depth and accepted.

Subsection 202.12 shall include the following:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal of Asphalt Mat	Square Yard

Unless otherwise specified in the Contract, the disposal of the asphalt mat or its use in other locations on the project will not be measured and paid for separately, but shall be included in the work.

**REVISION OF SECTION 202  
REMOVAL OF ASPHALT MAT (PLANING)**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work includes the removal and disposal of existing asphalt mat within the project limits as shown on the plans or at locations directed by the Engineer.

Subsection 202.09 shall include the following:

Irregularities and distresses on the milled or unfinished surface, such as, but not limited to, delamination, raveling, and potholes that are identified by the Engineer shall be repaired as soon as possible. All milled or unfinished surfaces shall be covered with new asphalt within 3 calendar days.

The roadway shall be left in a safe and usable condition at the end of each work day. The Contractor shall take appropriate measures to ensure that the surface does not trap or hold water. All required pavement markings removed shall be restored before the roadway is opened to traffic.

Subsection 202.11 shall include the following:

The removal of the existing asphalt mat will be measured by the area, in square yards, completed to the required depth and accepted.

Subsection 202.12 shall include the following:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal of Asphalt Mat (Planing)	Square Yard

**REVISION OF SECTION 202**  
**REMOVAL OF BRIDGE**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work consists of removal of the existing bridges F-16-DT and F-16-DW, northbound and southbound I-25 over Santa Fe. Bridge removal shall consist of the complete removal of all superstructure and substructure elements unless otherwise shown on the plans.

Subsection 202.02 shall include the following:

- (a) *Safety.* The removal of the existing bridge shall be performed in a safe manner.
- (b) *Permits.* The Contractor shall obtain and follow a structure demolition permit from the Colorado Department of Public Health and Environment (CDPHE). The Contractor must obtain the permit at least ten business days prior to starting bridge demolition. The Contractor is responsible for all costs associated with the application for and maintenance of this permit.
- (c) *Bridge Removal Plan.* The Contractor shall submit a bridge removal plan to the Engineer, for record purposes only, at least 20 working days prior to the proposed start of removal operations. This Plan shall detail procedures, sequences, and all features required to perform the removal in a safe and controlled manner. The Bridge Removal Plan shall be stamped "Approved for Construction" and signed by the Contractor. The Bridge Removal Plan will not be approved by the Engineer.

The Bridge Removal Plan shall provide complete details of the bridge removal process, including:

- (1) The removal sequence, including staging of removal operations. Sequence of operation shall include a detailed schedule that complies with the working hour limitations.
- (2) Method and details for maintaining the stability of the existing structure during all stages of the removal, including partial removal. The Contractor shall design and provide all necessary temporary structures or supplemental structural members needed to maintain stability of the existing structures during removals or partial removals.
- (3) Equipment descriptions including size, number, type, capacity, and location of equipment during removal operations.
- (4) Shoring that exceeds 5 feet in height, all falsework and bracing.
- (5) Detailed methods for mitigation of fugitive dust resulting from the demolition.
- (6) Details for dismantling, removing, loading, and hauling steel elements.

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**REVISION OF SECTION 202  
REMOVAL OF BRIDGE**

- (7) Method of complying with Section 250.04 Heavy Metal Based Paint Management requirements for handling materials with lead paint.
- (8) Methods of Handling Traffic, including bicycles and pedestrians, in a safe and controlled manner.
- (9) Copy of the above mentioned CDPHE permit.

The Contractor's Engineer shall sign and seal (1) and (3) listed above in the final Bridge Removal Plan. Calculations shall be adequate to demonstrate the stability of the structure remaining after the end of each stage of removal, before traffic is allowed to resume in its normal configuration.

The final Bridge Removal Plan shall be stamped "Approved for Construction" and signed by the Contractor. The Contractor shall submit a final Bridge Removal Plan to the Engineer prior to bridge removal for record purposes only. The Contractor shall not begin the removal process without the Engineer's written authorization.

Submittal of the final Bridge Removal Plan to the Engineer, and field inspection performed by the Engineer, will in no way relieve the Contractor and the Contractor's Engineer of full responsibility for the removal plan and procedures.

- (d) *Pre-Removal Conference.* A Pre-Removal Conference shall be held at least seven days prior to the beginning of removal of the bridge. The Engineer, the Contractor, the removal subcontractor, the Contractor's Engineer, and the Traffic Control Supervisor (TCS) shall attend the Pre-Removal Conference. The Bridge Removal Plan shall be finalized at this Conference.
- (e) *Contractor's Engineer Responsibilities.* Unless otherwise directed, the Contractor's Engineer need not be on site when bridge removal operations are in progress, but shall be present to conduct daily inspection for written approval of the work. The Contractor's Engineer shall inspect and provide written approval of each phase of the removal prior to allowing vehicles or pedestrians on, below, or adjacent to the structure. The Contractor's Engineer shall certify in writing that the falsework, bracing, and shoring conform to the details of the final Bridge Removal Plan. A copy of the certification shall be submitted to the Engineer.

The Contractor's Engineer shall inspect the bridge removal site and report in writing on a daily basis the progress of the operation and the status of the remaining structure. A copy of this daily report shall be available at the site of the work at all times, and a copy of the previous day's inspection report shall be submitted to the Engineer daily.

- (f) *Traffic Control.* The Contractor shall have all necessary workers, materials, and equipment at the site prior to closing any lanes to traffic to accommodate bridge removal operations. While the lanes are closed to public traffic, work shall be pursued promptly and without interruption until the roadway is reopened to traffic.

All required traffic control devices, night time flagging stations, barricades and VMS signs shall be in place, with detours in operation, prior to the beginning of removal operations each day. Night work shall conform to the requirements of the MUTCD, Parts 1, 5, and 6.

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**REVISION OF SECTION 202  
REMOVAL OF BRIDGE**

Prior to reopening the roadway to public traffic, all debris, protective pads, materials, and devices shall be removed and the roadways swept clean.

- (g) *Contaminated Materials.* Hazardous and contaminated materials encountered as part of this work shall be handled in accordance with Section 250 Environmental, Health and Safety Management.

The Contractor shall take all steps to avoid contaminating state waters, in accordance with subsection 107.25 Water Quality Control.

- (h) *Unplanned Events.* Should an unplanned event occur or the bridge removal operation deviate from the submitted bridge removal plan, the bridge removal operations shall immediately cease after performing any work necessary to ensure worksite safety. The Contractor shall submit to the Engineer, the procedure or operation proposed by the Contractor's Engineer to correct or remedy the occurrence of this unplanned event or to revise the final Bridge Removal Plan.

The Contractor shall submit his Engineer's report in writing, within 24 hours of the event, summarizing the details of the event and the procedure for correction.

- (i) *Suspension of Bridge Demolition.* Bridge removal may be suspended by the Engineer for the following reasons:
- (1) Final Bridge Removal Plan has not been submitted, or written authorization has not been provided by the Engineer to begin the removal.
  - (2) The Contractor is not proceeding in accordance with the final Bridge Removal Plan, procedures, or sequence.
  - (3) The Contractor's Engineer is not on site to conduct inspection for the written approval of the work.
  - (4) Safety precautions are deemed to be inadequate.
  - (5) Existing neighboring facilities are damaged as a result of bridge removal.

Suspension of bridge removal operations shall in no way relieve the Contractor of his responsibility under the terms of the Contract. Bridge removal operations shall not resume until modifications have been made to correct the conditions that resulted in the suspension, as approved in writing by the Engineer.

- (j) *Emergency Service Agency Notification.* The Contractor shall notify all emergency response agencies of the proposed removal work and any detours 24 hours in advance of work. This shall include the Colorado State Patrol, local Police Department, local Fire Department, all local ambulance services, and the Sheriff's Department, as appropriate.
- (k) *Use of Explosives.* Explosives shall not be used for removal work without the written approval of the Engineer.

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**REVISION OF SECTION 202  
REMOVAL OF BRIDGE**

- (l) *Extent of Removal.* Removal shall include the superstructure, the substructure, which includes the piers, the abutments and wingwalls, the bridge rail, and any approach slabs and sleeper slabs.

Removal of the substructure shall be taken down to at least two feet below the natural existing or future ground surface unless otherwise approved by the Engineer. Holes resulting from substructure removal shall be backfilled with Structure Backfill (Class 2) to the adjacent existing grades.

- (m) *Removed Materials.* Materials removed from the existing structure shall become the property of the Contractor and shall be properly disposed of offsite at the Contractor's expense, unless otherwise stated in the plans.

- (n) *Damage to Surrounding Facilities.* Existing structures, facilities, and surrounding roadways shall not be damaged by the removal operations. Damage that does occur shall be repaired immediately at the Contractor's expense.

Subsection 202.11 shall include the following:

Removal of bridge will be measured by the actual number of bridges removed and accepted.

Subsection 202.12 shall include the following:

Payment will be made under:

<b>Pay Item</b>	<b>Unit</b>
Removal of Bridge	Each

Payment for Removal of Bridge will be full compensation for all labor and materials required to complete the work, including preparation and implementation of the Bridge Removal Plan; inspection; equipment; debris handling and disposal of non-salvage materials outside of CDOT ROW.

Asbestos, lead based paint and other miscellaneous hazardous materials handling will be paid for in accordance with Section 109.04, under Force Account Environmental, Health and Safety Management.



**REVISION OF SECTION 203**  
**UNCLASSIFIED EXCAVATION**

Section 203 of the Standard Specifications is hereby revised for this project as follows:

Subsection 203.02 (a) *Unclassified Excavation* shall include the following:

Unclassified excavation will include excavation into bedrock in various locations throughout the project.

Delete Subsection 203.02 (d) *Rock Excavation*.

**REVISION OF SECTION 203**  
**EXCAVATION AND EMBANKMENT**

Section 203 of the Standard Specifications is hereby revised for this project as follows:

Subsection 203.01 shall include the following:

This work also consists of furnishing and installing clay lining (Clay Plating) on the East Alameda Water Quality Pond to the limits shown on the plans.

Subsection 203.03 shall include the following:

Material for Clay Plating shall meet the requirements noted on the plans.

Subsection 203.06 shall include the following:

Construction of Clay Plating shall meet the requirements noted on the plans.

In Subsection 203.07, delete the fifth paragraph and replace with the following:

The amount of water to be used in compacting soils shall be in the moisture content range of 2 percent below optimum to 2 percent above optimum as determined by AASHTO T-99 / ASTM D-698. A-4 soils which are unstable at the above moisture content shall be compacted at a lower moisture content to the specified density.

Subsection 203.14 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Clay Plating (Complete In Place)	Cubic Yard

Payment for Clay Plating (Complete in Place) shall be full compensation for all work necessary to complete the item including all work in available materials pits, borrow, hauling, placement, compaction, construction, shaping, and compaction of bases of cuts and fills.

**REVISION OF SECTION 203**  
**EMBANKMENT MATERIAL**

Section 203 of the Standard Specifications is hereby revised for this project as follows:

In subsection 203.03(a), first paragraph, after the second sentence add the following:

Embankment material shall have a resilient modulus value of at least 5000 psi when tested by the Hveem Stabilometer (R = 20).

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**REVISION OF SECTION 206**  
**SHORING**

Section 206 of the Standard Specifications is hereby revised for this project as follows:

Subsection 206.01 shall include the following:

This work consists of providing shoring for various construction activities during the course of this project.

Delete the first sentence in Subsection 206.06 in Standard Special Provision, Revision of Section 206 Shoring, and replace with the following:

Shoring will not be measured, but will be paid for on a lump sum basis for each area as follows:

- Shoring Area 1: Shoring required along SB I-25 to accommodate the proposed Santa Fe alignment
- Shoring Area 2: Shoring required for Phase 4 I-25 construction south of Santa Fe
- Shoring Area 3: Shoring required for Phase 5 I-25 construction south of Santa Fe
- Shoring Area 4: Shoring required for construction of Ramp 1 Wall 4 and Abutment 12 of Ramp 1 Bridge, adjacent to existing northbound I-25
- Shoring Area 5: Shoring required for crane placement during girder erection of the I-25 over Santa Fe Bridge girders
- Shoring Area 6: Shoring required for construction of Ramp 1 Bridge Piers
- Shoring Area 7: Shoring required for construction of drainage system outfall to the South Platte River**

**REVISION OF SECTION 206  
FILTER MATERIAL (SPECIAL)**

Section 206 of the Standard Specifications is hereby revised for this project as follows:

Subsection 206.01 shall include the following:

This work also consists of furnishing and installing filter material (special) on the East Alameda Water Quality Pond and the Ramp 4 Water Quality Pond to the limits shown on the plans.

Section 206.02 (c) shall include the following:

Filter Material (Special) is a uniform mixture of eighty-five percent course sand meeting the requirements of ASTM C-33 and fifteen percent rain garden compost mixture (by volume). The rain garden compost mixture shall consist of fifty percent Class 1 STA Registered Compost (approximate bulk density 1,000 lbs/cy) and fifty percent loosely packed shredded paper similar to a cardboard grind or Grade (4) Boxboard Cuttings (approximate bulk density 50 to 100 lbs/cy). The Filter Material (Special) shall be produced by the compost supplier to ensure the mixture is uniform.

Subsection 206.05 shall include the following:

Construction of Filter Material (Special) shall meet the requirements noted on the plans.

Section 206.06 shall include the following:

Filter Material (Special) will be measured by the cubic yard and includes both the course sand and rain garden compost mixture.

Section 206.07 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Filter Material (Special)	Cubic Yard

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**REVISION OF SECTION 206 AND 504  
PANEL FACING MSE WALLS**

Section 504 of the Standard Specification is hereby revised for this project to include the following:

**DESCRIPTION**

**This work shall consist of a Concrete Panel Facing Mechanically Stabilized Earth (MSE) Retaining Wall System constructed in accordance with these specifications and in conformity with the lines, grades, and dimensions shown on the plans. Either metallic or geosynthetic reinforcement (woven fabrics or geogrids) as specified in this specification may be used as MSE reinforcement in the reinforced structure backfill zone. Design requirements and details such as: precast concrete facing panels, construction details, and specified reinforcement length shall be as shown on the plans and as required by the specification.**

The MSE wall systems listed below are pre-approved for this project. 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: (1) responsible to ensure that the selected supplier is in conformance with all the requirements of this specification and the project plans, and (2) responsible for adapting the design and construction of the wall system to this specific project site conditions and requirements, except for the global stability and long-term foundation settlement.

<b>System Names</b>	<b>Supplier's Phone Numbers</b>
Reinforced Earth	(314) 474-6979
Foster Geotechnical	(619) 688-2400
VSL	(214) 647-0200
<b>Tensar</b>	<b>(303) 429-9511</b>

**MATERIALS**

**Shop Drawings** - Design calculations and shop drawings are required with this project and shall be submitted in accordance with subsection 105.02 of the Standard Specifications.

The Contractor shall submit to the Engineer six sets of design calculations and shop drawings, stamped by a licensed Professional Engineer in the State of Colorado, for review and approval prior to beginning MSE wall construction.

Use of a firm to prepare these drawings and design calculations shall be limited to a specialty firm regularly engaged in the design and construction of permanent MSE walls. The Contractor shall submit the name of shop drawing provider at or before the pre-construction meeting. The Engineer may reject shop drawings prepared by a non-specialty firm.

Design calculations submitted with the shop drawings shall show reference to sections, tables and charts in the Sixteenth (16<sup>th</sup>) Edition of AASHTO Standard Specifications for Highway Bridges, including all current Interim Revisions.

The shop drawings shall provide details necessary to demonstrate compliance with the requirements in the plans and these specifications, including:

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

- (a) The details of the facing panels and attachments to the soil reinforcement. The sequence of panel placement shall also be shown.
- (b) Facing panel form liner patterns and locations.
- (c) **The soil reinforcement types, Minimum Average Roll Value of the Ultimate tensile strength  $T_{ult}$  (MARV) for geosynthetic soil reinforcement or yield strength for metallic reinforcement, spacing, soil reinforcement lengths (RL), elevations, and the corresponding wall design height (DH) shall be shown on the wall layout. Soil reinforcement lengths shall be measured from the back face of the panel to the end of the reinforcements and shall not be less than any lengths or length requirements shown on the plans.**
- (d) Certifications, Calculations and Testing Reports. The Contractor shall provide the following reports, certifications, calculations and checklists as needed to accompany the shop drawing submittal. All engineering calculations, as stated in subsections (a) 6 B, (a) 7 B, (a) 10 (a) 11, (f) 5, (f) 6, (f) 7, and (f) 9 under MATERIALS shall be certified and stamped by a Professional Engineer licensed in the State of Colorado.
  1. **Certification of  $T_{ULT}$  (MARV). For geo-synthetic reinforced system only, the Contractor shall submit a certification letter from the manufacturer which provides  $T_{ult}$  (MARV) and certifies the  $T_{ult}$  (MARV) of the supplied materials have been determined in accordance with ASTM D4595 or ASTM D6637 as appropriate.**
  2. Mill report for metallic reinforcements and connectors. This includes, but is not limited to mill certifications on weldability, ultimate tensile and 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. The report shall provide data on the ultimate as well as service limit state.
  4. Report for soil to reinforcement interface pullout test. The test report shall be prepared and certified by an independent laboratory. The soil to reinforcement interface pullout test method shall conform to the requirements of ASTM D6706. 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.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

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 Engineer will approve the time of shipping, method of lifting and supporting condition during shipping as well as storage condition at the site before panel installation.
8. Calculations. Calculation of the LTDS of reinforcement shall conform to the 17<sup>th</sup> edition of the AASHTO Standard Specifications for Highway Bridges.
9. Efflorescence and Air Content Test. Panel shall be visually efflorescence free. Efflorescence control agent shall be used in concrete mix design. When fly ash is used as the efflorescence control agent, the fly ash shall be ASTM C618 Class F fly ash and shall be a minimum of 20 percent by weight of the total cementitious material content. Air Content shall be determined in accordance with AASHTO T152. Concrete shall be tested a minimum of the first three batches each day and then once per five batches for the rest of the day to assure specified air entrainment.
10. Submittal Checklist. The Contractor shall submit the Panel Faced MSE Wall Submittal Checklist, Form 1402 with the Certifications, Calculations and Testing Report submittal package included with the shop drawing submittal. The form is attached at the end of this specification.

**Test Section** - Prior to the commencement of MSE wall construction, the Contractor shall construct a wall test section using the proposed MSE wall system materials, construction techniques and equipment. The location of the test panel will be selected by the Engineer with the intent that the test section be incorporated into the work upon approval. The wall shall have a minimum length of 20 feet and a minimum design height of 5 feet. Soil reinforcement lengths shall be as required by this specification. Construction shall match where possible all the details shown on the plans for MSE walls including foundation preparation, any required leveling pad, groundwater drainage, surface drainage, and coping.

**Structure Backfill** - The structure backfill for the reinforced soil zone shall be free-draining Structure Backfill (Class 1), and shall conform to the requirements of Section 206, with the exceptions and additions noted below:

- (a) *Design Values*. The structure backfill shall: have a minimum coefficient of friction ( $\Phi$ ) of 34° when tested in direct shear, and a minimum in-place density of 125 pcf.



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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

- (b) *Gradation and Plasticity.* The structure backfill shall meet the requirements of Subsection 703.08 for Class 1 Structure Backfill.
- (c) *Soundness.* The structure backfill shall be substantially free of shale or other soft, poor durability particles. The material shall have magnesium sulfate soundness loss of less than 30% after four cycles, as determined by AASHTO T 104.
- (d) *Corrosion.* The structure backfill shall be a non-aggressive soil in terms of corrosion. The Engineer may require chemical and organic content tests if the source is questionable.
- (e) *Resistance Value.* The top two feet of structure backfill below the ABC Class 6 and Pavement shall have a minimum resistance value when tested by the Hveem Stabilometer, or equivalent resilient modulus value, of at least 45.

The Contractor shall not use pulverized concrete or asphalt for backfill.

**Foundation** - Soil materials replaced under the reinforced soil mass due to over excavation shall meet the requirements of Aggregate Base Course (Class 6) defined in Standard Specification 206.

**Groundwater Drainage** - Materials for drainage of the reinforced soil mass shall be as shown on the plans.

**Leveling Pad** - Concrete for the leveling pad shall be Concrete Class D.

**Facing Panels** - The facing panels shall be fabricated in accordance with Section 601 with the exceptions and additions noted below.

The facing panel configuration, size, dimensions and finish shall be as shown on the plans. Facing panels having a configuration, size, dimensions or finish different from that shown on the plans will not be permitted.

The facing panels shall have a minimum thickness of 5 inches plus the thickness of formliner.

Facing panels shall be designed to accommodate differential movement of 12 inches in 100 feet.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

- (a) *Concrete.* Concrete for the precast concrete facing panels shall conform to the requirements of Section 601, Concrete Class D.
- (b) *Steel Reinforcement.* Steel reinforcement 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 Bridge Design code and as required for soil reinforcement anchorage.

Steel reinforcement shall have a minimum cover of 1 ½ inches to the outside face of the wall. The coil embeds, tie strip guide, or other galvanized devices shall not contact or be attached to the facing panel reinforcement steel.

Steel reinforcement shall be epoxy coated or galvanized for any panel within ten feet horizontally from the edge of an adjacent roadway and within ten feet vertically from an adjacent roadway surface.

- (c) *Construction.* Facing panels shall be cast face down on flat level surfaces. Clear form oil or release agent shall be used throughout the casting operation. Guides shall be used to locate and support attachment devices set in the back face of the panel.

The ambient temperature shall be a minimum of 40° F and rising when casting panels. The concrete in each panel shall be placed without interruption. The concrete shall be compacted using a vibrating table, grid vibrator or vibrating screed.

Forms shall not be removed until the concrete reaches a minimum compressive strength of 1,500 psi. The units may be shipped after reaching a minimum compressive strength of 3,500 psi. At the option of the Contractor, the units may be installed after the concrete reaches a minimum compressive strength of 3,500 psi.

Facing panels shall be cured in accordance with AASHTO M 170.

- (d) *Finish.* The front face of the facing panels shall have form liner finishes, as shown on the plans. The rear of the facing panel shall have a uniform surface finish. The project requires multiple patterns for use specifically on the project. Nine (9) goose patterns are required for construction of the concrete facing. The geese patterns will be surrounded by a standard formliner pattern, "Sandblast No. 2" (as provided by Scott System or approved equal). Other panels without the geese patterns will either be standard formliner pattern "Sandblast No. 2" or "Rugged Flagstone" (as provided by Scott System, or approved equal). The master molds and the subsequent form liners for the nine (9) custom artwork patterns are to be manufactured by a supplier approved by the Engineer and the Landscape Architect. Use of a contractor to prepare these molds and formliners shall be limited to a specialty firm regularly engaged in the design and construction of master molds and formliners, with experience on projects of similar magnitude. Electronic CAD files will be provided to the contractor for fabrication of the custom artwork. Master molds shall be submitted for approval by the Engineer and the Landscape Architect at least 14 days prior to creating formliners.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

The accent will be a standard formliner pattern, "Rugged Flagstone" (as provided by Scott System, or approved equal). The form liner is to be manufactured by a supplier approved by the Engineer and the Landscape Architect.

The Contractor shall include in the cost of Precast Panel Facing the cost of purchasing all necessary master molds and sufficient form liners to meet the project schedule. The shop drawings for each wall shall identify the locations / use of each pattern. The Engineer reserves the right to review and relocate the various patterns on each wall during the shop drawing review process. Fabrication of master molds and form liners shall not proceed until the shop drawings are approved.

Formliners shall be thoroughly cleaned after each use to remove all dirt, mortar and foreign material.

All concrete facing shall be constructed within the following tolerances:

Formliner Placement: Position of formliners shall be placed within 1/2 inch of adjacent sections, to properly align the pattern along the wall.

Smooth formed (surfaces not to receive a form liner finish) and finished surfaces measured over a length of 10 feet shall not be out of plane by more than 1/4 inch.

The front face of all panels shall receive a structural concrete stain. Form release agents and curing compounds used for the facing panels shall comply with the requirements of Revision of Sections 601 and 708, Structural Concrete Stain. The color shall be as indicated on the plans.

- (e) *Tolerances.* All units shall be manufactured within the following tolerances:

Panel Dimensions: Position of panel connection devices within 1 inch, except for coil and loop embeds which shall be 1/4 inch. All other dimensions within 1/4 inch.

Panel Squares: Squareness as determined by the difference between the two diagonals shall not exceed 1/2 inch.

- (f) *Marking.* The date of manufacture, the production lot number, and the piece mark shall be clearly scribed on an unexposed face of each panel.
- (g) *Testing.* Acceptance of facing panels with respect to compressive strength will be determined based on production lots. A production lot is defined as a group of panels that will be represented by a single compressive strength sample and will consist of either 40 panels or a single day's production, whichever is less.

During the production of facing panels, the manufacturer will randomly sample the concrete in accordance with AASHTO T 141. A single compressive strength sample, consisting of a minimum of five cylinders, will be randomly selected for every production lot.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

Compression tests shall be made on standard 4 inch by 8 inch test specimens prepared in accordance with AASHTO T 23. Compressive strength testing shall be conducted in accordance with AASHTO T 22.

Air content will be performed in accordance with AASHTO T 152 or AASHTO T 196. Air content samples will be taken at the beginning of each day's production and at the same time as compressive samples are taken to ensure compliance.

The slump test will be performed in accordance with AASHTO T 119. The Slump will be determined at the beginning of each day's production and at the same time as the compressive strength samples are taken.

For every compressive strength sample a minimum of three cylinders shall be cured in accordance with AASHTO T 23 and tested at 28 days. The average compressive strength of these cylinders, when tested in accordance with AASHTO T 22, will provide a compressive strength test result, which will determine the compressive strength of the production lot.

If the Contractor wishes to remove forms or ship the panels prior to 28 days, a minimum of two additional cylinders will be cured in the same manner as the panels. The average compressive strength of these cylinders when tested in accordance with AASHTO T 22 will determine whether the forms can be removed or the panels shipped.

Acceptance of a production lot will be made if the compressive strength test result is greater than or equal to 4,500 psi. If the compressive strength test result is less than 4,500 psi, then the acceptance of the production lot will be based on its meeting the following acceptance criteria in their entirety.

Ninety percent of the compressive strength test results for the overall production shall exceed 4,650 psi. The average of any six consecutive compressive strength test results shall exceed 4,750 psi. No individual compressive strength test result shall fall below 4,000 psi.

(h) *Rejection.* Units will be rejected because of failure to meet any of the requirements specified above. In addition, any or all of the following defects shall be sufficient cause for rejection:

- Defects that indicate imperfect molding.
- Defects indicating honeycombing or open texture concrete.
- Cracked or severely chipped panels.
- Color variation on front face of panel due to excess form oil or other reasons.

**Joint Materials** - In horizontal joints between panels provide preformed cord conforming to AASHTO M 153 Type II; preformed EPDM rubber pads conforming to ASTM D 2000 for 4AA; 812 rubbers; neoprene elastomeric pads having a Durometer Hardness of 55±5; or high density polyethylene pads with a minimum density of 60 pcf in accordance with ASTM D 1505.

Provide flexible foam strips or open cell polyether foam for filler for vertical joints between panels, and in horizontal joints where pads are used.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

Provide geotextile and adhesive for sealing the back face of the joints where recommended by the wall supplier.

**Soil Reinforcement** - All reinforcing shall be carefully inspected to ensure it is true to size and free from defects that may impair its strength and durability.

- (a) *Corrosion Resistance and Durability.* **Soil reinforcement shall be either galvanized steel or geosynthetic.** The reinforcement in the soil mass shall be designed to have corrosion resistance and durability to ensure a minimum design life of 75 years. Sacrificial thickness for metallic reinforcing shall be computed for each exposed surface as follows:

Galvanization loss	= 0.6 mils/year for the first 2 years
	= 0.15 mils/year for subsequent years
Carbon steel loss	= 0.50 mils/year after zinc depletion

- (b) *Reinforcing Strips.* Reinforcing strips shall be hot rolled from bars. Their physical and mechanical properties shall conform to ASTM A-572 Grade 65 (AASHTO M-223). Galvanization shall conform to the minimum requirements of ASTM A123 (AASHTO M 111).
- (c) *Reinforcing Mesh.* Reinforcing mesh shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of ASTM A82 and shall be welded into the finished mesh fabric in accordance with ASTM A185. Galvanization shall be applied after the mesh is fabricated and conform to the minimum requirements of ASTM A123 (AASHTO M 111).
- (d) ***Geosynthetic (Extensible) Soil Reinforcement.* 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. Unless otherwise specified, LTDS shall not exceed the following K percent of its ultimate tensile strength,  $T_{ult}$  (MARV):**

$$LTDS = K * T_{ult} (MARV)$$

**(1) Geogrid reinforcement (HDPE, PET):**

<b>Tensar</b>	<b>K = 20%</b>
<b>Fortrac, Miragrid, Strata, Synteen and Raugrid</b>	<b>K = 24%</b>

**(2) All products not listed above:**

<b>All geogrid or woven geotextile products which meet AASHTO Standard Specifications for Highway Bridges, 16<sup>th</sup> Edition</b>	<b>K = 10%</b>
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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

**Connection and Alignment Devices** - All connections shall be positive structural connections subject to the same metal loss rates and allowable tension requirements as reinforcements. Adequacy and capacity of panel connections shall be demonstrated by providing test data from pullout and flexural tests on full size panels with all connections loaded simultaneously.

- (a) *Tie Strips.* The tie strips shall be shop fabricated of a hot rolled steel conforming to the minimum requirements of ASTM A570, Grade 50 or equivalent. Galvanization shall conform to ASTM A123 (AASHTO M 111).
- (b) *Coil Embeds/Loop Embeds.* Coil embeds and loop embeds shall be fabricated of cold drawn steel wire conforming to ASTM A510, UNS G-10350, or ASTM A82. Loop imbeds shall be welded in accordance with ASTM A185. Both shall be galvanized in accordance with ASTM B 633 or equivalent.  
The distribution of stress in coil and loop connections shall be shown to be below the maximum allowable tension in the reinforcement. Test data from an independent laboratory shall be supplied to document the stress distribution on representative sample connections of a full-width specimen.
- (c) *Fasteners.* Fasteners shall consist of hexagonal cap screw bolts and nuts, which are galvanized and conform to the requirements of ASTM A325 (AASHTO M 164) or equivalent.
- (d) *Connector Pins.* Connector pins and mat bars shall be fabricated from ASTM A36 steel and welded to the soil reinforcement mats as shown on the plans. Galvanization shall conform to ASTM A123 (AASHTO M 111). Connector bars shall be fabricated of cold drawn steel wire conforming to the requirements of ASTM A82 and galvanized in accordance with ASTM A123.

**Surface Drainage** - . A Geomembrane shall be installed on all walls at the top of the reinforced structure backfill zone and retained structure backfill zone to intercept surface runoff and prevent salt penetration into the backfill of the wall as shown on the plans. The Geomembrane shall meet the requirements of subsection 712.08 for geomembrane, and shall have a minimum thickness of 30 mils. It shall be spliced with a dual track field seamed joint in accordance with ASTM D4437 or ASTM D7717.

For small local coverage areas, less than 30 square feet, the membrane may be spliced using a 6 inch minimum overlap and an adhesive or a single seam portable thermal welding tool, as suggested by the membrane manufacturer and approved by the Engineer. Unless otherwise shown on the plans, the membrane shall have a minimum coverage length measured perpendicular to the wall face of at least the wall Design Height (DH) plus Soil Reinforcement Length (RL) plus 1.5 feet. The membrane shall be installed with a slope between 20:1 (minimum) and 10:1 (maximum) , as shown in the plans, from the panel facing to a drainage system located at the cut or pre-filled slope as shown on the plans.

The drainage system shall consist of a 12 inch wide Geo-Composite strip drain inserted into a slot in the Geomembrane, at 10 foot maximum spacing, that collects the water from the membrane and conveys it to a water collector system at the toe of the 1:1 slope as shown on the plans. The water collector system shall consist of a 4 inch diameter perforated collector pipe surrounded by Filter Material Class B and wrapped with Class 3 Geotextile. A 4 inch diameter non-perforated drain pipe, at 100 foot maximum spacing, shall be used to discharge the water in the water collector system out the face of the wall.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

Alternatives for the drainage system shown on the plans may be used by the Contractor. A detailed layout of this equivalent water collection system shall be provided by the Contractor and approved by the Engineer.

**DESIGN REQUIREMENTS**

The design of the MSE Wall System shall be by a Professional Engineer registered in the State of Colorado.

The wall design, including design assumptions and calculation of lateral earth loads, shall conform to the requirements of the AASHTO Standard Specifications for Highway Bridges, Seventeenth (16<sup>th</sup>) Edition, as amended by all current Interim Revisions; the requirements of the AASHTO-AGC-ARTBA Joint Committee, subcommittee on New Highway Materials, Task Force 27 Report; the Colorado Department of Transportation Bridge Design Manual; the plans and these specifications.

**Design Height** - Unless otherwise defined on the plans, the wall design height shall be measured vertically from the top of the leveling pad to the top of the concrete rail anchoring slab at the roadway flow line.

**Special Loading Conditions** - External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, sound or noise barriers, fences, slope surcharge, hydrostatic and seismic loads, shall be accounted for in the design.

- (a) *Traffic*. Traffic surcharge loads shall be applied to the wall as external loads.
- (b) *Sound Walls*. The loads from sound or noise barriers and walls shall be applied to the wall as external loads. The design loads to be used shall be as shown or noted on the plans.
- (c) *Hydrostatic*. Unless specified otherwise, when a design high water surface is shown on the plans at the face of the wall, the design stresses calculated from the elevation to the bottom of the wall shall include 3 feet minimum differential head of saturated backfill. In addition, the buoyant weight of the saturated soil shall be used in the calculation of pullout resistance.
- (d) *Anchoring / Rail Slab*. The additional load from the weight difference between the anchoring slab system and soil shall be applied as a surcharge to the wall, with the design height taken from the top of leveling pad to the top of anchoring slab.

The upper layers or rows of reinforcement shall be designed and sized to resist the horizontal live load from rail impact, and the horizontal and vertical loads from the sound or noise barriers.

The bearing pressure applied by the anchoring or rail slab on the soil below the slab shall be considered in the design of the wall. Sufficient reinforcement shall be included in the design to provide adequate bearing strength and to resist rotational and vertical displacements from the applied loads.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

**Limiting Dimensions for Soil Reinforcement**

- (a) *Length.* The soil reinforcement length shall be measured from the back face of the facing panel. Unless otherwise required on the plans the length of soil reinforcement shall be equal from top to bottom at all layers of wall.

Unless otherwise required on the plans, the soil reinforcement length shall not be less than 70% of the wall design height (DH) or 8 feet.

- (b) *Spacing.* The first (bottom) layer of soil reinforcement shall be no further than 15 inches average above the top of the leveling pad.

The last (top) layer of soil reinforcement shall be no further than 15 inches average below the top of the uppermost facing panel.

The maximum vertical spacing between layers of adjacent soil reinforcement shall not exceed 30 inches.

**Factors of Safety** - Calculations shall include analysis for the internal and external stability of the wall. The wall designer shall be responsible for the following stability calculations:

- (a) *Sliding.* (FS  $\geq$  1.5)  
(b) *Overturing.* (FS  $\geq$  2.0)  
(c) *Loss of Heel.* (Eccentricity  $\geq$  L/6)  
(d) *Bearing.* (As specified on the plans) An analysis shall be performed for each location of the wall where the foundation bearing capacity changes and/or where the change in wall height is 2 feet or greater.  
(e) *Reinforcement Pullout.* (FS  $\geq$  1.5)  
(f) *Connection Failure.* (FS  $\geq$  2.0) - The horizontal force used to design the connections may be taken as no less than 85% of the maximum calculated force, except for the lower half of the structure where it shall be 100%.  
(g) *Global Stability.* Deep seated shear failure of the MSE Wall System shall not be the responsibility of the MSE wall system designer.

**Allowable Reinforcement Stresses** - The allowable tensile stress for steel reinforcements and connections shall be  $0.55F_y$  except that for grid reinforcing, this shall be reduced to  $0.48F_y$ .  $F_y$  shall not be taken as greater than 65,000 psi.

**CONSTRUCTION REQUIREMENTS**

**Quality Assurance**

- (a) *Manufacturer's Facilities.* The Engineer shall be allowed access to the manufacturer's facilities to inspect and sample facing panels ready for delivery to the project.  
(b) *Technical Representative.* The Contractor shall arrange for a technical representative from the wall system supplier to be present at the project site at the beginning of the construction of the



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**REVISION OF SECTIONS 206 AND 504**  
**PANEL FACING MSE WALLS**

MSE walls, available by telephone as necessary during construction of the MSE walls, and as requested by the Engineer. The representative shall provide all necessary instructions and guidelines to construct the walls in accordance with these specifications and the manufacturer's product specific requirements.

**Structure Excavation** - Structure excavation shall conform to the requirements of subsection 206.03 of the Specifications and the excavation limits shown on the plans.

**Foundation Preparation** - The foundation for the structure shall be graded level for a width equal to the length of leveling pad plus 12 inches or as shown on the plans. Prior to wall construction, except where constructed on rock, the foundation shall be compacted with a smooth wheel vibratory roller.

**Groundwater Drainage** - Drainage materials shall be installed as shown on the plans.

**Storm Sewer System** - The Contractor shall coordinate the construction of the storm sewer system with the wall. The storm sewer shall be constructed concurrently with backfill and reinforcing.

**Leveling Pad** - A concrete leveling pad shall be utilized under precast concrete facing panels connected integrally to the reinforcement. The top of the concrete leveling pad shall be placed at or below those elevations designated on the plans as bottom of wall or at least 1'-6" below the final grade line

The leveling pad shall be cured a minimum of 12 hours before placement of facing panels.

**Facing Panels** - Facing panels shall be placed so that their final position is vertical or battered as shown on the plans. Panels should be placed in successive horizontal lifts in the sequence shown on the plans as structure backfill placement proceeds. As structure backfill material is placed behind the panels, the panels shall be maintained in position by means of temporary wedges or bracing according to the wall supplier's recommendations.

Concrete facing vertical tolerances and horizontal alignment tolerances shall be maintained in position by means of temporary wedges or bracing according to the wall supplier's recommendations.

Before starting a new course of facing panels, the Contractor shall take steps to ensure matching the elevation at the next leveling pad step. Shimming material (Expansion Joint Material, Concrete Mortar Grout, Roofing Felt) may be used on top of the leveling pad to obtain necessary panel elevations at the next leveling pad steps.

Joint materials shall be installed to the dimensions and thickness shown on the plans or approved shop drawings.

Facing elements, which are out of alignment, shall not be pulled back into place, but shall be removed and reset.

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PANEL FACING MSE WALLS**

**Structure Backfill**

- (a) *Backfill Sequencing.* Backfill placement shall closely follow erection of each course of panels. At each reinforcement level, the backfill shall be placed to the level recommended by the wall supplier.

Backfilling of the wall shall be performed parallel to the line of the facing elements and shall progress from 3 feet from the back face of the wall toward the back of the reinforced soil zone.

Backfill shall be placed in such a manner as to avoid any damage or disturbance of the wall materials or misalignment of the facing panels of reinforcing element. Any wall materials, which become damaged during backfill placement, shall be removed and replaced at the Contractor's expense. The Contractor, at the Contractor's expense, shall correct any misalignment or distortion of the wall facing panels due to placement of backfill outside the limits of this specification.

After each lift of backfill is placed and compacted, the triangular area formed at the backface of panel facing and the spill of backfill shall be filled with 3/8 inch crushed rock or filter aggregate as approved by the Engineer.

At the end of each day's operation, the Contractor shall slope the level of the backfill away from the wall facing to rapidly direct runoff away from the face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

- (b) *Compaction Equipment.* Compaction of backfill shall be performed with a smooth drum vibratory roller.

Backfill placement methods near the facing panels shall assure that no voids exist directly beneath the reinforcing elements. Only hand-operated compaction equipment shall be allowed within 3 feet of the back face of the panel. Compaction, as specified, shall be achieved by at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

- (c) *Lift Thickness.* The maximum compacted lift thickness shall not exceed 10 inches. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density. At least 6 inches of backfill material shall be in place prior to operation of tracked vehicles over wall reinforcements.

- (d) *Compaction Requirements.* The backfill shall be compacted to a density of not less than 95% of maximum density determined in accordance with AASHTO T 180. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. The moisture content of the backfill material shall not deviate from optimum on the dry side by more than two percentage points as determined by AASHTO T 180. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

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PANEL FACING MSE WALLS**

The frequency of backfill testing shall be as directed by the Engineer.

- (a) *Backfill Settlement.* A final inspection of the backfill shall be made 30 to 45 days after the completion of the top layer of facing elements. If the Engineer determines that settlement has occurred, the Contractor shall place facing panels and backfill, properly compacted, to return the finished grade to plan elevations.

If the settlement is determined to be the result of the non-conforming backfill or backfill not meeting compaction requirements, the Contractor shall bring the elevation to the finished grade at no additional cost to the Department.

**Soil Reinforcement** - Prior to placement of the soil reinforcement, backfill shall be compacted in accordance with these specifications.

**Steel Reinforcement shall be slack free and geosynthetic reinforcement shall be slightly pre-tensioned. The minimum coverage ratio for geogrid reinforcement shall be 67 percent and the spaces between rolls shall be staggered between layers of soil reinforcement. The minimum coverage ratio of woven fabric reinforcement shall be 100 percent and an overlap between rolls is not required. Soil reinforcement shall not be cut to avoid obstructions unless shown on the shop drawings.**

Steel reinforcement shall be placed normal to the face of the wall, unless otherwise shown on the plans. If skewing of the reinforcement is required due to obstructions in the backfill, rotatable connections may be used with a maximum skew angle of 15°. For acute corners, redundant reinforcements shall be provided in accordance with the wall supplier's recommendations. Bending of reinforcement in the horizontal plane that results in permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations may be allowed with the approval of the Engineer.

**Construction Tolerances**

- (a) *Leveling Pad.* The leveling pad shall be level within the tolerance of ½ inch for any two points, and within 1/4 inch for any two points 10 feet apart.
- (b) *Facing Panels.* Concrete facing vertical tolerances and horizontal alignment tolerances shall not exceed ½ inch when measured with a 10 foot straight edge. During construction, the maximum allowable offset in any panel joint shall be ½ inch.
- (c) The overall vertical tolerance of the wall (top to bottom) shall not exceed ½ inch per 10 feet of wall height.

An overall negative batter (wall face leaning outward) between bottom and top of wall is not allowed. The final wall face shall be vertical, or have a positive batter of 3% maximum. The surface of wall face shall be tested with a 10 foot straight edge laid along the surface in all directions. Except as necessary for horizontal alignment of the wall, convex deviation of the wall face from the straight

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PANEL FACING MSE WALLS**

edge (belly wall) shall not be allowed, and concave deviation from the straightedge shall be less than ½ inch.

The maximum allowable panel offset between adjacent panels shall be ½ inch. Panels with broken corners in excess of 2 inches measured along any side will be rejected prior to installation.

**Acceptance of Materials** - The Contractor shall furnish the Engineer a Certificate of Compliance certifying the wall system materials, excluding structure backfill, comply with the applicable contract specifications.

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the structure backfill material complies with these specifications.

A copy of all test results performed by the Contractor necessary to assure contract compliance shall be furnished to the Engineer.

Acceptance will be based on the certificate of Compliance, accompanying test reports, and visual inspection by the Engineer.

Subsection 206.06 shall include:

**Mechanical Reinforcement of Soil** - Mechanical reinforcement of soil will not be measured but shall be the quantities designated in the Contract, except for: revisions requested in writing by the Engineer, or for an error of plus or minus two percent of the total volume shown on the plans for each wall. When there are revisions requested by the Engineer or errors in the plan quantity, the volume will be measured by the cubic yard of the reinforcement zone, based on the reinforcement lengths as shown in the Contract, from the top of the leveling pad (or foundation where a leveling pad is not required) to the top of the precast panel facing based on the elevations shown in the Contract or as revised by the Engineer. Adjustments will not be made for Contractor changes to leveling pad or top of wall elevations to facilitate the Contractor's construction method, or for changes in required soil reinforcement length due to use of structure backfill which exceeds the plan-designed in-place density of 125pcf.

**Structure Backfill (Class 1).** Structure Backfill (Class 1) quantity will be the calculated volume lying within the prism shown on the plans. Adjustments will not be made for increases in required backfill quantity as a result of the Contractor's changes in soil reinforcement length due to the use of structure backfill which exceeds the plan-designed in-place density of 125pcf.

**Aggregate Base Course (Class 6).** Aggregate Base Course (Class 6) quantity will be the calculated volume lying within the prism shown on the plans.

**Structure Excavation.** Structure excavation will be measured and paid for in accordance with Section 206.

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**REVISION OF SECTIONS 206 AND 504  
PANEL FACING MSE WALLS**

Subsection 504.04 shall include:

**Precast Panel Facing** - The square foot of Precast Panel Facing will not be measured but shall be the quantities designated in the Contract, except for: revisions requested in writing by the Engineer, or for an error of plus or minus two percent of the total area shown on the plans for each wall.

When there are revisions requested by the Engineer or errors in the plan quantity, the Precast Panel Facing will be measured by the square foot of the wall front face from the top of the leveling pad (or foundation where a leveling pad is not required) to the top of wall, as designated in the plans. Measurements shall be based on the elevations shown in the Contract or as revised by the Engineer. Adjustments will not be made for Contractor changes to leveling pad or top of wall elevations to facilitate the Contractor's construction method.

Subsection 206.07 shall include the following:

The accepted quantity will be paid for at the contract unit price per unit of measurement for the pay item listed below.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Mechanical Reinforcement of Soil	Cubic Yard
Structure Backfill (Class 1)	Cubic Yard
Aggregate Base Course (Class 6)	Cubic Yard

Subsection 504.05 shall include:

The accepted quantity of Precast Panel Facing will be paid for at the contract unit price per square foot.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Precast Panel Facing	Square Foot

Payment will be full compensation for all materials, equipment and labor necessary to complete the work.

The technical representative's work will not be paid for separately but shall be included in the work.

Precast Panel Facing shall include the cost of the precast facing panels required for the test section, all master molds and form liners, leveling blocks and pads, dowels, neoprene pads, joint material, and any shoring required for the placement and erection of the panel facing.

Mechanical Reinforcement of Soil shall include the cost of all other items required to complete the work, such as: impervious membranes; subsurface drains, drain pipes, connections and accessories; and splash blocks. The cost of structure backfill within the reinforced zone is not to be included in the cost of

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**REVISION OF SECTIONS 206 AND 504**  
**PANEL FACING MSE WALLS**

mechanical reinforcement of soil, but will be measured and paid for separately as Structure Backfill (Class1) in accordance with Section 206.

Structure excavation; structure backfill; foundation material; groundwater drainage; railing; anchoring or rail slabs; lighting, sound or noise barriers, and fences located at the top of the panel facing MSE walls, if applicable, shall be paid for separately.

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**PANEL FACING MSE WALLS**

<b>COLORADO DEPARTMENT OF TRANSPORTATION</b> <b>PANEL FACED MSE WALL SUBMITTAL CHECKLIST</b>	Project No.: <hr/> Project Code (SA#): <hr/> Date:
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Instructions for shop drawing submittal and approval:

- This form is to be used on projects that require construction of Concrete Panel Facing MSE Walls or alternate hybrid walls. The Contractor is to fill out this form and submit it with the shop drawings.
- Yes = Yes, the required submittal is included in this submittal package.
- No = No, the required submittal is not included in this submittal package. Provide the reason why the required submittal is not included in this submittal package in the space below the requirement. This may result in the rejection of the submittal package.
- NA = The required submittal does not apply. In lieu of required submittal provide alternative documentation as needed. Provide reason why in the space below the requirement.
- Add = The required submittal is not available at this time. Provide planned date when test results will be provided in the space below the requirement.
- (1) = An explanation is required and has been provided in the space below the requirement.

Contractor's Name:
Subcontractor's Name:
Description of Wall(s):

Standard Special Provision Reference	Requirement Description (see Standard Special Provision for complete description and requirements)	Enter Yes, No (1), NA (1) and/or Add (1)
MATERIALS, (d) 1	Certification of T <sub>ULT</sub> (MARV) conforming to the requirements of ASTM D4595, ASTM D6637 or other methods as appropriate.	
MATERIALS, (d) 2	Ultimate Tensile Strength, a mill test report containing the ultimate tensile strength and/or of yield strength of the steel.	
MATERIALS, (d) 3	Report of the Panel/Reinforcement Connection Test.	
MATERIALS, (d) 4	Report for soil to reinforcement interface pullout test conforming to the requirements of ASTM D6706 or other methods as appropriate.	
MATERIALS, (d) 5	Certification of facial panel to reinforcement long-term connection strength	
MATERIALS, (d) 6	Certification of reinforcement pullout	
MATERIALS, (d) 7	Certification of the initial concrete compression strength and Report of shipping and handling stress calculations	
MATERIALS, (d) 8	Design calculations and/or pull out test report for soil reinforcement embedment in the concrete panel	
MATERIALS, (d) 9	Air Content Test conforming to the requirements of ASTM C173 or ASTM C231. Multiple submittals may be required per frequency of tests.	

I certify that the Panel Faced MSE Wall Certifications, Calculations and Testing Reports Submittal is complete and correct.	
Authorized Prime Contractor Representative Signature:	Title:

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## **REVISION OF SECTION 206 AND 504 WIRE FABRIC FACING MSE WALLS**

Section 504 of the Standard Specifications is hereby revised for this project to include the following:

### **DESCRIPTION**

This work includes the construction of mechanically stabilized earth (MSE) walls, with a welded wire fabric face, in accordance with this special provision and in conformity with the lines, grades, details and dimensions as shown on the plans.

### **MATERIALS**

**Shop Drawings.** Design calculations and shop drawings shall be submitted in accordance with subsection 105.02 of the Standard Specifications. The Contractor shall submit to the Engineer six sets of design calculations and shop drawings, stamped by a licensed Professional Engineer in the State of Colorado, for review and approval prior to beginning wire fabric facing MSE wall construction. Use of a firm to prepare these drawings and design calculations shall be limited to a specialty firm regularly engaged in the design and construction of permanent MSE walls. The Contractor shall submit the name of shop drawing provider at or before the pre-construction meeting. The Engineer may reject shop drawings prepared by a non-specialty firm.

Design calculations submitted with the shop drawings shall show reference to sections, tables and charts in the Sixteenth (16th) Edition of AASHTO Standard Specifications for Highway Bridges, including all current Interim Revisions.

The shop drawings shall provide details necessary to demonstrate compliance with the requirements in the plans and these specifications, including:

- With close conformity to line and grades shown on the plans, the wall layout including wall elevations.
- The details of the wire fabric facing and attachment of the soil reinforcement.
- The soil reinforcement types, spacing, lengths, elevations, and the corresponding wall design height shall be shown on the wall layout. Soil reinforcement lengths shall be measured from the back face of fabric facing unit to the end of the reinforcements and shall not be less than any lengths or length requirements shown on the plans.

**Soil Reinforcement, Connection and Alignment Devices.** Soil reinforcement, connection and alignment devices for wire fabric facing MSE walls shall be from the same manufacturer as the reinforcement and devices supplied for the Panel Facing MSE Walls. See Revision of Section 206 and 504 Panel Facing MSE Walls, for soil reinforcement, connection and alignment device material requirements.

**Facing Unit.** Galvanized steel welded wire fabric shall be used as the facing for the wire fabric facing MSE walls. Retention of the backfill shall be accomplished using the welded wire fabric facing, in combination with wrapped geogrid and soil retaining filter fabric or a geotextile placed between the welded wire fabric and the backfill. The facing unit shall be designed for 100% of the required LTDS. Steel welded wire fabric shall meet the minimum requirements of AASHTO M 55 (ASTM A 185).



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**REVISION OF SECTION 206 AND 504  
WIRE FABRIC FACING MSE WALLS**

Galvanization shall be applied after welded wire fabric is fabricated, and shall conform to the minimum requirements of AASHTO M 111 (ASTM A123).

**Backfill.** The structure backfill for the reinforced soil zone shall be the same as supplied for the Panel Facing MSE Walls. Structure Backfill (Class 1) shall conform to the requirements of Section 206, with the exceptions and additions as noted below:

- (a) *Design Values.* The structure backfill shall: have a minimum coefficient of friction ( $\Phi$ ) of  $34^\circ$  when tested in direct shear, and a minimum in-place density of 125 pcf.
- (b) *Gradation and Plasticity.* The structure backfill shall meet the requirements of Subsection 703.08 for Class 1 Structure Backfill.
- (c) *Soundness.* The structure backfill shall be substantially free of shale or other soft, poor durability particles. The material shall have magnesium sulfate soundness loss of less than 30% after four cycles, as determined by AASHTO T 104.
- (d) *Corrosion.* The structure backfill shall be a non-aggressive soil in terms of corrosion. The Engineer may require chemical and organic content tests if the source is questionable.
- (e) *Resistance Value.* The top two feet of structure backfill below the ABC Class 6 and Pavement shall have a minimum resistance value when tested by the Hveem Stabilometer, or equivalent resilient modulus value, of at least 45.

The Contractor shall not use pulverized concrete or asphalt for backfill.

**Corrugated Paper Void Material.** The purpose of this material, if and where shown or noted on the plans, is to create a temporary support surface during placement of the mechanically stabilized earth behind bridge abutments. If not shown on the plans, the minimum void space between the mechanically stabilized earth and the abutment shall be maintained without the use of the void material. The corrugated paper void material shall meet the following minimum requirements:

1. Biodegradable, having a moisture resistant exterior on one side, and an interior fabrication of a uniform cellular configuration composed of non-moisture resistant components thoroughly glued to the inside of each face.
2. Maintain the separation as shown on the plans between the structure and the mechanically stabilized earth during the construction process.
3. Have a minimum average "dry" compressive strength of 1500 psf. The compressive strength of the material shall be certified and tested by an independent testing laboratory.
3. Have a thickness of 6 inches prior to installation.
4. The manufacturer shall provide to the Contractor written instructions regarding the use, care, and installation of the corrugated paper void material.
5. A technical representative of the manufacturer shall be available as necessary during construction of the mechanically stabilized earth, and as requested by the Engineer, to respond to questions, which may arise regarding the void material.

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**REVISION OF SECTION 206 AND 504  
WIRE FABRIC FACING MSE WALLS**

**DESIGN REQUIREMENTS**

The design of the wire fabric facing MSE walls shall be designed and stamped by a Professional Engineer registered in the State of Colorado.

The wall design, including design assumptions and calculation of lateral earth loads, shall conform to the requirements of the AASHTO Standard Specifications for Highway Bridges, 16th Edition, as amended by all current Interim Revisions; the requirements of the AASHTO-AGC-ARTBA Joint Committee, subcommittee on New Highway Materials, Task force 27 Report; the Colorado Department of Transportation Bridge Design Manual; the plans and these specifications.

**Design Height.** The wall design height shall be as designated in the plans.

**Limiting Dimensions for Soil Reinforcement.**

- (a) *Length.* The soil reinforcement length shall be measured from the back face of the wall facing. Unless otherwise required on the plans the length of primary soil reinforcement, defined as the reinforcement that provides for the internal and external stability of the wall system, shall be equal from top to bottom at all layers of wall. Likewise, the length of secondary reinforcement, defined as reinforcement placed between the primary reinforcement layers and that used as a construction aid to provide additional soil stiffness to limit bulging at the wall face, shall also be of equal length unless otherwise specified. Unless otherwise required on the plans, the soil reinforcement length shall not be less than 70% of the wall design height (DH) as defined on the plans, or 8 feet, whichever is larger.
- (b) *Spacing.* The first (bottom) layer of soil reinforcement shall be no further than 15 inches average above the subgrade. The last (top) layer of soil reinforcement shall be no further than 6 inches average below the finish grade or top of the wire fabric facing MSE wall.

The maximum vertical spacing between layers of adjacent soil reinforcement shall be as shown on the plans.

**Factors of Safety.** Calculations shall include analysis for the internal and external stability of the wall. The wall designer shall be responsible for the following stability calculations:

- (a) *Sliding.* (FS  $\geq$  1.5)
- (b) *Overtipping.* (FS  $\geq$  2.0)
- (c) *Loss of Heel.* (Eccentricity  $\geq$  L/6)
- (d) *Bearing.* (As specified on the plans.) An analysis shall be performed for each location of the wall where the foundation bearing capacity changes and/or where the change in wall height is 2 feet or greater.
- (e) *Reinforcement Pullout.* (FS  $\geq$  1.5)
- (f) *Connection Failure.* (FS  $\geq$  2.0) - The horizontal force used to design the connections may be taken as no less than 85% of the maximum calculated force, except for the lower half of the structure where it shall be 100%.

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### REVISION OF SECTION 206 AND 504 WIRE FABRIC FACING MSE WALLS

- (g) *Global Stability.* Deep-seated shear failure of the MSE Wall System shall not be the responsibility of the MSE wall system designer.

**Allowable Reinforcement Stresses.** The allowable tensile stress for steel reinforcements and connections shall be  $0.55F_y$  except that for grid reinforcing, this shall be reduced to  $0.48F_y$ .  $F_y$  shall not be taken as greater than 65,000 psi.

### CONSTRUCTION REQUIREMENTS

**Technical Representative.** The Contractor shall arrange for a technical representative from the system supplier to be present at the beginning of the construction of the wire fabric facing MSE walls, periodically as necessary during construction, and as requested by the Engineer. The representative shall provide all necessary instructions and guidelines to construct the wire fabric facing MSE walls in accordance with these specifications and the manufacturer's product specific requirements.

**Structure Backfill and Filter Material.** The soil reinforcement shall be straight and pulled taut before fill is placed. Backfill shall be placed, spread, and compacted to minimize movement of the soil reinforcement. Backfilling shall progress from the face toward the back of the reinforced soil zone, and in a manner, which ensures that, the soil reinforcement remains taut. The soil reinforcement shall be protected during construction from deleterious substances such as oil, grease, epoxy, wet concrete, etc.

The maximum compacted backfill lift thickness shall be 6 inches. Backfill compaction shall be accomplished without damaging the soil reinforcement. Backfill placement methods near the face shall assure that no voids exist within the soil reinforcing elements. The Contractor shall compact structure backfill to at least 95% of the maximum density as determined by AASHTO T-99 within 2 percentage points of optimum.

Backfill material with a placement moisture content below or above the above moisture content requirement shall be removed, moisture-conditioned if needed, and reworked until the moisture content is uniformly acceptable throughout the entire lift.

Heavy compaction equipment shall not operate within 2 feet of the face of the wire fabric facing MSE walls. Only hand-operated compaction equipment shall be allowed within 2 feet of the face. In addition to the above compaction requirements, compaction near the wall face shall be achieved by at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

At the end of each day's operation, the Contractor shall slope the backfill away from the facing to rapidly direct precipitation runoff away from the face of the wire fabric facing MSE walls. The Contractor shall not allow surface runoff from adjacent areas to enter the construction site. Materials, which become damaged, shall be removed and replaced at the Contractor's expense.

**Soil Reinforcement.** Prior to placement of the soil reinforcement, backfill shall be compacted in accordance with these specifications.

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**REVISION OF SECTION 206 AND 504  
WIRE FABRIC FACING MSE WALLS**

**Steel Reinforcement shall be slack free and geosynthetic reinforcement shall be slightly pre-tensioned. The minimum coverage ratio for geogrid reinforcement shall be 67 percent and the spaces between rolls shall be staggered between layers of soil reinforcement. The minimum coverage ratio of woven fabric reinforcement shall be 100 percent and an overlap between rolls is not required. Soil reinforcement shall not be cut to avoid obstructions unless shown on the shop drawings.**

Reinforcement shall be placed normal to the face of the wall, unless otherwise shown on the shop drawings or plans. If skewing of the reinforcement is required due to obstructions in the backfill, rotatable connections may be used with a maximum skew angle of 15°. For acute corners, redundant reinforcements shall be provided in accordance with the supplier's recommendations. Bending of reinforcement in the horizontal plane that results in permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations may be allowed with the approval of the Engineer.

**Corrugated Paper Void Material.** If used, the Contractor shall be responsible for protection and placement of the corrugated paper void material in accordance with the manufacturer's recommendations. The void material shall be kept dry prior to and during placement of the soil reinforcement and backfill. The corrugated paper void material shall be placed continuously in each direction with no more than 1 inch between units, with the moisture resistant treated exterior placed adjacent to the mechanically stabilized earth. The void material shall be attached to the concrete surface with an approved construction adhesive as recommended by the manufacturer of the void material. Only that portion of void material as required for daily construction operations need be installed at a time.

**Acceptance of Materials.** The Contractor shall furnish the Engineer a Certificate of Compliance certifying the wall system materials, excluding structure backfill and filter material, comply with the applicable contract specifications.

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the structure backfill and filter material comply with these specifications.

A copy of all test results performed by the Contractor necessary to assure contract compliance shall be furnished to the Engineer.

Acceptance will be based on the certificate of Compliance, accompanying test reports, and visual inspection by the Engineer.

Subsection 206.06 shall include the following:

**Mechanical Reinforcement of Soil.** Mechanical reinforcement of soil will not be measured but shall be the quantities designated in the Contract: except, measurements will be made for revisions requested by the Engineer, or for an error of plus or minus two percent of the total volume shown on the plans for each wall. When there are revisions requested by the Engineer or errors in the plan quantity, the volume will be measured by the cubic yard of the reinforcement zone, based on the reinforcement lengths as shown in the Contract, or as revised by the Engineer. Adjustments will not be made for changes in required soil

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**REVISION OF SECTION 206 AND 504  
WIRE FABRIC FACING MSE WALLS**

reinforcement length due to use of structure backfill which exceeds the plan-designed in-place density of 125pcf.

**Structure Backfill (Class 1).** Structure Backfill (Class 1) quantity will be the calculated volume lying within the prism shown on the plans. Adjustments will not be made for increases in required backfill quantity as a result of the Contractor's changes in soil reinforcement length due to the use of structure backfill which exceeds the plan-designed in-place density of 125pcf.

**Aggregate Base Course (Class 6).** Aggregate Base Course (Class 6) quantity will be the calculated volume lying within the prism shown on the plans.

**Structure Excavation.** Structure excavation will be measured and paid for in accordance with Section 206.

Subsection 206.07 shall include the following:

The accepted quantity will be paid for at the contract unit price per unit of measurement for the pay item listed below:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Mechanical Reinforcement of Soil	Cubic Yard

Payment will be full compensation for all materials, equipment and labor necessary to complete the work.

Mechanical Reinforcement of Soil shall include the cost of all soil reinforcement, welded wire fabric facing, geosynthetic fabric, corrugated paper void material, filter fabric, drain pipes and all other incidentals required for the construction of the system.

The unit cost for "Mechanical Reinforcement of Soil" shall be a weighted average, which considers the quantity, work requirements, and cost of each individual work item.

The cost of structure backfill and filter material within the reinforced zone is not to be included in the cost of Mechanical Reinforcement of Soil, but will be measured and paid for separately as Structure Backfill (Class 1) and Aggregate Base Course (Class 6).

The technical representative's work will not be paid for separately but shall be included in the work.

**REVISION OF SECTION 208  
GRAVEL BAG**

Section 208 of the Standard Specifications is hereby revised for this project as follows:

Subsection 208.01 shall include the following:

This work consists of the installation of gravel bags at locations shown on the plans.

Subsection 208.02 shall include the following:

(o) *Gravel Bag.* Gravel bags shall consist of aggregate filled fabric with the following dimensions:

Diameter	4 to 6 inches
Section Length	1 foot minimum

The sediment control device shall consist of a woven geotextile fabric with the following properties:

Grab tensile strength	90 lbs. min.	ASTM D 4632
Trapezoid Tear Strength	25 lbs. min.	ASTM D 4533
Mullen Burst	300 psi.	ASTM D 3786
Ultraviolet Resistance	70%	ASTM D 4355

Gravel bags shall be capable of remaining in place during a storm event. Aggregate contained in the gravel bags shall consist of gravel or crushed stone conforming to Table 703-7 for Class C.

Subsection 208.05 shall include the following:

(s) *Gravel Bag.* Gravel bags shall be placed on a stable surface, consisting of pavement, grass or aggregate. Gravel bags shall be placed to conform to the surface without gaps. Discharge water shall not cause erosion.

Subsection 208.07 shall include the following:

Gravel Bags will be measured by the linear foot of bags that are installed and accepted.

Subsection 208.08 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Gravel Bag	Linear Foot

Payment will be full compensation for all work, materials and equipment required to complete the item, including surface preparation, maintenance throughout the project, and removal upon completion of work.

Aggregate will not be measured and paid for separately, but shall be included in the work.

**REVISION OF SECTION 208  
PERMANENT WATER QUALITY BMP  
AS CONSTRUCTED SURVEY**

Section 208 of the Standard Specifications is hereby revised for this project as follows:

Subsection 208.10(b) shall include the following:

The permanent BMPs to be surveyed will be discussed at the Environmental Preconstruction Conference. The results of the survey shall be provided on an electronic drawing of each BMP in MicroStation format showing the information specified in section 6.1.3 of the CDOT Survey Manual.

The survey shall be performed in accordance with the Section 6.1.3 of the CDOT Survey Manual. The Contractor may request copies of the MicroStation electronic design files for the permanent BMPs if available. A draft of the printed copy of the MicroStation format drawing shall be provided 14 days in advance of the final water quality project walkthrough. At the final water quality walkthrough the as constructed BMP survey shall be reviewed and any necessary revisions determined. The Contractor shall make the requested revisions as needed within 5 days of the final water quality walkthrough and submit final copies of the electronic files on a CD to the Project Engineer.

Listed below are the permanent water quality BMPs to be surveyed:

- Water quality ponds

Subsection 208.12 shall include the following:

All work and materials required to perform the permanent BMP survey and furnish the three electronic files shall be included in the original unit price bid for surveying. Surveying will be measured and paid for in accordance with Section 625.

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**REVISION OF SECTION 209  
TIME-RELEASED WATER PRODUCT**

Section 209 of the Standard Specifications is hereby revised for this project as follows:

Subsection 209.01 shall include the following:

This work consists of supplying and placing a time-released water product to trees as indicated on the plans or as designated by the R6 Landscape Architect, Wetlands Biologist & Engineer.

Subsection 209.02 shall include the following:

When applied for watering and establishment of plant materials, time-released water product shall be DRiWATER as manufactured by DRiWATER, Inc., 600 East Todd Road, Santa Rosa, CA 95407, or approved equal. The product packaging shall consist of a one-quart #205 paper carton stock container, measuring approximately 2.765" x 2.764" x 7.625", which is biodegradable and printed with non-toxic vegetable ink. Each biodegradable paper carton shall be clearly labeled with the expiration date. The chemical composition of the time-released water product shall conform to the following:

<b>Chemical Constituents</b>	<b>%</b>
Potable Water	97.85
Cellulose Gum	2
Aluminum Sulfate	0.15

Subsection 209.03 shall include the following:

One month prior to the start of planting, a one-quart sample of the time-released water product shall be submitted to the Engineer for approval.

Installation of product shall be in accordance with the manufacturer's recommendations.

Replacement applications shall be done every 45 days, until the establishment period is completed. Additional applications of time-released water product shall be applied as directed by the Engineer.

Subsection 209.07 shall include the following:

Time-released water product, water for both pre-watering and post-watering during planting, excavation and backfill for each placement of watering packages and any incidentals necessary to complete this work, will not be measured and paid for separately, but shall be included in the cost of time-released water product.

Subsection 209.08 shall include the following:

<b>Pay item</b>	<b>Pay Unit</b>
Time-released water product	Each



**REVISION OF SECTION 210  
RESET VARIABLE MESSAGE SIGN**

Section 210 of the Standard Specifications is hereby revised for this project as follows:

Subsection 210.01 shall include the following:

This work consists of resetting the RTD overhead variable message sign (VMS) housing and associated control equipment that is located along SB I-25, south of Santa Fe Drive. The VMS shall be carefully removed, stored and reinstalled in a manner that will avoid any damage.

Subsection 210.12 shall include the following:

The quantity measured for reset “Variable Message Sign” shall be the number of VMS housings complete with associated control equipment and cabinets, and shall include all work and materials necessary to safely remove the item from its existing location with proper traffic controls, storing the item in a location that will be protected from any damage, vandalism or theft, reinstalling the item using all new mounting hardware and wiring, and re-establishing all electrical and/or communication service connections.

Subsection 210.13 shall include the following:

<b>Pay item</b>	<b>Pay Unit</b>
Reset Variable Message Sign	Each

**REVISION OF SECTION 210**  
**VALVE BOX AND MANHOLE ADJUSTMENTS**

Section 210 of the Standard Specifications is hereby revised for this project as follows:

Subsection 210.10 shall include the following:

The Contractor shall notify each utility company (Owner) prior to any construction that will involve the adjustment of its valve boxes or manholes.

Each Owner will mark all of its valve boxes and manholes that will be involved in the specified construction area.

Prior to commencing construction, the Contractor shall coordinate and conduct, with the Engineer and each Owner, an inspection of all impacted manholes and valve boxes. The purpose of this inspection will be to account for all valve boxes and manholes involved in the construction and determine their accessibility and condition. The Contractor shall provide traffic control for this inspection and for the final inspection. The Contractor shall coordinate construction with the Owner to allow sufficient time for the Owner to make all necessary repairs to, or supply replacements for valve boxes and manholes before construction begins in the area of the valve boxes and manholes. All parties shall agree on the condition of each valve box and manhole prior to construction.

The Contractor shall replace all valve box sections damaged or misplaced during construction with new valve box sections complying with the requirements of the Owner's specifications. The Contractor shall set each valve box to be adjusted so that it is ¼ inch to ½ inch below the final grade of the paved surface, or to the satisfaction of the Owner, and so that it is plumb over the operating nut of the valve.

The Contractor shall replace all manhole sections damaged or misplaced during construction with new manhole ring and cover complying with the requirements of the Owner's specification. The Contractor shall adjust each manhole so that it is ¼ inch to ½ inch below the final grade of the paved surface, or to the satisfaction of the Owner. Some adjustments may require the addition, removal, or replacement of a manhole or cone section. If manhole adjustment requires a manhole cone or barrel section to be added, removed, or replaced, this work will not be considered as "Adjust Manhole", but shall be performed in accordance with the Section 210 requirements for the item "Modify Manhole".

The Contractor shall prevent tools, concrete, dirt, or debris of any kind from falling into the channel of the existing manhole. The Contractor shall clean or remove debris from downstream sewer that enters as a result of the Contractor's work.

When the project includes planing prior to resurfacing, the Contractor shall first lower all valve boxes and manholes below the surface to be planed and then adjust them up to final grade after the paving operation is complete.

Prior to the final inspection, the Contractor shall thoroughly clean all valve boxes designated for cleaning. This work shall be performed in accordance with the Section 202 requirements for the item "Clean Valve Box".

The Contractor shall coordinate and conduct, with the Engineer and each Owner, a final inspection upon completion of construction. This inspection shall assure that all valve boxes and manholes are in compliance with these requirements. The Engineer will obtain the Owner's written approval before accepting the work.

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**REVISION OF SECTION 210**  
**VALVE BOX AND MANHOLE ADJUSTMENTS**

Subsection 210.12 shall include the following:

The Contractor will be paid separately for each valve box or manhole adjustment completed down and for each adjustment completed up.

Subsection 210.13 shall include the following:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Adjust Valve Box	Each
Adjust Manhole	Each

Adjustments that include adding, removing, or replacing a manhole cone or barrel section will be paid for under the Section 210 pay item, Modify Manhole.

Cleaning designated valve boxes will be paid for under the Section 202 pay item, Clean Valve Box.

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## REVISION OF SECTION 211 DEWATERING

Section 211 is hereby added to the Standard Specifications for this project as follows:

### DESCRIPTION

**211.01** This work consists of dewatering to facilitate construction activities.

**The Contractor is advised that a Modified Phase I Environmental Site Assessment, Limited Phase II Environmental Subsurface Investigations, and a Material Management Recommendation Report have been completed for this project. These documents are listed in Revision of Section 102 Project Plans and Other Data.**

### CONSTRUCTION REQUIREMENTS

**211.02** The Contractor is advised that groundwater within the project limits contains chemical compounds at concentrations greater than that acceptable for direct discharge under standard National Pollutant Discharge Elimination System (NPDES) permits. The Contractor is advised to limit pumping of groundwater in all project excavations, by careful scheduling, expediting the work and use of conscientious construction methods.

Permitting, removal, sample collection, analytical testing, containerization, transportation, and disposal or treatment of all contaminated groundwater will be in accordance with Section 107.25 Water Quality Control and as described in Revision of Section 250 Environmental, Health and Safety Management.

The Contractor shall:

- (1) Minimize the disturbance of contaminated groundwater by avoidance.
- (2) Limit intrusion of groundwater into excavations.

The Contractor shall obtain the appropriate Colorado Discharge Permit System (CDPS) general permit for management of groundwater from CDPHE Water Quality Control Division, as determined necessary. A completed application must be submitted to CDPHE at least four weeks prior to dewatering operations.

The Contractor shall measure the rate of groundwater discharge during the dewatering using an inline flow device capable of measuring slow rates with an accuracy of plus or minus five (5) gallons per minute. The Contractor shall record the rate of discharge daily and shall submit a discharge report to the Engineer weekly or as approved by the Engineer.

The Contractor shall submit a Dewatering Plan to the Engineer at least four (4) weeks prior to the proposed start of dewatering operations. **This plan shall be prepared by a certified industrial hygienist, certified hazardous materials manager, professional engineer licensed in the State of Colorado, certified safety professional, or registered environmental manager meeting the criteria set forth in 29 CFR 1926.** This Plan shall detail the Contractor's method of dewatering for all major excavations including caisson construction. The Dewatering Plan shall be stamped "Approved for Construction" and signed by the Contractor. The Dewatering Plan will not be approved by the Engineer.

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**REVISION OF SECTION 211  
DEWATERING**

The Engineer will review the Dewatering Plan and issue a written acceptance letter or request for changes within two (2) weeks of receiving the Plan. If changes are requested the Contractor shall update the Plan and resubmit it to the Engineer within one (1) week after receiving the request for changes.

The Engineer's written acceptance of the Dewatering Plan is required before construction.

The Dewatering Plan shall provide complete details of the Contractor's method for construction dewatering including:

- (1) Copies of all permits required for dewatering, treatment of and (or) disposing of water.
- (2) If applicable, copies of agreements for disposing of water in storm sewers, sanitary sewers etc.
- (3) Method and details for minimizing dewatering in excavations and during caisson construction.
- (4) Method of measuring groundwater discharge.
- (5) Equipment descriptions including size, number, type, capacity, and location of equipment during dewatering operations.
- (6) Methods of testing groundwater to determine appropriate disposal.
- (7) Detailed methods for disposal of water.
- (8) If applicable, name of facility where contaminated water is to be delivered to.

**BASIS OF PAYMENT**

**211.03** Preparation of the Dewatering Plan will be paid under pay item Section 250 Environmental Health and Safety Management, Lump Sum.

Permitting, removal, sample collection, analytical testing, containerization, transportation, and disposal or treatment of all contaminated groundwater will be paid for in accordance with Section 109.04, under Force Account Dewatering.

**REVISION OF SECTION 212  
SOIL PREPARATION (SPECIAL)**

Section 212 of the Standard Specifications is hereby revised for this project as follows:

**DESCRIPTION**

212.01 This work shall include all necessary work and material required to provide soil amendments to the project.

**MATERIALS**

Subsection 212.02 (d) shall include the following:

Hydrated polyacrylamide (PAM) for water conservation in tree pits.

**CONSTRUCTION REQUIREMENTS**

Subsection 212.04 shall include the following:

Conduct soil preparation operations after grading and topsoiling tasks have been completed, but prior to start of planting operations.

Furnish Engineer with fertilizer analysis and bag weights and weight tickets for fertilizer at the construction site when loading the machines in preparation to placing any fertilizer.

Furnish Engineer with fertilizer analysis and bag weights and weight tickets for fertilizer at the construction site when loading the machines in preparation to placing any fertilizer.

Apply soil amendments at the following rate to areas that have already received topsoil.

1. Fertilizer: Distribute evenly at the rate recommended by the soil analysis.
2. Plant pits shall be backfilled with 20% volume organic amendments.
3. Tree pits shall include of hydrated polyacrylamide (PAM) as described in Section 214.

Incorporate into the topsoil fertilizer and organic matter by any method that will provide an even distribution.

Remove all rocks larger than 1 inch diameter, trash and debris brought to the surface by the incorporation of the soil preparation materials.

**METHOD OF MEASUREMENT**

212.05 The accepted quantities of soil preparation shall be paid for at the contract unit price per cubic yard as listed below.

**BASIS OF PAYMENT**

PAY ITEM  
Soil Preparation (Special)

PAY UNIT  
Cubic yard

### **REVISION OF SECTION 213 FLEXIBLE GROWTH MEDIUM**

Section 213 of the Standard Specifications is hereby revised for this project as follows:

Subsection 213.01 shall include the following:

This work consists of furnishing and applying Flexible Growth Medium (FGM) on top of rock cuts and slopes after seeding or as temporary stabilization as shown on the plans or as directed by the Engineer.

Subsection 213.02 shall include the following:

FGM shall consist of wood fibers bound together by adhesive and photodegradable synthetic fibers and premixed in an air stream at the factory. The fibers may be crimped or uncrimped. The wood fibers shall be manufactured expressly from clean whole wood chips and contain a range of fiber lengths, with a minimum of 25 percent of the fibers averaging 0.4 inches long. The adhesive binder shall be formulated to form a water resistant bond. The fibers shall be colored yellow or green with a water-soluble, non-toxic dye to help the operator apply the material uniformly. The mixture shall also contain a copolymer gel. A sample of the FGM shall be submitted for approval at least two weeks in advance of its use on the project.

Subsection 213.03 shall include the following:

*(f) Flexible Growth Medium (FGM).* A technical representative of the manufacturer or authorized distributor shall be present for the initial mixing and application of the FGM.

The FGM shall be mixed and applied according to the following procedure:

- (1) The FGM shall be mixed at a ratio of 50 lbs. of FGM/125 gallons of water. Seed will not be mixed in to the FGM mix.
- (2) Fill tank with water sufficient to reach the level of the agitator shaft.
- (3) Start mixing agitators and regulate throttle throughout the loading process to achieve agitation.
- (4) Load machine with FGM and the balance of the required water. Load FGM through breaker or break by hand.
- (5) Vigorously agitate the mixture for a minimum of ten minutes after loading to allow thickening. Reduce agitation to a minimum.
- (6) Apply mixture in even layers, working back and forth between top and bottom of the slope, to uniformly cover soil with the mixture. Spray the product through a fan or slit type nozzle (22 to 50 degree tip). The nozzle shall create a fine, uniformly dispersed spray that "rains down" on the soil.

The FGM shall be applied at the rate of 2600 pounds per acre.

The FGM shall have no cure time once placed on the area of application.

FGM shall not be applied in ditches or other areas of concentrated flow.

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**REVISION OF 213**  
**FLEXIBLE GROWTH MEDIUM**

Subsection 213.04 shall include the following:

Flexible growth medium will be measured by the actual number of acres to which it is applied based on slope distances.

Subsection 213.05 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Flexible Growth Medium	Acre

Payment will be full compensation for all work necessary to complete the item.



**REVISION OF SECTION 214  
PLANTING**

Section 214 of the Standard Specifications is hereby revised for this project as follows:

Subsection 214.04 shall include the following:

The beginning of the Landscape Establishment period depends upon receipt of the written "Notice of Substantial Landscape Completion" from the Engineer. Substantial Landscape Completion occurs when all plant materials in the Contract have been planted and all work under Sections 212, 213, 214 and 623 has been performed, except for the Section 214 pay item, Landscape Maintenance. If the Notice of Substantial Landscape Completion is issued during the spring planting season, the Landscape Establishment period begins immediately and lasts for a period of 12 months. If the Notice of Substantial Landscape Completion is issued at any other time, the Landscape Establishment period begins at the start of the next spring planting season and lasts for a period of 12 months.

Subsection 214.02 (d) shall include the following:

In each tree pit, 2 to 3 cups of hydrated polyacrylamide (PAM) shall be evenly distributed in contact with the root ball in the planting hole of each tree.

In subsection 214.04(a) delete the second paragraph and replace it with the following:

Dead, dying or rejected material shall be removed each month during the Landscape Establishment period as directed. Plant replacement shall be performed during the spring planting seasons at the beginning and end of the Landscape Establishment Period. Plant replacement stock shall be planted in accordance with the Contract and is subject to all requirements specified for the original material. Plant replacement shall be at the Contractor's expense.

Section 214.04(b) shall include the following:

During the landscape establishment period, the Contractor shall water, cultivate, and prune the plants and repair, replace, or readjust guy material, stakes, and posts as required or directed by the Engineer. The Contractor shall reshape plant saucers, repair washouts and gullies, replace lost wood chip mulch, keep all planting sites free from weeds and do other work necessary to maintain the plants in a healthy and vigorous growing condition. This includes seasonal spraying or deep root watering with approved insecticides or fungicides as required.

**BASIS OF PAYMENT**

Hydrated polyacrylamide shall not be paid for separately, but will be included in the cost of the trees.

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## REVISION OF SECTION 216 SOIL RETENTION COVERING

Section 216 of the Standard Specifications is hereby deleted for this project and replaced with the following:

### DESCRIPTION

**216.01** This work consists of furnishing, preparing, applying, placing, and securing soil retention blankets and turf reinforcement mats for erosion control on roadway ditches, slopes, or channels as designated in the Contract or as directed.

### MATERIALS

**216.02** Soil retention covering shall be either a soil retention blanket or a turf reinforcement mat as specified in the Contract. It shall be one of the products listed on CDOT's Approved Products List and shall conform to the following:

- (a) *Soil Retention Blanket*. Soil retention blanket shall be composed of degradable natural fibers mechanically bound together between two slowly degrading synthetic or natural fiber nettings to form a continuous matrix. The blanket shall be of consistent thickness with the fiber evenly distributed over the entire area of the mat.

When biodegradable blanket is specified, the thread shall be 100 percent biodegradable; polypropylene thread is not allowed.

When photodegradable netting is specified the thread shall be polyester, biodegradable or photodegradable.

Blankets and nettings shall be non-toxic to vegetation and shall not inhibit germination of seed. The materials shall not be toxic or injurious to humans. Class 1 blanket shall be an extended term blanket with a typical 24 month functional longevity. Class 2 blanket shall be a long term blanket with a typical 36 month functional longevity. The class of blanket is defined by the physical and performance characteristics.

1. *Soil Retention Blanket (Straw-Coconut)*. Soil Retention Blanket (Straw-Coconut) shall be a machine produced mat consisting of 70 percent agricultural straw and 30 percent coconut fiber. It shall be either biodegradable or photodegradable. When specified lightweight polypropylene netting shall be 1.5 pounds per 1000 square feet; heavyweight netting shall be 2.9 pounds per 1000 square feet. Blankets shall be sewn together on 1.50 inch to 2 inch centers.

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a Leno weave which allows the strands of the net to move independently of each other.

When photodegradable netting is specified, the bottom side shall be lightweight polypropylene. The top side shall be heavyweight or lightweight polypropylene.

2. *Soil Retention Blanket (Excelsior)*. Soil retention blanket (excelsior) blanket shall consist of a machine produced mat of 100% curled wood excelsior with 80 percent, 6 inch or longer fiber length. It shall be either biodegradable or photodegradable. When specified lightweight polypropylene netting shall be on both sides of the blanket and shall be 1.5 pounds per 1000 square feet. Blankets shall be sewn together at a maximum of 4 inch centers.

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**REVISION OF SECTION 216  
 SOIL RETENTION COVERING**

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a Leno weave which allows the strands of the net to move independently of each other.

When photodegradable netting is specified, the bottom side shall be lightweight polypropylene. The top side shall be heavyweight or lightweight polypropylene.

3. *Soil Retention Blanket (Coconut).* Soil Retention Blanket (Coconut) shall be a machine produced mat consisting of 100 percent coconut fiber. It shall be either biodegradable or photodegradable.

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a Leno weave which allows the strands of the net to move independently of each other.

When photodegradable netting is specified, the bottom and top side shall be heavyweight polypropylene.

**Table 216-1  
 PHYSICAL REQUIREMENTS FOR SOIL RETENTION BLANKET –  
 PHOTODEGRADABLE OR BIODEGRADABLE BLANKETS**

Product Class	Minimum Roll Width	Minimum Thickness ASTM D 6525	Acceptable Matrix Fill Material	Min. Mass per Unit Area ASTM D 6475	Size of Net Opening	
					Photo-degradable	Bio-degradable
1	6.5'	0.25"	Straw/Coconut	8 oz/sy	Minimum: 0.50"x0.50" Maximum: 0.75"x0.75"	Minimum: 0.50"x0.50" Maximum: 0.5"x1.0"
1	6.5'	0.25"	Excelsior	8 oz/sy	Minimum: 0.50"x0.50" Maximum: 1.0"x2.0"	NONE
2	6.5'	0.20"	Coconut Fibers	8oz/sy	Minimum: 0.50" x0.5" Maximum: 0.75"x0.75"	Minimum: 0.50"x0.50" Maximum: 0.5"x1.0"

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**REVISION OF SECTION 216  
 SOIL RETENTION COVERING**

**Table 216-2  
 PERFORMANCE REQUIREMENTS FOR SOIL RETENTION BLANKET –  
 PHOTODEGRADABLE OR BIODEGRADABLE BLANKETS**

Product Class	Slope Application "C" Factor <sup>1</sup> ASTM D 6459	Channel Application Permissible Shear Stress <sup>2</sup> (Un-vegetated) ASTM D 6460	Minimum Tensile Strength ASTM D 6818
1	≤ 0.10@3:1	2.00 lbs/sf	100 lbs/ft
2	≤ 0.10@3:1	2.25 lbs/sf	125 lbs/ft
Notes: <sup>1</sup> "C" Factor calculated as ratio of soil loss from soil retention blanket protected slope (tested at specified or greater gradient, h:v) to ratio of soil loss from unprotected (control) plot in large-scale testing. <sup>2</sup> Permissible shear stress is the minimum shear stress that a product must be able to sustain without physical damage or excess soil loss when it is installed on a bare soil channel. Failure is defined as ½ inch of soil loss during a 30 minute flow event in large scale testing.			

Blankets shall be tested for physical properties and have published data from a pre-approved independent testing facility.

Large scale testing of Permissible Shear Stress and Slope Erosion Protection ("C" factor) shall be performed by a pre-approved independent testing facility.

A sample of the staples and a copy of the manufacturer's product data showing that the product meets the Contract requirements shall be submitted for approval at the environmental preconstruction conference.

- (b) *Turf Reinforcement Mat.* Turf reinforcement mat (TRM) shall be a rolled mat consisting of UV stabilized, corrosion resistant, non-degradable synthetic fibers, filaments, or nets processed into a permanent three-dimensional matrix of the thickness specified in Table 216-3. TRMs shall provide sufficient thickness, strength and void space to permit soil filling and retention and the development of vegetation within the matrix. When TRM is not soil filled, the mat shall be tan in color. The class of TRM is defined by the physical and performance characteristics.

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**REVISION OF SECTION 216  
 SOIL RETENTION COVERING**

**Table 216-3  
 PHYSICAL REQUIREMENTS<sup>1</sup> FOR TURF REINFORCEMENT MAT**

Product Class	Minimum Roll Width	Minimum Thickness ASTM D 6525	Acceptable Matrix Fill Material <sup>2</sup>	Size of Net Opening <sup>2</sup>
1	6.5'	0.25"	Excelsior, Straw/Coconut, Coconut, or Polymer fibers	Minimum: 0.50"x0.50" Maximum: 0.75"x0.75"
2	6.5'	0.25"	100% UV Stabilized Synthetic Fibers	0.50"x 0.50"
3	6.5'	0.25"	100% UV Stabilized Synthetic Fibers	0.50"x 0.50"

**Notes:**

<sup>1</sup> For TRMs containing degradable components, all property values shall be obtained on the non-degradable portion of the matting alone.

<sup>2</sup> For TRMs with nets and fill material. Netted TRMs shall be sewn together on 1.5 inch to 2 inch centers.

**Table 216-4  
 PERFORMANCE REQUIREMENTS FOR TURF REINFORCEMENT MAT**

Product Class	Tensile Strength MD ASTM D 6818	UV Stability @ 500 Hours ASTM D 4355	Maximum Permissible Shear Stress <sup>1</sup> (Vegetated) ASTM D 6460
1	125 lbs/ft	80%	6.0 lbs/sf
2	150 lbs/ft	80%	8.0 lbs/sf
3	175 lbs/ft	80%	10.0 lbs/sf

**Notes:**

<sup>1</sup> Permissible shear stress is the minimum shear stress that a product must be able to sustain when placed on a fully vegetated channel without physical damage or excess soil loss. Failure is defined as ½ inch of soil loss during a 30 minute flow event in large scale testing.

TRMs shall be tested for physical properties and have published data from a pre-approved independent testing facility.

Large scale testing of Permissible Shear Stress will be performed by a pre-approved independent testing facility.

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### REVISION OF SECTION 216 SOIL RETENTION COVERING

A sample of the staples and a copy of the manufacturer's product data showing that the product meets the Contract requirements shall be submitted for approval at the environmental preconstruction conference.

(c) *Staples.* Staples shall be made of wire:

For use in Channel: 0.165 inch, "U" shaped staples shall be 8 inches long and have a 1 inch crown.

For use on Slope: 0.165 inch, "U" shaped staples shall be 8 inches long and have a 1 inch crown.

"T" shaped pins shall not be used.

### CONSTRUCTION REQUIREMENTS

**216.03** The Contractor shall install soil retention coverings using the following procedure:

- (1) Prepare a stable and firm soil surface free of rocks, weeds, clods, roots, sticks, rivulets, gullies, and other obstructions.
- (2) Apply topsoil or soil conditioning as directed in the Contract to prepare seed bed.
- (3) Place seed in accordance with the Contract.
- (4) Unroll the covering parallel to the primary direction of flow.
- (5) Ensure that the covering maintains direct contact with the soil surface over the entirety of the installation area.
- (6) Do not stretch the material or allow it to bridge over surface inconsistencies.
- (7) Staple the covering to the soil such that each staple is flush with the underlying soil.
- (8) Ensure that staples are installed full depth to resist pull out. No bent over staples will be allowed. Install anchor trenches, seams, and terminal ends as shown on the plans.

If filling a TRM with soil, the Contractor shall:

- (1) Place 3 inches of topsoil or soil amended with soil conditioning.
- (2) Apply seed and rake into soil.
- (3) Install TRM
- (4) Place 0.5 inch to 1 inch of topsoil or soil amended with soil conditioning into the matrix to fill the product thickness.
- (5) Apply seed and rake into soil.
- (6) Install soil retention blanket (Class 1) over the seeded area and TRM.

When applicable, the covering shall be unrolled with the heavyweight polypropylene netting on top and the lightweight polypropylene netting shall be in contact with the soil.

**216.04 Slope Application.** Soil retention coverings shall be installed on slopes as follows:

The upslope end shall be buried in a trench 3 feet beyond the crest of the slope. When specified by the manufacturer, trench depth shall be increased up to 12 inches in depth. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and stapled at 1 foot on center.

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**REVISION OF SECTION 216  
SOIL RETENTION COVERING**

There shall be an overlap wherever one roll of fabric ends and another begins with the uphill covering placed on top of the downhill covering. Staples shall be installed in the overlap.

There shall be an overlap wherever two widths of covering are applied side by side. Staples shall be installed in the overlap.

Staple checks shall be applied on the slope every 35 feet. Each staple check shall consist of two rows of staggered staples.

The down slope end shall be buried in a trench 3 feet beyond the toe of slope. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and stapled. If a slope runs into a receiving water or cannot be extended 3 feet beyond the toe of slope, the end of covering shall be secured using a staple check as described above.

Coverings shall be securely fastened to the soil by installing staples at the minimum rate shown on the plans. Staple spacing shall be reduced where required due to soil type or steepness of slope.

**216.05 Channel Application.** Soil retention coverings shall be installed as follows on a channel application:

Coverings shall be anchored at the beginning and end of the channel across its entire width by burying the end in a trench. When specified by the manufacturer, trench depth shall be increased up to 12 inches in depth. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil and compacted by foot tamping, and seeded. Fabric shall be brought back over the trench and stapled.

Covering shall be unrolled in the direction of flow and placed in the bottom of the channel first. Seams shall not be placed down the center of the channel bottom or in areas of concentrated flows when placing rolls side by side.

There shall be an overlap wherever one roll of covering ends and another begins with the upstream covering placed on top of the downstream covering. Two rows of staggered staples shall be placed.

There shall be an overlap wherever two widths of covering are applied side by side. Staples shall be placed in the overlap.

The covering shall be anchored every 30 feet with a check slot. Check slots shall extend the entire width of the channel. The covering shall be buried in a trench. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and continued down the channel.

Coverings shall be securely fastened to the soil by installing staples at the minimum rate shown on the plans. Staple spacing shall be reduced where needed due to soil type or high flows.

**216.06 Maintenance.** The Contractor shall maintain the soil retention coverings until all work on the Contract has been completed and accepted. Maintenance shall consist of the repair of areas where damage is due to the Contractor's operations. Maintenance shall be performed at the Contractor's expense. Repair of those areas damaged by causes not attributable to the Contractor's operations shall be repaired by the Contractor and will be paid for at the contract unit price. Areas shall be repaired to reestablish the condition and grade of the soil and seeding prior to application of the covering.

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**REVISION OF SECTION 216  
SOIL RETENTION COVERING**

**METHOD OF MEASUREMENT**

**216.07** Soil retention coverings, including staples, complete in place and accepted, will be measured by the square yard of finished surface. Allowance will not be made for overlap.

**BASIS OF PAYMENT**

**216.08** The accepted quantities of soil retention coverings will be paid for at the contract unit price per square yard.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Soil Retention Blanket (____) (Photodegradable Class _)	Square Yard
Soil Retention Blanket (____) (Biodegradable Class _)	Square Yard
Turf Reinforcement Mat (Class _)	Square Yard

Preparation of seedbed, fertilizing, and seeding will be measured and paid for in accordance with Section 212.

When soil filled TRM is required, each TRM and its associated blanket will be measured and paid for separately. Placing and preparation of seedbed, fertilizing, and seeding of soil under the TRM layer will be measured and paid for in accordance with Section 212. Topsoil or amended soil and seed placed on the TRM will be measured and paid for in accordance with Section 207 and 212



## **REVISION OF SECTION 217 HERBICIDE TREATMENT**

Section 217 of the Standard Specifications is hereby revised for the project as follows:

Section 217.03 is hereby revised to include the following:

The Contractor is advised that several species of noxious weeds were identified within the project area in a survey done in the fall of 2010. The Contractor shall implement actions identified in the Integrated Weed Management Plan (IWMP). The Contractor shall have an environmental specialist or botanist familiar with the noxious weed requirements of the State of Colorado (Colorado Noxious Weed Act 35-5.5-115, C.R.S.: 1996 Supp.) and certified by the State, to conduct noxious weed spraying and maintenance per the attached Table.

All equipment will be thoroughly cleaned before entering and exiting the project area. Any equipment used in a noxious weed area shall be thoroughly cleaned prior to moving to another site or leaving the project. Wash water shall be contained in a bermed contained site and shall not be allowed to enter into a storm drain. Failure to do so will be deemed a violation of the IWMP.

All herbicides shall be applied by commercial pesticide applicators licensed by the Colorado Department of Agriculture as qualified applicators. The Contractor shall furnish documentation of such licensing prior to herbicide application. Herbicide mixing and application shall be done in accordance with instructions on the registered product label. The Engineer shall be furnished such label information prior to mixing and application.

The Contractor shall notify the Engineer at least 24 hours prior to each herbicide application and shall indicate the time and location application will begin. Application will not be allowed on Saturdays, Sundays, or holidays unless otherwise approved by the Engineer. All noxious weed treatments will be coordinated with the City & County of Denver Weed Supervisor.

Herbicides shall not be applied when weather conditions, including wind conditions, are unsuitable for such work. Herbicides shall not be applied when soil is extremely dry.

Herbicide application method shall be such that plant growth outside the designated treatment areas (see Environmental Plan Sheet) will not be damaged. Herbicides will be applied by hand with spot-sprayers, wicks, and/or sponges to avoid off-target application. Broadcast herbicide spraying will only be approved through written consent of the project engineer and will be applied when weather conditions (including wind) are suitable for such work. All damage caused by improper herbicide application shall be repaired at the Contractor's expense.

Pre-treat all noxious weed populations in areas where disturbance is planned. Imported topsoil will be minimized during construction, and if necessary pre-treated with herbicides. Noxious weeds observed in and near the construction area at the start of construction will be treated with herbicides or physically removed to prevent seeds blowing into disturbed areas during construction.

All plant and mulch materials used on the site must be inspected and regulated by the Weed Free Forage Act, Title 35, Article 27.5 Colorado Revised Statutes (CRS). Certified weed-free mulch will be used for reclamation, and all seed mixes and nursery materials used for reclamation will be free of noxious weed seeds, roots, and rhizomes. All mulches, erosion bales, and erosion logs used at the site will be certified weed-free.

The project area will be surveyed for noxious weeds throughout construction to identify and treat weeds.

During construction and reclamation/reseeding all areas disturbed by construction and adjacent undisturbed vegetation should be monitored for noxious weeds in the spring, mid-summer, and fall, or as long as construction activities are active. Monitoring personnel should be familiar with identification of the noxious weed species and native species that may resemble them.

All weed control actions should be recorded, including the date, personnel, methods used, areas of application, and result of any follow-up surveys with noxious weed monitoring results also recorded and kept on file.

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**REVISION OF SECTION 217  
 HERBICIDE TREATMENT**

Because of the proximity to the South Platte River, all herbicides applied on-site should be aquatic safe herbicides.

**Table Noxious Weed Control Summary**

Common Name	Scientific Name	Treatment Action
<b>List B Species (CDA)</b>		
Canada thistle	<i>Cirsium arvense</i>	Successful control will involve spraying glyphosate (Aquatic Roundup®, Rodeo®) in the spring and/or fall combined with mowing.
Diffuse knapweed	<i>Centaurea diffusa</i>	Successful control involves preventing the plant from flowering and going to seed. Spraying in the spring/fall, mowing during flowering stage and seeding with competitive native grasses works well. Spray with aminopyralid (Milestone®). Add non-ionic surfactant.
Quackgrass	<i>Elytrigia repens</i>	Successful control includes preventing dense stands. Using a mechanical and chemical approach works the best. Mowing before plants come to seed and spraying with glyphosate (Aquatic Roundup®) (Appendix 4:Profiles of Colorado State-Listed Noxious Weeds, Colorado State Parks, List M-L, page 237-238).
Russian olive	<i>Elaeagnus angustifolia</i>	The best control of Russian olive is the cut-stump treatment, which involves cutting and herbicide application (Aquatic Roundup®). This method is most effective during the winter months.
Scotch thistle	<i>Onopordum acanthium</i>	Successful control will involve spraying in the spring and/or fall combined with reseeding with competitive native plants Spray with aminopyralid (Milestone®). Add non-ionic surfactant. Herbicide application should be followed-up with annual spot cutting (just before flowering) to deplete the seed bank in the soil.
Spotted knapweed	<i>Centaurea maculosa</i>	Effective control includes seeding with competitive native grasses and spraying in the spring/fall. Spray with aminopyralid (Milestone®). Add non-ionic surfactant.
<b>List C Species (CDA)</b>		
Cheatgrass (Downy brome)	<i>Bromus tectorum</i>	Best results are with herbicide (Glyphosate (Aquatic Roundup®)) applications in spring when the plants are small and are growing vigorously at the time of application.
Field bindweed	<i>Convolvulus arvensis</i>	The key to successful control is best done by repeated foliar applications of herbicide (glyphosate (Aquatic Roundup®)).
Puncturevine	<i>Tribulus terrestris</i>	Successful control consists of eliminating seed production and destroying any new seeds. A combination of tilling and spraying during seedling state is recommended. Spray with aminopyralid (Milestone®). Add non-ionic surfactant. (Appendix 4:Profiles of Colorado State-Listed Noxious Weeds, Colorado State Parks, List M-L, page 237-238).

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## REVISION OF SECTION 240 PROTECTION OF MIGRATORY BIRDS

Section 240 is hereby added to the Project Special Specifications for this project as follows:

### DESCRIPTION

**240.01** This work consists of protecting migratory birds during construction. The Contractor shall schedule clearing and grubbing operations and work on structures to avoid impact to migratory birds protected by the Migratory Bird Treaty Act (MBTA).

### MATERIALS AND CONSTRUCTION REQUIREMENTS

**240.02** The Contractor shall retain a qualified wildlife biologist for this project. The wildlife biologist shall have a minimum of three years experience conducting migratory bird surveys and implementing the requirements of the MBTA.

- (a) Vegetation removal activities shall be timed to avoid the migratory bird breeding season which begins on April 1 and runs to August 15. All areas scheduled for clearing and grubbing between April 1 and August 15 shall be surveyed within the work limits for active migratory bird nests. The wildlife biologist shall also survey active migratory bird nests up to 50 feet outside work limits. The Contractor shall avoid all active migratory bird nests and within the area recommended by the biologist until all nests within that area have become inactive. Inactive nest removal and other necessary measures shall be incorporated into the work as follows:

*Tree and Shrub Removal or Trimming.* Due to the potential for nesting birds, tree and shrub removal or trimming shall occur before April 1 or after August 15 if possible. If tree and shrub removal or trimming will occur between April 1 and August 15, a survey for active nests shall be conducted by the wildlife biologist within the seven days prior to beginning work in each area or phase of tree and shrub removal or trimming. If an active nest containing eggs or young birds is found, the vegetation shall remain undisturbed and protected until the young fledge. Protection shall consist of fence (plastic) placed at a distance recommended by the biologist. Work shall not proceed within the fence line until the young have fledged or the nests have become inactive. If the fence is knocked down or destroyed by the Contractor, the Engineer will suspend the work, wholly or in part, until the fence is satisfactorily repaired at the Contractor's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

- (b) Work on structures. The Contractor shall take one of the two following options:

1. Complete all construction activities on structures, including large (equal or greater than 48 inch) culvert pipes, prior to April 1 or after August 15; or
2. If construction occurs on structures between April 1 and August 15, prevent swallow nests from being constructed.

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**SECTION 240  
PROTECTION OF MIGRATORY BIRDS**

If Option 2 is chosen, the Contractor shall perform the following:

- (i) The Contractor shall remove existing swallow nests prior to April 1. If the Contract is not awarded prior to April 1 and CDOT has removed existing swallow nests, then the monitoring of nest building shall become the Contractor's responsibility upon Notice to Proceed.
- (ii) During the time that the swallows are trying to build or occupy their nests, between April 1 and August 15, the Contractor shall monitor the structures at least once every three days for any nesting activity.
- (iii) If the birds have started to build any nests, the nests shall be removed immediately, before a substantial portion of the nest is constructed. Water shall not be used to remove the nests. Workers shall wear an appropriate respirator that can filter particles as small as 0.3 microns. Workers shall wear disposable protective gloves, hat, coveralls and boots
- (iv) Using netting or another approved method to prevent swallows from building nests at a site is acceptable.

If active swallow nests become established, i.e. there are eggs or young in the nest, all work that impacts the nests shall be avoided until the chicks have fledged or the nest is unoccupied as determined by the wildlife biologist. The Contractor shall prevent construction activity from displacing swallows after they have laid their eggs and before the young have fledged.

If the project continues into the following spring, this cycle shall be repeated.

**METHOD OF MEASUREMENT**

**240.03** Wildlife Biologist will be measured by the actual authorized number of hours a wildlife biologist is on site performing the required tasks.

**BASIS OF PAYMENT**

**240.04** The accepted quantities of wildlife biologist will be paid for at the contract unit price per hour as shown in the bid schedule.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Wildlife Biologist	Hour

Payment for Wildlife Biologist will be full compensation for all work and materials required to complete the work, including wildlife biologist, wildlife survey, and documentation.

Removal and management of swallow nests will not be measured and paid for separately, but shall be included in the work.

Fence (Plastic) will not be measured or paid for separately but included in the work.

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**REVISION OF SECTION 250  
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT**

Section 250 of the Standard Specifications is hereby revised for this project as follows:

Subsection 250.03 shall include the following:

The Contractor is advised that a Modified Phase I Environmental Site Assessment, Limited Phase I Environmental Subsurface Investigations, a Material Management Recommendation Report, and Asbestos and Limited Lead-Based Paint Inspections for Bridge F-16-DT and Bridge F-16-DW have been completed for this project. These documents are listed in Revision of Section 102 Project Plans and Other Data.

**~~The Monitoring Technician duties shall include managing submittal of samples for analytical purposes.~~**

Subsection 250.05 shall include the following:

The Contractor shall prepare a Materials Management Plan (MMP) to detail proposed methods of handling contaminated soils and, water and groundwater. This plan shall be prepared by a certified industrial hygienist, certified hazardous materials manager, professional engineer licensed in the State of Colorado, certified safety professional, or registered environmental manager meeting the criteria set forth in 29 CFR 1926.

**The Contractor shall submit a project-specific MMP to the CDOT Project Engineer at least four (4) weeks prior to the proposed start of dewatering and materials handling operations. The project-specific MMP shall detail the Contractor's method for all materials management activities. The project-specific MMP shall be stamped "Approved for Construction" and signed by the Contractor. The MMP will not be approved by the CDOT Project Engineer.**

**The CDOT Project Engineer will review the MMP and issue a written acceptance letter or request for changes within two (2) weeks of receiving both Plans. If changes are requested the Contractor shall update the Plan and resubmit it to the CDOT Project Engineer within one (1) week after receiving the request for changes.**

**The CDOT Project Engineer's written acceptance of the MMP is required before construction.**

Subsection 250.06 shall include the following:

CDOT has an existing relationship with Environmental Science Corporation (ECS) for laboratory services. Unless directed otherwise by the Engineer, the Contractor shall arrange for the analysis of project samples through ESC. CDOT rates should apply for project samples.

Primary ECS Contact:	Mr. John Blackman	(800) 767-5859 Ext. 9677
Secondary ECS Contact:	Mr. Rodney Mann	

Copies of the chain of custody forms shall be maintained at Contractor's field office for the duration of the project and shall be available for review by the Engineer.

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**REVISION OF SECTION 250  
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT**

**Subsection 250.07 shall be revised to include the following:**

**All asbestos related activities shall be performed by Colorado certified asbestos professionals, contractors, or consultants. Certifications are issued by the CDPHE Indoor Air Quality Unit. The Indoor Air Quality Unit within CDPHE is the only unit that certifies such professionals. The contractor shall furnish a copy of the license to the CDOT Project Engineer.**

**The Health and Safety Officer (HSO) shall recommend and supervise those actions that minimize the risk of hazardous substance related injuries, prepare written procedures, conduct or supervise all hazardous substance and solid waste related testing, sampling, monitoring and handling for this project to ensure compliance with applicable regulations.**

**The Monitoring Technician (MT) duties shall perform the day-to-day monitoring of construction activities that may encounter contaminated soil and groundwater and engineered and artificial fill material and shall manage submittal of samples for analytical purposes.**

**Upon encountering potentially asbestos containing materials (ACM), such as buried facility components, abandoned utility lines, buried foundations, and demolition materials, and potentially asbestos contaminated soil during soil disturbing construction and excavation activities, a Colorado Certified Asbestos professional shall direct the management and disposal of asbestos contaminated soil and other ACM.**

Subsection 250.09 shall be revised to include the following:

Preparation of the Health and Safety Plan (HASP) will be paid under pay item Section 250 Environmental Health and Safety Management, Lump Sum.

Preparation of the MMP will be paid under pay item Environmental Health and Safety Management, Lump Sum.

A State Certified Asbestos Building Inspector (CABI) will be paid for in accordance with Section 109.04, under Force Account Environmental, Health and Safety Management.

Asbestos, lead based paint and other miscellaneous hazardous materials handling will be paid for in accordance with Section 109.04, under Force Account Environmental, Health and Safety Management.

Removal, sample collection, analytical testing, containerization, transportation, and disposal or treatment of all contaminated soil will be paid for in accordance with Section 109.04 Force Account Hazardous Waste Disposal.

**REVISION OF SECTION 304**  
**AGGREGATE BASE COURSE**

Section 304 of the Standard Specifications is hereby revised for this project as follows:

Subsection 304.02 shall include the following:

Materials for the base course shall be Aggregate Base Course (Class 6) as shown in subsection 703.03

The aggregate base course (Class 6) must meet the gradation requirements and have a resistance value of at least 78 when tested by the Hveem Stabilometer method.

**REVISION OF SECTIONS 401 AND 703**  
**STONE MATRIX ASPHALT PAVEMENT**

Sections 401 and 703 of the Standard Specifications are hereby revised for this project as follows:

Subsection 401.02 shall include the following:

Recycled Asphalt Pavement (RAP) shall not be used in Stone Matrix Asphalt (SMA) mix.

Subsection 401.09 shall include the following:

Each SMA load shall be completely covered and securely fastened with a full tarp.

Subsection 401.16 shall include the following:

The SMA mixture shall be transported and placed on the roadway without drain-down or flushing. All flushed areas behind the paver shall be removed immediately upon discovery. If more than 50 square feet of flushed SMA pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the flushing has been found and corrected. The Engineer will designate the depth and area of all flushed areas requiring removal and replacement. All costs associated with the removal and replacement of the flushed areas shall be at the Contractor's expense.

Subsection 40.17 shall include the following:

Rollers shall not be used in a vibratory mode on SMA unless they are first used successfully in the demonstration control strip specified in subsection 403.03. Pneumatic wheel rollers shall not be used on SMA mix.

Stone Matrix Asphalt Pavement shall be placed and compacted in accordance with the temperatures listed in subsection 401.07 as revised for this project.

The relative compaction for all SMA mixtures will be measured from roadway cores in accordance with CP 44, Method B, unless the SMA mixture is being placed on a structure (bridge deck) in which case the Engineer may specify that nuclear gauge measurements be used.

When cores are used, the Contractor shall provide all labor and equipment for the coring operation and filling the core holes. When nuclear density gauges are used, the tests will be performed in accordance with CP 81 and CP 82.

In-place density for SMA shall be 93 to 97 percent of the SMA mix maximum specific gravity as measured according to CP 51.

Subsection 401.22 shall include the following:

Acceptance, testing, and pay factors for SMA shall be in accordance with subsections 105.05 and 106.05 as revised for this project for Hot Mix Asphalt. The Specifications for gradation acceptance shall be applied for all SMA placed on the project.



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**REVISION OF SECTIONS 401 AND 703  
STONE MATRIX ASPHALT PAVEMENT**

Subsection 703.06 shall include the following:

Mineral filler for the Stone Matrix Asphalt pavement shall be limestone dust and shall meet the requirements of this subsection and the following:

Plasticity Index (AASHTO T90)            4% Maximum

The Contractor shall submit hydrometer analysis (AASHTO T88) for the mineral filler used in the SMA mix.

**REVISION OF SECTION 403  
 HOT MIX ASPHALT**

Section 403 of the Standard Specifications is hereby revised for this project as follows:

Subsection 403.02 shall include the following:

The design mix for hot mix asphalt shall conform to the following:

**TABLE 403-1**

Property	Test Method	Value For Grading			
		S (100 )		SX(100 )	Patching
Air Voids, percent at: N (initial) [for information only] N (design)	CPL 5115	3.5 – 4.5		3.5 – 4.5	3.5 – 4.5
Lab Compaction (Revolutions): N (initial) [for information only] N (design)	CPL 5115	8 100		8 100	8 100
Stability, minimum	CPL 5106	30		30	30
Aggregate Retained on the 4.75 mm (No. 4) Sieve with at least 2 Mechanically Induced fractured faces, % minimum	CP 45	70		70	70
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109 Method B	80		80	80
Minimum Dry Split Tensile Strength, kPa (psi)	CPL 5109 Method B	205 (30)		205 (30)	205 (30)
Grade of Asphalt Cement, Top Layer		PG 64-22*		PG 76-28	PG 76-28
Grade of Asphalt Cement, Layers below Top		PG 64-22			PG 64-22
Voids in the Mineral Aggregate (VMA) % minimum	CP 48	See Table 403-2		See Table 403-2	See Table 403-2
Voids Filled with Asphalt (VFA), %	AI MS-2	65-75		65-75	65-75
Dust to Asphalt Ratio Fine Gradation Coarse Gradation	CP 50	0.6 – 1.2 0.8 – 1.6		0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6
Note: AI MS-2 = Asphalt Institute Manual Series 2 Note: The current version of CPL 5115 is available from the Region Materials Engineer. Note: Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems. Note: Gradations for mixes with a nominal maximum aggregate size of one-inch or larger are considered a coarse gradation if they pass below the maximum density line at the #4 screen. Gradations for mixes with a nominal maximum aggregate size of ¾ inch or smaller are considered a coarse gradation if they pass below the maximum density line at the #8 screen.					

\* PG 64-22 allowed on top layer of detour pavement only

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**REVISION OF SECTION 403  
 HOT MIX ASPHALT**

All mix designs shall be run with a gyratory compaction angle of 1.25 degrees and properties must satisfy Table 403-1. Form 43 will establish construction targets for Asphalt Cement and all mix properties at Air Voids up to 1.0 percent below the mix design optimum.

**TABLE 403-2**

<b>Minimum Voids in the Mineral Aggregate (VMA)</b>			
<b>Nominal Maximum Size*, mm (inches)</b>	<b>***Design Air Voids **</b>		
	<b>3.5%</b>	<b>4.0%</b>	<b>4.5%</b>
37.5 (1½)	11.6	11.7	11.8
25.0 (1)	12.6	12.7	12.8
19.0 (¾)	13.6	13.7	13.8
12.5 (½)	14.6	14.7	14.8
9.5 (¾)	15.6	15.7	15.8
* The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%. ** Interpolate specified VMA values for design air voids between those listed. *** Extrapolate specified VMA values for production air voids beyond those listed.			

The Contractor shall prepare a quality control plan outlining the steps taken to minimize segregation of HMA. This plan shall be submitted to the Engineer and approved prior to beginning the paving operations. When the Engineer determines that segregation is unacceptable, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

Hot mix asphalt for patching shall conform to the gradation requirements for Hot Mix Asphalt (Grading SX) (100) (PG 76-28) for the top lift. Lower lifts shall conform to the gradation requirements for Hot Mix Asphalt (Grading SX) (100) (PG 76-28) or Hot Mix Asphalt (Grading S) (100) (PG 64-22). Patching asphalt for the detour section may also utilize Hot Mix Asphalt (Grading S) (100) (PG 64-22) for the top lift.

A minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the aggregate for all hot mix asphalt.

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**REVISION OF SECTION 403  
HOT MIX ASPHALT**

Subsection 403.03 shall include the following:

If liquid anti-stripping additive is added at the plant, an approved in-line blender must be used. The blender shall be in the line from the storage tank to the drier drum or pugmill. The blender shall apply sufficient mixing action to thoroughly mix the asphalt cement and anti-stripping additive.

The Contractor shall construct the work such that all roadway pavement placed prior to the time paving operations end for the year, shall be completed to the full thickness required by the plans. The Contractor's Progress Schedule shall show the methods to be used to comply with this requirement.

Delete subsection 403.05 and replace with the following:

**403.05** The accepted quantities of hot mix asphalt will be paid for in accordance with subsection 401.22, at the contract unit price per ton for the bituminous mixture.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Hot Mix Asphalt (Grading SX)(100)(PG 76-28)	Ton
Hot Mix Asphalt (Grading S)(100)(PG 64-22)	Ton
Hot Mix Asphalt (Patching)(Asphalt)	Ton

Aggregate, asphalt recycling agent, additives, hydrated lime, and all other work necessary to complete each hot mix asphalt item will not be paid for separately, but shall be included in the unit price bid. When the pay item includes the PG binder grade, the asphalt cement will not be measured and paid for separately, but shall be included in the work. When the pay item does not include the PG binder grade, asphalt cement will be measured and paid for in accordance with Section 411. Asphalt cement used in Hot Mix Asphalt (Patching) will not be measured and paid for separately, but shall be included in the work.

Excavation, preparation, and tack coat of areas to be patched will not be measured and paid for separately, but shall be included in the work.

**REVISION OF SECTION 403  
 STONE MATRIX ASPHALT PAVEMENT**

Section 403 of the Standard Specifications is hereby revised for this project as follows:

Subsection 403.01 shall include the following:

This work includes placing a Stone Matrix Asphalt (SMA) pavement as shown on the plans.

Subsection 403.02 shall include the following:

The SMA gradation for this project shall be ½ inch.

Mixture design and field control testing of SMA shall be performed using either the SuperPave (CPL 5115, 100 Gyration) or the Marshall Method (AASHTO T245, 50 Blow).

A minimum of two weeks prior to the proposed use of any Stone Matrix Asphalt pavement on the project, a pre-paving conference will be conducted. At that time, the Contractor shall submit to the Engineer, a mix design meeting the appropriate specification requirements for one of the following:

The SuperPave SMA mix design shall conform to the requirements of Table 403-1a:

**Table 403-1a**

Property	Test Method	Value for SMA
Air Voids, percent at: N(Design)	CPL 5115	3.0 – 4.0
Lab compaction (Revolutions) N(Design)	CPL 5115	100
Accelerated Moisture Susceptibility, tensile strength Ratio, (Lottman), minimum	CPL 5109, Method B	70
Minimum Dry Split Tensile Strength, psi	CPL 5109, Method B	30
Grade of Asphalt Cement		PG 76-28
Voids in the Mineral Aggregate (VMA) %, minimum	CP 48	17
Draindown at Production Temperature	AASHTO T305	0.3 maximum
% VCA <sup>1</sup> <sub>MIX</sub>	AASHTO R 46	Less than VCA <sub>DRC</sub> <sup>2</sup>
Note: The current version of CPL 5115 is available from the Region Materials Engineer		
Note: Copies of AASHTO R 46 and M 325 can be obtained from the Region Materials Engineer		
Note: <sup>1</sup> Voids in the Coarse Aggregate		
Note: <sup>2</sup> Dry-rodged condition		

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**REVISION OF SECTION 403**  
**STONE MATRIX ASPHALT PAVEMENT**

Form 43 will establish construction targets for asphalt cement and all mix properties at air voids up to 1.0 percent below the mix design optimum.

The Marshall SMA mix design shall conform to the following:

Mix Properties	Value
Stability, Marshall Compactor	1400 lbs., min
% Voids in Total Mix	3 – 4%
VMA (% Voids in the Mineral Aggregate)	17 min.
Lottman, CPL 5109, Method B	70% min
Dry Tensile Strength, (CPL 5109)	30 psi, min.

Regardless of mix design method, a minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the aggregate for all Stone Matrix Asphalt.

The SMA Mix design must be approved by the Engineer before any pavement is placed on the project. In addition, the Contractor shall provide field control testing during production of the SMA mix and for the demonstration control strip. The Contractor shall perform the following tests and provide the results to the Engineer during production:

If a SuperPave SMA mix design is used, the Contractor shall perform the following tests and provide the results to the Engineer during production:

Superpave Mix Property	Frequency
Draindown (AASHTO T 305)	1/1000 tons or fraction thereof
Percent Voids in the total mix @ $N_{(design)}$	1/1000 tons or fraction thereof
VMA (Percent Voids in the Mineral Aggregate) @ $N_{(design)}$	1/1000 tons or fraction thereof
Lottman, CPL 5109, Method B	1/5000 tons or fraction thereof
Dry Tensile Strength, CPL 5109	1/5000 tons or fraction thereof
Percent AC & Aggregate Gradation CP 5120	1/1000 tons or fraction thereof

If a Marshall SMA mix design is used, the Contractor shall perform the following tests and provide the results to the Engineer during production:

Marshall Mix Property	Frequency
Draindown (AASHTO T 305)	1/1000 tons or fraction thereof
Stability (Marshall)	1/1000 tons or fraction thereof
Percent Voids in the total mix	1/1000 tons or fraction thereof
VMA (Percent Voids in the Mineral Aggregate)	1/1000 tons or fraction thereof
Lottman, CPL 5109, Method B	1/5000 tons or fraction thereof
Dry Tensile Strength, CPL 5109	1/5000 tons or fraction thereof
Percent AC & Aggregate Gradation CP 5120	1/1000 tons or fraction thereof

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**REVISION OF SECTION 403  
STONE MATRIX ASPHALT PAVEMENT**

Subsection 403.03 shall include the following:

The mineral filler for SMA shall be stored in a separate silo and added automatically in the correct proportion. The mineral filler addition equipment shall be electronically or mechanically interlocked to the aggregate feed sensors so that the proper amount of mineral filler is added whenever SMA is produced.

The SMA mineral filler shall be added at the same point the asphalt cement is added to the aggregate.

Tack coat between the existing pavement and Stone Matrix Asphalt pavement shall be placed at a rate between 0.03 and 0.05 gallons per square yard.

Before proceeding with SMA placement, the Contractor shall demonstrate the ability to produce and place a satisfactory mix in a Demonstration Control Strip (DCS). The Contractor will coordinate with the Engineer on the proposed location of the DCS. The DCS shall consist of a minimum quantity of 500 tons placed in one lane, full width. Within the last 200 tons of SMA placed in the DCS, the Contractor and CDOT shall determine properties (VMA, Voids, in-place density, AC content, gradation, and Marshall Stability, if required) of the project produced SMA mix used in the DCS and provide the results to the Engineer. The Contractor may proceed with full production if all mixture properties are within the specified tolerances.

To determine the in-place density and roller pattern, one core shall be taken at three random locations within the last 200 tons of the DCS. The Engineer will determine the coring locations using a stratified random sampling process. The cores shall be immediately submitted to the Engineer and will be used for determining acceptance of the DCS. Densities of the random samples will be determined by cores according to CP 44. Coring shall be performed by the contractor under CDOT observation. Coring will not be measured and paid for separately but shall be included in the work.

The DCS will be designated as a separate process. Payment for the DCS will be made in accordance with Subsection 105.05, Conformity to the Contract of Hot Mix Asphalt.

Subsection 403.04 shall include the following:

Stone Matrix Asphalt will be measured by the actual number of tons that are completed and accepted.

Subsection 403.05 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Stone Matrix Asphalt (Fibers)(Asphalt)	Ton

Mix design, furnishing, hauling, preparing, and placing all materials, including aggregates, asphalt cement, limestone dust, hydrated lime, tack coat, and approved demonstration control strip; labor, equipment tools, setting of lines and guides where specified, and all other work necessary to complete the item will not be paid for separately but shall be included in the work.

**REVISION OF SECTION 403**  
**HOT MIX ASPHALT TICKET COLLECTION**

Section 403 of the Standard Specifications is hereby revised for this project as follows:

Subsection 403.05 shall include the following:

The Contractor shall collect the scale ticket on each load when it is delivered to the project site, and ensure that the information required in subsection 109.01 is shown on each ticket:

The scale tickets shall be available on site for CDOT personnel to inspect.

Each day the Contractor shall provide to the Engineer envelopes which contain the previous day's signed tickets and the following:

1. On each envelope: Project number, date of paving, type of material, daily total and cumulative total.
2. One of the following:
  - A. Two adding machine tape tabulations of the weight tickets with corresponding totals run and signed by different persons,
  - B. One signed adding machine tape tabulation of the weight tickets that has been checked and signed by a second person,
  - C. Signed check tape of computer scale tickets that have a cumulative total. These scale tickets must be consecutive and without voids adjustments.
3. A listing of any overweight loads on the envelope, including ticket numbers and amount over legal limit.
4. A comparison of the actual yield for each day's placement to the theoretical yield. Theoretical yield shall be based on the actual area paved, the planned thickness, and the actual density of the mixture being placed. Any variance greater than +2.5% shall be indicated on the envelope and a written explanation included.

The Contractor shall provide a vehicle identification sheet that contains the following information for each vehicle:

- (1) Vehicle number
- (2) Length
- (3) Tare weight
- (4) Number of axles
- (5) Distance between extreme axles
- (6) All other information required to determine legal weight.
- (7) Legal weight limit.



**REVISION OF SECTION 412  
TIE BAR INSERTION**

Section 412 of the Standard Specifications is hereby revised for this project as follows:

Subsection 412.13(b) 1 shall include the following:

If tie bars are inserted into plastic concrete with a tie bar insertion machine, tie bar location and concrete consolidation shall be subject to the following additional requirements:

Each 2500 linear feet of longitudinal weakened plane joint resulting from the procedure shall have one random location cored where the core intercepts an inserted tie bar. The core shall be six-inch diameter taken in the presence of the Engineer.

If non-consolidated concrete is evident above the inserted tie bar, the Contractor shall cease paving operations and submit a corrective action plan in writing for approval. Correction of the joint and further paving shall take place only after written approval of the corrective action plan has been provided by the Engineer. Additional coring may be required, as directed by the Engineer. Coring operations, including patching, shall be at the Contractor's expense.

Further failure to consolidate the concrete over the tie-bars will be justification to preclude the use of automatic tie-bar insertion for the remainder of the project.

**REVISION OF SECTION 503  
DRILLED CAISSONS**

Section 503 of the Standard Specifications is hereby revised as follows:

Subsection 503.02 shall include the following:

At the bridge abutments for the I-25 Bridge over Santa Fe (Structure Number F-16-XS), the void between the caisson and the casing shall be filled with a bentonite slurry. The following mix will yield approximately 1.2 cubic yards of acceptable slurry:

- 50 lbs. dry bentonite powder
- Approximately 125 gallons of water or sufficient amount to make a pourable mix
- 1 cubic yard of sand, free of material larger than ½ inch

Cement, lime, fly ash or other pozzolonic or highly alkaline materials shall not be added.

This mixture may be mixed by portable concrete mixers or concrete mixer trucks.

In Subsection 503.06 delete the first sentence and replace with the following:

Temporary casings shall be used, they shall be steel of ample thickness and strength to withstand distortion due to handling, the internal pressure of fresh concrete, and the external pressure of the surrounding soil and groundwater, and shall be watertight.

In Subsection 503.07 delete the first, second, third, fourth and fifth paragraphs and replace with the following:

**503.07 Concrete.** For any portion of the shaft socketed in sandstone/siltstone bedrock, if the concrete is not placed the same day the drilling of the socket occurs, the Contractor shall increase the socket 1/3 of the specified socket prior to placing the concrete. The reinforcing cage shall extend to the new tip elevation.

Foundation piling shall not be drilled, excavation performed or additional caissons drilled within a clear distance of 20 feet of a recently placed caisson until the concrete for that caisson has attained a minimum strength of 1500 psi as determined by the engineer.

Concrete for each drilled caisson shall be placed in one continuous pour. Concrete shall be carefully placed in its final position by means of a concrete pumping machine and a rigid discharge pipe. The bottom of the discharge pipe shall be lowered to within one foot of the bottom of the drilled hole to start concrete placement and shall be raised at a rate that will keep the discharge pipe continuously embedded in the fresh concrete a minimum of five feet. Air and water shall be excluded from the discharge pipe by keeping it continuously filled. The continuity of the operation shall be maintained without breaking the seal between the concrete mass and the discharge pipe until the placement is completed. The layer of water diluted concrete which has been floated to the top during placement shall be removed to a depth as directed by the Engineer and disposed. In no case shall the removed layer be less than 1 foot thick. Only that concrete which meets specification requirements shall remain as part of the caisson. The caisson concrete shall not be disturbed after it has been deposited.

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**REVISION OF SECTION 503  
DRILLED CAISSONS**

Add Subsection 503.071 immediately following Subsection 503.07 as follows:

**503.071 Cross-Hole Sonic Logging**

(a) *General Requirements.*

The nondestructive testing method called Cross-hole Sonic Logging (CSL) shall be used on the below listed production drilled shafts:

I25 over Santa Fe (F-16-XS):

- All Pier Caissons (48 inch diameter)

Ramp 1 Flyover (F-16-XR):

- Pier 5 Caisson (72 inch diameter)

The testing shall not be conducted until 48 hours after the placement of all concrete in a shaft, and must be completed within 45 calendar days after placement on production drilled shafts. The Engineer may specify a longer minimum time if special retarders, mix designs, or other factors result in slower-setting concrete.

The CSL tests shall be conducted by an experienced independent testing organization retained by the Contractor and approved by the Engineer prior to testing.

The CSL tests measure the time it takes for an ultrasonic pulse to travel from a signal source in one access tube to a receiver in another access tube. In uniform, good quality concrete, the travel time between equidistant tubes will be relatively constant and correspond to a reasonable concrete pulse velocity from the bottom to the top of the foundation. In uniform, good quality concrete, the CSL test will also produce records with good signal amplitude and energy. Longer travel times and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, voids, honeycomb and soil intrusions. The signal will be completely lost by the receiver and CSL recording system for the more severe defects such as voids and soil intrusions.

Upon completion of CSL testing all water shall be removed from access tubes and any other drilled holes. After the CSL results have been evaluated, required repair of defects has been conducted and the repair has been evaluated with another CSL survey, the CSL tubes shall then be grouted at the direction of the Engineer with an approved prepackaged grout having a minimum compressive strength of 4000 psi.

(b) *Preparation for Testing*

A minimum of **four** (4) CSL tubes shall be installed in each drilled shaft, equally spaced around the perimeter of the shaft at 90 degrees, as shown in the Contract Plans.

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**REVISION OF SECTION 503  
DRILLED CAISSONS**

The tubes shall be Schedule 40 steel with an inside diameter of 1 ½ inches to 2 inches. Galvanized steel will not be permitted. Substitution will not be permitted. Pipes shall have a round, regular internal diameter free of defects or obstructions, including any at pipe joints (all pipe joints shall be threaded without any couplings), in order to permit the free, unobstructed passage of a 1.35 inch diameter source and receiver probe. Tubes shall be watertight and free from corrosion with clean internal and external faces to ensure passage of the probes, and to provide good bond with the concrete.

CSL pipes shall be fitted with a watertight shoe on the bottom and a removable cap on the top. The pipes shall be securely attached to the interior of the reinforcement cage with a minimum cover of 3 inches.

Pipes shall be installed in each shaft in a regular, symmetric pattern such that each tube is placed the maximum distance possible from each adjacent tube, with a spacing of 90 degrees around the perimeter of the cage as specified above. The tubes shall be as near to parallel as possible, and are typically wire-tied to the reinforcing cage every 3 feet, or are otherwise secured such that the tubes stay in position during placement of the rebar cage and concrete.

The tubes shall extend from ½ foot above the shaft bottoms to at least 3-feet above the shaft tops. Under no circumstances shall the tubes be allowed to rest on the bottom of the drilled excavation. If the shaft top is sub-surface, the tubes shall extend at least 3 feet above the ground or water surface.

All joints in the tubes required to achieve full-length shall be made watertight. Care shall be taken during reinforcement installation operations in the drilled shaft hole so as not to damage the tubes. After placement of the reinforcement cage and prior to concreting the caisson, the tubes shall be filled with clean water as soon as possible (no later than 4 hours after placement of cage) and the tube tops capped or sealed to keep debris out of the tubes. Care shall be exercised in the removal of caps or plugs from the pipes after installation so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and the concrete.

The Contractor shall submit to the Engineer for review the proposed CSL system including equipment schematics, material specifications, tube size, installation details, testing procedures, and joint connections at least 30 days prior to starting drilled caisson construction.

(c) *Typical CSL Test Equipment.* Typical CSL test equipment consists of the following components:

1. A microprocessor based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses and printing of CSL logs.
2. Ultrasonic source and receiver probes for 1-½ inches to 2-inch inside diameter pipe, as appropriate.
3. An ultrasonic voltage pulsar to excite the source with a synchronized triggering system to start the recording system.
4. A depth measurement device to determine and record depths.
5. Appropriate filter/amplification and cable systems for CSL testing.

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**REVISION OF SECTION 503  
DRILLED CAISSONS**

(d) *CSL Logging Procedures*

Before the placement of concrete, a minimum of one tube per shaft shall be plumbed and the tube length recorded, including a notation of the tube projection above the shaft tops. Information on the shaft bottom and top elevations and/or length, along with construction dates shall be provided to the Engineer before the CSL tests.

CSL tests shall be conducted between the pairs of tubes encompassing the perimeter and the major diagonals. Additional logs shall be conducted at no additional cost to the Department in the event anomalies are detected.

The CSL tests shall be carried out with the source and receiver probes in the same horizontal plane unless test results indicate potential defects, in which case, the questionable zone may be further evaluated with angled tests (source and receiver vertically offset in the tubes). CSL measurements shall be made at depth intervals of 0.5 feet or less, and shall be done from the bottom of the tubes working upward to the top of each shaft. Probes shall be pulled simultaneously, starting from the bottoms of the tubes, over a depth-measuring device.

Any slack shall be removed from the cables prior to pulling to provide for accurate depth measurements of the CSL records. Any defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals shall be reported to the Engineer, and further tests shall be conducted as directed by the Engineer to evaluate the extent of such defects.

Additional NDT methods may be used to evaluate possible shaft defects including Single hole Sonic Logging, Gamma-Gamma Nuclear Density Logging, 3D Tomography, and/or Surface Sonic Echo and Impulse Response tests. The Contractor shall provide consultants and/or personnel, on an as needed basis, who are experienced and competent performing the above NDT methods. If a defect is found by the additional NDT, then the cost of the additional NDT shall be the responsibility of the Contractor. If no defect is found by the additional NDT, then the cost of the additional NDT will be the responsibility of the Department.

(e) *CSL Testing Results*

CSL results shall be presented to the Engineer in a report. The test results shall include CSL logs with analyses of:

1. Initial pulse arrival time versus depth
2. Pulse energy/amplitude versus depth

A CSL log shall be presented for each tube pair tested, with any defect zones indicated on the logs and discussed in the test report as appropriate.

Additional needed NDT results shall also be presented to the Engineer in a report format.

Copies of all data (written, electronic, etc.) obtained from the CSL and NDT inspections shall be submitted to the Department in an expedient manner. These submitted copies shall become the property of the Department.

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**REVISION OF SECTION 503**  
**DRILLED CAISSONS**

(f) *Evaluation of CSL Test Results*

The Engineer will evaluate the CSL and NDT (if needed) results within 30 days of receipt from the Contractor and determine whether or not the drilled shaft construction is acceptable.

If the NDT records are complex or inconclusive, the Engineer may require coring in accordance with subsection 503.071(g) below, or excavation of the shaft to verify shaft conditions. If a defect is confirmed, the Contractor shall pay for all coring or excavation costs, including grouting of all core holes. If no defect is encountered, the Department shall pay for all coring or excavation costs, including grouting of all core holes.

The acceptance of each drilled shaft shall be the decision of the Engineer, based on the results of the shaft integrity testing report(s), including shaft coring, and other information on the shaft placement. Rejection of a shaft based on the shaft integrity testing shall require conclusive evidence that a defect exists in the shaft which will result in inadequate or unsafe performance under expected loads.

In the case that any shaft is determined to be unacceptable, the Contractor shall submit a plan for remedial repairs to the Engineer for approval. Any modifications to the foundation shafts and load transfer mechanisms caused by the remedial action will require calculations and working drawings stamped by a Professional Engineer registered in the State of Colorado for all foundation elements affected. All labor and materials required to perform remedial shaft repairs shall be provided at no cost to the Department and with no extension of the contract time.

(g) *Core Drilling of Drilled Shaft Concrete*

When directed by the Engineer, production drilled shafts that are determined to be unacceptable by the CSL tests shall be cored to determine the quality of the concrete. One core sample shall be taken from each defective shaft for the full depth of the irregularities and for three (3) feet above and below the irregularity.

Because it is desired to obtain a high percentage of core recovery for visual inspection and testing methods, equipment shall be as follows:

1. The core drill shall be in good condition and capable of delivering a smooth flow of power to the bit, both in rotation and down thrust. The pump shall be in good condition and of the positive displacement type. The pump shall be capable of delivering a minimum of 15 gallons of water per minute at 200 psi. It shall be equipped with a relief valve set to release at a maximum of 200 psi. It shall be equipped with a pressure gauge with range from 0 psi to 1,000 psi.
2. The drill shall be size HW or larger. The core barrel shall be size HW or larger, M series, double-tubed, with a chromed inner barrel. The diamond set bit for each hole shall be of best quality, new, and with a minimum of four waterways. The Engineer may require a new bit or replacement of the core barrel at any time inspection indicates excessive wear or loss of diamonds.

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**REVISION OF SECTION 503  
DRILLED CAISSONS**

3. The core drill machine shall be set so that the drill force will be exactly vertical and so there will be not more than five (5) feet of laterally unsupported drill rod between the bottom of the drill spindle (chuck) and the top of the shaft concrete when the hydraulic feed is in the up position. When longer laterally unsupported sections of drill stem are necessary, braced casing or rigidly braced guides must be used to prevent lateral whip.

An accurate log of cores shall be kept and the cores shall be placed in a suitable wooden crate and properly marked showing the shaft depth at each interval of core recovery. The cores along with two (2) copies of the coring log shall be turned over to the Engineer for inspection and testing.

Construction shall not proceed above the drilled shaft until the quality of the concrete in the shaft, as represented by the core samples, is determined to be acceptable and notification to continue construction is given by the Engineer.

If the quality of the concrete in a drilled shaft is determined to be acceptable, or after shaft remedial repairs are complete and accepted by the Engineer, the Contractor shall grout the core hole with an approved prepackaged grout having a minimum compressive strength of 4000 psi.

Subsection 503.09 shall include the following:

Cross-Hole Sonic Logging, including but not limited to all preparation, materials, labor, equipment testing, analysis of results, and reporting will not be measured and paid for separately and shall be included in the work.

Materials and labor for mixing and placing bentonite slurry will not be paid for separately, but will be included in the Pay Item Drilled Caisson (42 inch).

## **REVISION OF SECTION 506 GROUTED BOULDERS**

For all work pertaining to the placement of grouted boulders, Section 506 of the Standard Specifications is revised as follows:

Subsection 506.01, include the following:

This work consists of the construction of grouted boulders in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

In Subsection 506.02, first paragraph, the third sentence shall be modified as follows:

Boulders shall have a specific gravity of at least 2.6, measured according to the bulk-saturated surface-dry basis, AASHTO T85.

Subsection 506.02 shall include the following:

Grouted boulder materials used shall conform to the following:

1. A small representative sample of the boulders shall be submitted to the Engineer for approval of the color prior to any deliveries to the project site.
2. Boulders shall be generally block shaped, with relatively flat surfaces on the top, bottom, and sides adjoining adjacent boulders to provide for stable placement, level top surfaces, and tight interlocking with minimal space between boulders.
3. Maximum Ratio of Largest to Smallest Rock Dimension shall be 1.75.
4. The boulders shall have a percentage loss of not more than 10 percent after 5 cycles when tested in accordance with AASHTO Test T104 for ledge rock using sodium sulfate.
5. The boulders shall have a percentage loss of not more than 10 percent after 12 cycles of freezing and thawing when tested in accordance with AASHTO Test T103 for ledge rock, procedure A.
6. Control of gradation will be by visual inspection. However, in the event the Engineer determines the boulders to be unacceptable, the Engineer will pick 2 random truckloads to be dumped and checked for gradation. Mechanical equipment and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the Owner.
7. Rock shall be free of calcite intrusions.



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**REVISION OF SECTION 506  
GROUTED BOULDERS**

8. Grout: Concrete for the grout shall be an approved batch meeting the following requirements: All concrete shall develop 3200 psi compressive strength within 28 days. One cubic yard of grout shall have a minimum of 6 sacks of Type II Portland cement. A maximum of 25% Type F fly ash may be substituted for the Portland Cement. The stone aggregate shall be comprised of 70% natural sand (fines) and 30% 3/4-inch rock (coarse), the slump shall be within a range of 4 to 6 inches and air entrainment shall be 6.5 percent +/- 1.0 percent. Stiffer grout mix or other measures shall be used for steeper slope applications as approved by the Engineer. The water/cement ratio shall not exceed 0.48. The grout shall contain 1.5 pounds per cubic yard of Fibermesh synthetic fiber reinforcement per manufacturer's instructions. The contractor shall submit grout mix design information as specified in Section 601.

Contractor shall furnish laboratory test results that the boulders meet the gradation and specific gravity requirements and the abrasion resistance/compressive strength requirements.

Subsection 506.03 shall include the following:

Prior to placement of boulders, the Engineer shall be notified in order to approve the depth and limits of boulders.

The subgrade to receive each boulder shall be excavated and any unstable material shall be removed. Approved material shall be placed and compacted in a maximum of 8-inch lifts to 95% of Maximum Standard Proctor Density (ASTM D698) and within 2 percent of optimum moisture to re-establish the subgrade of each boulder. Removal and replacement of unstable material shall only be completed at the direction of the Engineer.

The top of all boulders shall be as indicated on the Drawings. Finished grades and subgrades for boulders will be determined from the height of each boulder used.

Boulders shall be carefully picked and arranged so that adjacent rock surfaces match within 2 inches in top elevation and 2 inches along the vertical exposed face or channel side of rock (unless otherwise indicated in the drawings). Boulders shall be placed such that adjacent boulders "touch" each other and voids do not exceed 4 inches. It is the intent of construction to minimize voids and grout placed between boulders. Boulders shall be arranged in a step-like fashion and/or in rows to form "steps" as indicated on the Contract Drawings.

The grout depth shown on the Drawings applies to overall mass of grouted boulders and is intended to generally keep the top of grout well below the top of boulders; however, the depth of grout and/or size or placement of boulders shall be adjusted at the perimeters of the grouted boulders, and at the upstream and downstream ends of drop structures.

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**REVISION OF SECTION 506  
GROUTED BOULDERS**

Prior to placing the grout, all debris, fines, smaller rock, and silt shall be removed from around or under the boulders. Boulder placement shall be approved by the Engineer prior to placing the grout.

Dewatering shall be implemented to ensure that the grout will not be placed in water and for a period of 24 hours after the grout has been placed.

Clean boulders by brushing and washing before grouting. Boulders receiving grout shall be kept wet when receiving grout. The concrete grout shall be placed by means of a low pressure (less than 10 psi) grout pump using a 3-inch diameter nozzle to ensure complete penetration of the grout into the boulder layer as shown on the drawings. A "pencil" vibrator shall be used to make sure all voids are filled between and under the boulders. The intent is to fill all voids from the subgrade level around the boulders to the depth indicated. In all cases, grout must penetrate to the subgrade of boulders.

The operator shall be able to stop the flow and will place grout in the voids and not on the surface of the rocks. Any spillage of grout on exposed boulder faces shall be cleaned and washed before the grout sets. The visual surfaces of the rocks shall be free of grout to provide a clean natural appearance. If washing does not clean off grout residue, then the Contractor shall wash off any grout residue with muratic acid and water, using a brush to scrub off the residue.

All grout between boulders shall be finished with a broom finish.

Batching and mixing requirements, time constraints, and hot and cold weather limitations for grout placement shall conform to specifications in Section 601. Grout shall not be placed when the air temperature is below 40 degrees F. Grout shall not be placed if the weather conditions are such that the grout being placed cannot be completely protected before the advent of damaging weather (such as overnight below 35 degrees F, cold fronts, rainstorms, etc.).

All finished grout surfaces shall be cured immediately after placement by applying a clear membrane forming curing compound as specified in Section 601.13(b). In addition, the blanket method for curing as described in Subsection 601.13(d) shall be used in cold weather to maintain the grout surface at a temperature above 40 degrees F and in a moist condition during the first 7 days after placement. The minimum curing period shall be 7 days. Curing conditions and temperature will be monitored by the Engineer during the curing period.

Subsection 506.05 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Grouted Boulders (___ Inch)	Cubic Yard

Grout, weep drains, and smaller boulders in locations shown on the plans will not be measured or paid for separately, but shall be included in the price of the Grouted Boulders.

**REVISION OF SECTION 506  
SOIL RIPRAP**

Section 506 of the Standard Specifications is hereby revised for this project as follows:

Section 506.03 shall include the following:

Soil riprap is a uniform mixture of seventy percent riprap and thirty percent topsoil. Riprap voids shall be filled with soil materials. Riprap is to be placed in lifts approximately D50 in thickness with rock pieces fully interlocking and minimal voids, with soil added on the top of each lift and vibrated or washed into the voids before the next lift of riprap is placed.

Section 506.04 shall include the following:

Soil riprap will be measured by the cubic yard and includes both the rock (riprap) and topsoil as required in the proportions in Section 506.03.

Section 506.05 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Soil Riprap (9 Inch)	Cubic Yard

## **REVISION OF SECTION 509 PROVIDE TEMPORARY SUPPORT**

Section 509 of the Standard Specifications is hereby revised for this project to include the following:

### **DESCRIPTION**

Subsection 509.01 shall include the following:

This work shall consist of constructing a temporary support for Pier 2 of Bridge Structure No. F-16-DT at the west end of the pier girder in accordance with these specifications and the design shown on the plans. The temporary support is required such that a portion of the end of the existing straddle type pier can be removed in order to construct the I-25 Northbound portion of Structure No. F-16-XS. This temporary support will subsequently be removed in later phases of the project when the existing Bridge Structure F-16-DT is removed in its entirety.

In brief, the sequence of work as shown on the plans shall include the following:

1. Construct two new drilled caissons and foundation cap.
2. Construct concrete columns and cap for temporary support of the existing steel pier girder.
3. Install lateral bracing and bearing stiffeners.
4. Install jacking equipment on top of the temporary support concrete cap, under the existing pier girder.
5. Jack up the existing pier girder, until the vertical movement as specified has occurred.
6. Install new bearing at the temporary support concrete cap.
7. Remove existing bearing.
8. Release the jack, lowering the existing girder onto the new bearing and temporary support.
9. Remove the end of the existing pier girder as specified.
10. Remove the existing concrete column and footing.

Plans of the existing NB I-25 Bridge, Structure No. F-16-DT, are available for information from the Engineer.

### **MATERIALS**

Subsection 509.03 shall include the following:

Bearings shall conform to the requirements of Section 512. Concrete shall be Class D, or as specified on the plans, and shall conform to the requirements of Section 601. Reinforcing Steel shall conform to the requirements of Section 602.

### **CONSTRUCTION REQUIREMENTS**

Subsection 509.27 shall include the following:

The Contractor shall be fully responsible for completing the work safely. The Contractor shall construct the work and remove portions of the existing structure in such sequence and by such methods that will maintain the stability of members until all members have been re-supported and removed. The Contractor shall provide adequate temporary false work if and where necessary to maintain the stability of the structures under all conditions.

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**REVISION OF SECTION 509  
PROVIDE TEMPORARY SUPPORT**

The Contractor shall provide the Engineer with field survey elevations, at locations to be specified by the Engineer, at the existing Pier 2 steel pier girder both prior to construction and during load transfer. The Contractor shall not fabricate or order material until the initial survey elevations have been received by the Engineer and written authorization to proceed with construction of the temporary support has been received from the Engineer.

During transfer of load from the existing support column to the new temporary support, Southbound Santa Fe under the existing bridge, and Northbound I-25 will require a night time closure. The Contractor shall prepare and submit an MHT for this work.

Upon completion of the temporary support, and transfer of all load to the new support has occurred, the existing concrete column and footing shall be removed. All materials removed from the existing bridge structures shall become property of the Contractor and shall be disposed of off the project site unless noted or approved otherwise by the Engineer. Components of the structure that are structural steel may be coated with paint which contains lead. Management and disposal of these steel components, and any paint debris waste shall be accomplished in accordance with Section 250.

The Contractor shall submit a Temporary Support Construction Plan to the Engineer for review a minimum of six weeks prior to beginning the work:

- A detailed construction plan showing the proposed operations, methods, sequence, schedule and equipment to be used.
- Details of any required false work, stamped by a Colorado P.E.
- Permanent disposal location for removed materials.

A Temporary Support Preconstruction Conference shall be held at least fourteen days prior to the beginning the work. The Engineer, Contractor, the removal subcontractor, the Contractor's Health and Safety Officer and the Contractor's Traffic Control Supervisor (TCS) shall attend the preconstruction conference. The Temporary Support Construction Plan shall be finalized at this Conference.

Submittal of the final Temporary Support Construction Plan to the Engineer, and field inspection performed by the Engineer, will in no way relieve the Contractor of full responsibility for the work and procedures.

Should an unplanned event occur during the work or load transfer, or the work deviate from the Temporary Support Construction Plan, the work shall immediately cease after performing any work necessary to ensure worksite safety. Suspension of the work shall in no way relieve the Contractor of his responsibility under the terms of the Contract. Operations shall not resume until modifications have been made to correct the conditions that are resulted in the suspension, and a written notice to resume work is issued by the Engineer.

**METHOD OF MEASUREMENT**

Subsection 509.32 is hereby revised to include the following:

Provide Temporary Support will not be measured, but will be paid for as a single lump sum.

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**REVISION OF SECTION 509  
PROVIDE TEMPORARY SUPPORT**

**BASIS OF PAYMENT**

509.33 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Drilled Caisson (36 Inch)	Linear Foot
Provide Temporary Support (Structure F-16-DT)	Lump Sum
Bearing Device (Type I)	Each

Provide Temporary Support shall include the cost of all materials, equipment and labor to construct the temporary support, and after completion of the work, the removal of portions of the existing structure as shown on the plans. Payment will be full compensation to complete the work, including, but not limited to: excavation, backfill, concrete, reinforcing steel, structural steel, jacking and shoring, removal of portions of the existing structure, preparation and implementation of the Temporary Support Construction Plan, handling and disposal of all materials.

**-1-**  
**REVISION OF SECTION 601**  
**CONCRETE CLASS S50**

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

Delete Subsection 601.05 (6) and replace it with the following:

(6) Class H and HT concrete shall include a measurement of cracking by AASHTO T334 Standard Practice for Estimating the Cracking Tendency of Concrete. The sample shall be cured at a temperature of 65 to 75°F and relative humidity not exceeding 40 percent.

**REVISION OF SECTION 601  
CONCRETE FORM LINER**

Subsection 601.01 shall include the following:

This work shall consist of constructing cast-in-place concrete with form-lined finish in accordance with these specifications and in conformity with the lines, grades and dimensions as shown in the plans.

Subsection 601.12 shall include the following:

*Cast-in-Place Concrete Facing*

The project requires a pattern for use specifically on the project. The accent will be a standard formliner pattern, "Rugged Flagstone". The form liner is to be manufactured by a supplier approved by the Landscape Architect.

The Contractor shall include in the cost of Concrete Class D the cost of purchasing sufficient form liners to complete the construction and meet the project schedule. The form liner pattern and placement shall be as shown on the plans, and approved by the Engineer prior to installation. The Engineer reserves the right to review and relocate the various patterns on each element during construction to address unforeseen field conditions.

Formliners shall be thoroughly cleaned after each use to remove all dirt, mortar and foreign material.

Smooth formed surfaces (surfaces not to receive a form liner finish such as the monuments, wall caps and portions of the barriers) shall receive a Class 2 rubbed finish in accordance with Section 601.

Subsection 601.18 shall include the following:

All concrete facing shall be constructed within the following tolerances:

*Formliner Placement* Position of formliners shall be placed within 1/2 inch of adjacent sections, to properly align the pattern along the wall.

*Test Section* Prior to the commencement of construction, the Contractor shall construct a test section using the proposed formliner system with the proposed construction techniques and equipment. The location of the test panel will be selected by the Engineer. Construction shall match where possible all the details shown on the plans for formliner placement, required chamfers and tolerances.

Subsection 601.19 shall include the following:

The cost of formliners, the test section and all labor and materials associated with providing the patterned finish of concrete will not be measured nor paid for separately, but shall be included in the cost of Item 601 – Concrete Class D.



## **REVISION OF SECTION 601 ANTI-GRAFFITI COATING**

Section 601 of the Standard Specifications is hereby revised for this project to include the following:

### **DESCRIPTION**

Subsection 601.01 shall include the following:

This work consists of the application of a clear anti-graffiti coating to all specified concrete surfaces including, but not limited to, retaining walls, wall caps, bridge girders, bridge rail, bridge abutments, and piers, as indicated in the construction drawings.

### **MATERIALS**

Subsection 601.03 shall include the following:

The coating shall be “Acryli-Master” Anti-Graffiti Coating produced by TSW, Inc. or approved equal. The Contractor shall verify the compatibility of all concrete finishing products.

Approved equals shall be clear, water based, two component, cross-linked acrylic copolymer anti-graffiti coating. The anti-graffiti system shall create a seamless breathable, crack-free, monolithic appearing surface, and shall resist adverse effects from ultraviolet exposure, smog, sulfur dioxide, smoke, ozone, dirt, and other common urban pollutants.

### **CONSTRUCTION REQUIREMENTS**

Subsection 601.14 shall include the following:

Application of anti-graffiti coating shall follow the completed application of stain, in accordance with Revision of Section 601 and 708, Structural Concrete Stain. All staining shall be accepted prior to the anti-graffiti coating application.

The coating shall be applied in accordance with the manufacturer’s recommended procedures.

The coating shall be applied at the rate of approximately 600 square feet per gallon, per coat. A total of four coats is anticipated (or as recommended by the manufacturer).

Prior to application of anti-graffiti coating to the wall and bridge surfaces, the Contractor shall apply a complete coating system to two stained concrete samples, minimum 12 inches square. The samples shall be submitted to the Engineer a minimum of three weeks prior to the application of the coating.

Upon approval of the samples, and prior to the application of the anti-graffiti coating to the wall and bridge surface, the Contractor shall prepare a stained minimum 8 foot x 8 foot square mock-up panel and demonstrate anti-graffiti coating application. The Contractor shall then apply spray paint and permanent marker graffiti to the mock-up panel and demonstrate the actual graffiti removal process. The samples shall be approved by the Engineer a minimum two weeks prior to applying the coating to the project.

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**REVISION OF SECTION 601  
ANTI-GRAFFITI COATING**

**METHOD OF MEASUREMENT**

Subsection 601.19 shall include the following:

Anti-graffiti coating will not be measured but shall be the quantity, in square feet, shown in the plans, except that measurements shall be made when field changes are ordered, or if there is an error of plus or minus 10 percent of the plan quantity.

**BASIS OF PAYMENT**

Subsection 601.20 shall include the following:

The accepted quantities of the Anti-graffiti coating will be paid for at the contract unit price per square foot of surface area.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Structural Concrete Coating (Anti-Graffiti)	Square Foot

The cost shall include all materials and labor required for the complete coating system, as accepted. Samples submitted to the Engineer, mock-ups, and demonstrations required for approval will not be measured and paid for separately, but shall be included in the work.

**REVISION OF SECTIONS 601 AND 708**  
**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 elements constructed under this Contract and designated to receive Structural Concrete Stain; (2) providing and applying an opaque Structural Concrete Stain to all concrete surfaces designated in the Contract Plans to receive a Structure Concrete Stain and (3) provide 5-gallons of pre-mixed touch-up stain in aerosol spray cans.

The color of the Structural Concrete Stain shall be as noted on the plans, and shall be approved by the Engineer from test panels provided by the Contractor.

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, prior to application of the Structural Concrete Coating (Anti-Graffiti).

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

Unless otherwise shown on the plans, 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 coating from coming into contact with them.

The color of the Structural Concrete Stain shall have the written approval of the Engineer prior to final batching and application on the project. The final color of the approved Structural Concrete Stain shall be determined as follows:

- (1) Two (2) foot by two (2) foot samples of the colors required by the Contract, shall be submitted to the Engineer 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.

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**REVISION OF SECTIONS 601 AND 708  
STRUCTURAL CONCRETE STAIN**

- (2) At least three weeks prior to beginning of the application of the Structural Concrete Stain, one hundred (100) square foot test panels shall be prepared for the final color approval by the Engineer. The test panels shall be produced on the actual concrete surface on which the final product will be placed, at a location designated by the Engineer. The Stain shall be applied to the test panels by the same methods to be used in the final field application. The Engineer shall be allowed one week after application to the test panels for final review and approval.

Existing concrete designated to receive Structural Concrete Stain 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 recleaned as required prior to application of the coating.

For concrete construction in this Contract, 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 recleaned 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.

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**REVISION OF SECTIONS 601 AND 708  
STRUCTURAL CONCRETE STAIN**

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 the Engineer to be insufficiently stained shall be restained.

The Stain shall be applied only when the ambient temperature is between 50°F and 90°F, and is anticipated to remain above 40°F for a minimum of twenty-four hours. Stain shall not be applied in windy or wet conditions or when rain or snow is expected within 24 hours. The surface to be stained shall be dry and free of frost.

Subsection 601.18 shall include the following:

Structural Concrete Stain will not be remeasured but shall be the quantity shown on the plans; except that measurements will be made when field changes are ordered, or for an error of plus or minus five percent of the plan quantity.

Subsection 601.19 shall include the following:

The accepted quantities of Structural Concrete Stain will be paid for at the contract unit price per unit of measurement for the Pay Items listed below.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Structural Concrete Stain	Square Yard

Payment shall be full compensation for all work necessary to complete the item and shall include, but not limited to:

- (1) Water based form release agent.
- (2) Sample preparation, and test panels.
- (3) High pressure water blasting, including detergents.
- (4) Abrasive blasting.
- (5) Structural Concrete Stain and application.
- (6) Test Panels.
- (7) Structural Concrete Stain for Test Panels.

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**REVISION OF SECTIONS 601 AND 708  
STRUCTURAL CONCRETE STAIN**

Subsection 708.08 shall include the following:

708.08 Structural Concrete Stain: The stain shall be water-based acrylic microemulsionsiloxane solution containing not less than 15 percent solids by volume and not more than 210g/L VOC, or equal with Engineer's written approval.

All stain must be delivered to the project site in sealed containers bearing the manufacturer's original labels.

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 the Engineer before the Contractor begins applying the Stain.

**REVISION OF SECTION 603**  
**STORM SEWER PIPE**

Section 603 of the Standard Specifications is hereby revised for this project as follows:

Subsection 603.02 shall include the following:

The provision in the General Notes for Standard Plan M-603-2, which allows the use of non-reinforced concrete pipe in lieu of reinforced concrete pipe, is deleted.

All storm sewer pipe shall be reinforced concrete pipe in accordance with Section 706.02 and shall be produced as a sulfate-resistant product in accordance with the sulfate exposure class shown on the General Notes sheet of the plans and the requirements of the Standard Special Provision titled "Revision of Section 601 and 701 – Structural Concrete".

In addition to any deficiencies covered by the applicable AASHTO & ASTM Specifications, concrete pipe, which has any of the following visual defects, will not be accepted.

- A. Porous spots on either the inside or the outside surface of a pipe having an area of more than 10 square inches and a depth of more than 1/2 inch.
- B. Pipe which has been patched to repair porous spots, cracks, or other defects, when such patching was not approved by the Engineer.
- C. Exposure of the reinforcement when such exposure would indicate that the reinforcement is misplaced.
- D. Pipe that has been damaged during shipment or handling, even if previously approved before shipment

Acceptance of the pipe at the point of delivery will not relieve the Contractor of full responsibility for any defects in material or workmanship of the completed pipeline.

Subsection 603.03 shall be revised to include the following:

The Contractor shall clean all drainage structures and connecting pipes (including existing appurtenances within project limits) upon completion of the project. Adequate sediment control must be in place prior to cleaning.

Subsection 603.04 shall be revised to include the following:

No open trench for storm sewer, culverts, or other pipeline construction shall be left exposed during non-working hours by the Contractor.

Any trench excavation that is made in advance of pipe or structure installation shall be utilized by placing pipe and backfilling during the same working shift. If any open trench remains after pipe laying or structure construction takes place, the trench shall be backfilled or adequately protected with construction fencing at the Contractor's expense prior to the time that the Contractor's work stops and the site is vacated.

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**REVISION OF SECTION 603  
STORM SEWER PIPE**

The length of trench permitted to be open at any one time may be limited when such limitation is necessary for the safety and convenience of the public. All excavation, trenching, shoring, and stock-piling of excavated materials shall be in strict compliance with the applicable OSHA rules and regulations.

Subsection 603.06 shall include the following:

When plugs are specified on the plans, or when temporary plugs are needed to accommodate construction phasing, they shall be precast concrete or match the pipe material being plugged.

Subsection 603.07 shall include the following:

The Contractor shall use water-tight rubber gasketed joints in all storm sewer and irrigation pipe work. All joints shall be constructed in such a manner that the alignment and flow line grade of the bottom of the pipe is accurately maintained.

Subsection 603.11 and 603.12 shall include the following:

Additional backfill required over pipes to meet the minimum cover shown on the plans will not be measured and paid for separately, but shall be included in the work.

The cost for cleaning all drainage structures and connecting pipes upon completion of the project will not be paid for separately, but shall be included in the work.

Installation and removal of plugs (temporary or permanent) will not be paid for separately, but shall be included in the work.

<b>Pay Item</b>	<b>Pay Unit</b>
__ Inch Reinforced Concrete Pipe (Sulfate Resistance Class 3)	LF
__ Inch Reinforced Concrete End Section (Sulfate Resistance Class 3)	Each

(Note: “\_\_” shall be understood to be substituted with all sizes indicated in the plans.)

In subsection 603.12, the third paragraph shall be deleted and replace with the following:

Structure excavation, structure backfill, structure backfill (flow-fill), bedding, and bed course material for new pipes will not be measured or paid for separately, but will included in the work. Any additional backfill required over pipes to meet the minimum cover shown on the plans will not be measured and paid for separately, but shall be included in the work.



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**REVISION OF SECTION 604  
MANHOLES AND INLETS**

Section 604 of the Standard Specifications is hereby revised to include the following:

Subsection 604.02 shall include the following:

All concrete products and construction shall be sulfate-resistant product in accordance with the sulfate exposure class shown on the General Notes sheet of the plans and the requirements of the Standard Special Provision titled "Revision of Section 601 and 701 – Structural Concrete".

The contractor is hereby notified that the structure sizes shown on the plans for all inlets and manholes are based on the use of a cast-in-place structure. Precast structures are allowed for non-special structures, with the provisions provided in Section 604.04. In the event that the contractor determines that the use of a precast structure will require an increase in structure size, the cost associated with this size increase will not be paid for but shall be included in the work.

Subsection 604.04(a) shall include the following:

The contractor will take the responsibility that all rims match the proposed grades, for both precast and cast-in-place manholes. In the event that field conditions are not as anticipated, required modifications to all precast structures shall be at the contractor's expense.

Subsection 604.04(c) shall include the following:

Precast inlets are allowed. The contractor will take responsibility that all tops, rims and gutter sections shall be cast-in-place to match road profile and field conditions. In the event that field conditions are not as anticipated, required modifications to all precast structures shall be at the contractor's expense.

Subsection 604.07 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Manhole Slab Base (___ Foot) (Sulfate Resistance Class 3)	Each
Inlet Type C (___ Foot) (Sulfate Resistance Class 3)	Each
Inlet Type 13 (___ Foot) (Sulfate Resistance Class 3)	Each
Inlet Type R L ___ (___ Foot) (Sulfate Resistance Class 3)	Each

(Note: "\_\_\_" shall be understood to be substituted with all sizes indicated in the plans.)

Where inlet caps are required on the plans, caps shall not be measured and paid for separately, but shall be included in the cost of the inlet.

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**REVISION OF SECTION 604**  
**MANHOLES AND INLETS**

The use of precast inlets and manholes may require an increase in the structure size denoted on the plans. The cost associated with an increase in structure size due to the use of precast structures shall be included in the work.

Manhole rehabilitation, including reforming of deteriorated benches and inverts and the seal coating of manhole barrel sections will not be measured and paid for separately, but shall be included in the work.

Marker posts for new manholes shall not be paid for separately, but shall be included in the work.

**REVISION OF SECTION 604**  
**OUTLET STRUCTURE**

Section 604 of the Standard Specifications is hereby revised to include the following:

Subsection 604.01 shall include the following:

This work consists of the construction of the outlet structure for the North Bound Santa Fe Water Quality Pond as shown on the plans and details.

Subsection 604.02 shall include the following:

All concrete products and construction shall be sulfate-resistant product in accordance with the sulfate exposure class shown on the General Notes sheet of the plans and the requirements of the Standard Special Provision titled "Revision of Section 601 and 701 – Structural Concrete".

Orifice plates, trash racks, water quality screens, and other miscellaneous metals shall meet the requirements of subsection 712.06.

Subsection 604.04 shall be retitled as follows:

604.04 Manholes, Inlets, Outlet Structures, and Meter Vaults.

Subsection 604.04 shall include the following:

- (f) Outlet Structures. Outlet structures shall be cast-in-place to the grades and dimensions shown on the plans to insure proper alignment of grades. Precast structures will not be allowed.

Subsection 604.06 shall include the following:

Outlet Structures will be measured by the unit.

Structure excavation, structure backfill, filter material, concrete, reinforcing steel, inlet grates and frames, orifice plates, trash racks, water quality screens, other miscellaneous metals, connecting devices, and all other labor, equipment, materials, and incidentals required to construct outlet structures as shown on the plans will not be measured and paid for separately, but shall be included in the work.

Subsection 604.07 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Outlet Structure	Each

**REVISION OF SECTION 605  
 SUBSURFACE DRAINS**

Section 605 of the Standard Specifications is hereby revised for this project as follows:

Subsection 605.01 shall include the following:

This work consists of the furnishing and installation all materials required to construct underdrains and underdrain cleanouts at the end of each run of underdrain in the East Alameda Water Quality Pond and the Ramp 4 Water Quality Pond.

Subsection 605.02 shall include the following:

The underdrain pipe for the East Alameda Water Quality Pond and the Ramp 4 Water Quality Pond shall be of the materials and dimensions shown on the plans. Perforated underdrains shall be of the materials and dimensions shown on the plans. Perforations in the perforated underdrain shall be according to the table below:

<b>Pipe Size</b>	<b>Slot Length</b>	<b>Maximum Slot Width</b>	<b>Slot Centers</b>	<b>Open Area</b>
4 Inch	1-1/16 Inch	0.032 Inch	0.413 Inch	1.90 Inch <sup>2</sup>
6 Inch	1-3/8 Inch	0.032 Inch	0.516 Inch	1.98 Inch <sup>2</sup>

Subsection 605.03 shall be revised to include the following:

The underdrain pipes and underdrain cleanouts shall be installed to the dimensions and locations shown on the plans.

Subsection 605.07 shall be revised to include the following:

Underdrain cleanouts will not be measured.

Subsection 605.08 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
__ Inch Perforated Pipe Underdrain	Linear Foot

(Note: “\_\_” shall be understood to be substituted with all sizes indicated in the plans.)

All materials and work to construct underdrain cleanouts including but not limited to pipe fittings, solid underdrain pipe, cast iron frame and lid, and concrete pad will not be paid for separately but will be included in the cost of the work to install the perforated underdrain pipe.

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**REVISION OF SECTION 607  
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 plans and these specifications. The Contractor shall provide certification from the manufacturer that all materials used are in compliance with the requirements of the plans and these specifications.

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 plans. 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 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 Engineer for approval a 12" X 12" sample of the fabric (showing the exact coating and fabric construction to be used) and manufacturer's literature covering all aspects of the system he intends to install 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 plans. When 3/8" mesh with 12 gauge wire is specified in the plans the following properties shall apply.

Mesh	3/8" clear opening
Core wire breaking strength	650 lbs (minimum)
Core wire diameter	0.105 inch +/-0.005"
Galvanizing, Class C fabric	1.2 oz./sq. ft.
Galvanizing, Class B fabric	0.30 oz./sq. ft.
Vinyl Coating Class B Fabric	0.008 inch +/-0.002 inch

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

Tension wires shall be AASHTO M181 Type 1 Class 2; or, when vinyl coating is specified in the plans, 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, as noted in the plans, satisfying ASTM A53 Type E or S, Grade B (Fy = 35000 psi minimum yield strength); or, at the Contractor's option, ASTM A466 Grade D pipe (Fy = 50000 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, as approved by the Engineer.

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**REVISION OF SECTION 607  
FENCE CHAIN LINK SPECIAL**

Alternative Pipe

Nominal Diameter <u>(In.)</u>	Outside Diameter <u>(In.)</u>	Weight <u>(Lb / Ft)</u>	Wall Thickness <u>(In.)</u>
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 plans. 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 plans, 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 plans when the test load described in the plans is applied. The Engineer may choose to assure this quality by observing these tests, or by performing tests of his own. 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.

Subsection 607.04 shall include the following:

Fence Chain Link (Special) (36 Inch) will be measured by the linear foot. Measurement will be along the base of the fence from center to center of the extreme end posts.

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**REVISION OF SECTION 607**  
**FENCE CHAIN LINK SPECIAL**

Subsection 607.05 shall include the following:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Fence Chain Link (Special)(36 Inch)	Linear Foot

Payment per linear foot shall include all costs for a complete installation of anchorages, posts, horizontal members, truss rods, tension wires, fabric, stretcher bars, and ties as required by the plans. All other incidental hardware required will not be measured and paid for separately, but shall be included in the work.

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## REVISION OF SECTION 612 LOCATION MARKERS

Section 612 of the Standard Specifications is hereby revised for this project as follows:

Subsection 612.01 shall include the following:

This work includes the placement of location markers for identifying fiber optic cable and other utilities at locations shown on the plans.

Subsection 612.02 shall include the following:

(c) *Location Markers.*

1. *Location Marker (Fiber Optic) (Dome).* Domed location markers shall be made of non-conductive high-density polymer, and shall be integrally white in color with an orange cap. All colors shall be stabilized against ultraviolet light such that they will not fade under continuous exposure to direct sunlight. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F.
2. *Location Marker (Utility) (Flat Slat).* Flat slat location markers shall be made of fiberglass reinforced composite, and shall be integrally orange in color. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F.

Concrete aprons and footing supports shall be Concrete Class B and shall be in accordance with Section 601.

Subsection 612.03 shall include the following:

1. *Location Marker (Fiber Optic) (Dome).* Markers shall be installed at appropriate Pull Box and Manhole (TMS) locations as shown on the plans to identify both the backbone fiber cable and lateral fiber cable. To additionally designate the fiber cable, markers will be installed at 1000-foot spacings along the running line.

The markers shall include a label with CDOT contact information and the designation of "FIBER OPTIC CABLE". The label shall be black lettering on an orange background. The Contractor shall provide the labels per the information provided by the Project Engineer.

2. *Location Marker (Utility) (Flat Slat).* Markers shall be installed at appropriate Pull Box and Manhole (TMS) locations as shown on the plans to identify both electric and telephone communication lines. To additionally designate the utilities, an additional marker is to be installed midpoint between the CDOT utility "d-mark" connection point and the device.

The markers shall include a label with CDOT contact information and the designation of "ELECTRICAL CABLE" or "TELEPHONE CABLE". The label shall be black lettering on an orange background. Additional lettering shall be as directed by the Engineer.



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**REVISION OF SECTION 612**  
**LOCATION MARKERS**

The Contractor shall provide the Engineer with three copies of detailed As-Built drawings showing the installed locations of all markers and the associated utilities that they identify. These drawings shall include but not be limited to the following:

- (1) Type of location marker installed
- (2) Distances between location markers
- (3) Distances between pull boxes and manholes to ITS devices
- (4) The distance and location to each CDOT utility “d-mark” connection source point which the local utility companies have provided, including electrical power, transformer source, and telephone pedestals.

Two copies of the As-Built drawings shall be delivered to:  
Colorado Traffic Management Center  
425 C Corporate Center  
Golden, CO 80401

Subsection 612.04 shall include the following:

Location markers will not be measured and paid for separately, but shall be incidental to the pull box installation.

Payment will be full compensation for all work, materials and equipment required to place the markers at the locations shown on the plans, including excavation, backfill, and patching.

Concrete for aprons shall be paid for under Pay Item 613, Pull Box. Concrete for footing supports will not be measured and paid for separately but shall be included in the work.

## **REVISION OF SECTION 613 LIGHTING**

### **DESCRIPTION**

**613.01** This work consists of furnishing and installing foundations, light standards, luminaires, lamps, conduit, cable, wiring and incidental materials for highway lighting and for traffic signal installations in accordance with these specifications and in conformance with the details, lines, grades and locations shown on the plans or established.

### **MATERIALS**

**613.02** Highway lighting materials shall conform to the requirements of Section 715, and shall be compatible with the requirements of the local utility company.

Electrical conduit for traffic signal installations shall conform to 715.06.

At the preconstruction conference the Contractor shall submit three copies of a list of all materials and equipment to be incorporated into the work, to the Engineer for review and approval (including type of metal pole - either steel or aluminum). Also included shall be detail plans, drawings, photographs, photometric charts, templates, manufacturer's specifications and recommendations, and all other available information pertinent to this work. The Contractor shall not order materials or equipment until written approval is received from the Engineer. Approval of the above required submission shall not relieve the Contractor of responsibility for the proper functioning of the completed installation.

Materials shall conform to the applicable requirements of the National Electrical Code and shall be a type currently recommended and approved by Underwriters' Laboratories, Inc.

#### Mid Mast Materials

##### (a) General

Before ordering any materials, the Contractor shall submit to XCEL ENERGY for approval three (3) copies of a complete list of all of the mid mast lighting equipment and materials which the Contractor intends to install. This list shall include, but is not limited to, the following:

- Light standards, anchor bolts, and luminaire mountings.
- Luminaires, lamps, and ballasts.
- Cables, splicing, and termination devices.
- Conduits, conduit bends and splices, and electrical bushings.
- Fuseholders, fuses, and cable disconnect devices.
- Control equipment, breakers, switches, conductors, relays, enclosures, etc.
- Pull boxes.
- Wiring and connection diagrams of all circuits, fixtures, luminaires, etc.

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The list shall include the brand name, identifying numbers, relevant technical data, and all other information necessary for the agency responsible for maintenance of the system to procure exact replacements of any and all equipment and material used on the Project.

XCEL ENERGY Contact person is: Steve Smith (303-571-3945)

(b) Structural Steel

All structural steel furnished, except as otherwise specified on the Contractor's Drawings, shall meet the requirements of Section 509 of the Standard Specifications, galvanized in accordance with the requirements of ASTM A-123, and then treated as follows:

1. All galvanizing shall be performed in accordance with the requirements of ASTM A-123. All areas where galvanized coating has been damaged during handling and transporting shall be painted with one full brush coat of zinc-rich paint meeting Military Specification DOD-P-21035A. The longitudinal welding along the light standard and the welding of the end attachments made during fabrication shall be performed prior to galvanizing.

(c) Hardware

All miscellaneous bolts shall meet the requirements of ASTM A-325. All nuts, bolts, and washers supplied that are not galvanized, shall have chemical properties of ASTM A-325, Type III.

All anchor bolts shall be fabricated from steel as specified by the manufacturer. That portion of the anchor bolts and nuts that will be exposed above foundation shall be galvanized in accordance with ASTM A-123.

(d) Mid Mast Light Standards

The light standard and its accessories shall be manufactured of material of like appearance. The light standard cap, luminaire assembly, and its accessories need not necessarily match those of the light standard and its accessories.

All structural components of light standards, bases, anchor bolts, luminaires, and other attachments to be used for mid-mast lighting shall be designed for a minimum of 100 mph wind velocity, in accordance with the current edition of the Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals as published by AASHTO, except as provided herein.

The wind velocity (V) used in determination of the wind pressure (p) given by the formula  $p = 0.0473 (1.3V)^2 C_d C_h$  shall be 100 mph. Detailed computations are required and shall show the values used for the  $C_h$  and  $C_d$  factors in determining the wind pressure.

The wind load shall be applied to all areas seen in normal elevation.

A detailed stress analysis of the light standard shall be documented.

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Light standards shall be constructed of tapered round shafts of the length specified on the Contractor's Drawings. (The shaft may be furnished as a single welded unit or in telescoping sections.) The sections shall be cold formed. The shaft shall taper uniformly from top to bottom.

If the shaft is furnished in telescoping sections, the number of sections shall not exceed five for shafts of 120 feet or less, and shall not exceed six for shafts over 120 feet. Each shaft section shall be fabricated so that it may be telescoped over the next lower section a minimum of one and one-half (1.5) times the diameter of the female end at the joined sections with a firm, tapered fit. The sections shall be a minimum of 10 feet in length, prefitted, and match-marked at the factory. In the field, the sections shall be mechanically telescoped in a manner recommended by the manufacturer. Settlement after the first twenty-four (24) hours from installation shall not exceed 1/8 inch. Field welds will not be permitted.

If a single welded unit shaft is furnished and, because of hauling restrictions the shaft cannot be shop fabricated in one piece, a field weld will be allowed. This field welding shall be done by AWS certified welders working for and under the direct supervision of the pole manufacturer. The weld shall be tested according to the requirements of Section 509 of the Standard Specifications.

The shaft of single unit poles shall be welded with backed up 100 percent penetration circumferential transverse welds. All circumferential transverse welds, except the baseplate connection, shall be ground flush +1/32 inch to -0 inch. Backup material shall be contoured for full contacts, continuous and of the same material as the shaft.

Each shaft may have a maximum of two longitudinal electric welds with 60 percent minimum penetration. The weld shall have a smooth, uniform appearance.

Certified mill test reports shall be documented before shop fabrication work begins.

The Contractor shall maintain a set of shop drawings of the complete light standard assemblies, along with certification that all materials used in the fabrication are in accordance with this specification.

The service hand holes shall be constructed that its location shall not interfere with the operation of the lowering assembly and shall be reinforced to maintain the full strength of the light standard.

A grounding nut, sized to accommodate a No. 1/0 AWG stranded copper conductor, shall be located internally at the light standard base and within easy access of the service hand hole.

A service portal and cover shall be constructed to a minimum size of 10 inches by 20 inches. The light standard shall be reinforced to maintain full light standard strength in the area of the portal.

Base plate and anchor bolts shall be as specified by the light standard manufacturer. The manufacturer shall furnish a notarized certificate stating that the bolts are of adequate strength to resist the loading specified.

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Each anchor bolt shall come complete with a minimum of three (3) galvanized hex nuts or approved equal of the appropriate size. The anchor bolts shall be threaded for a minimum length equal to the exposed portion plus 75mm. The threaded portion shall be galvanized to coat the exposed portion plus 75mm of the threaded end. Threads shall be full and sound, Type UNC. All galvanizing shall be in accordance with ASTM A 153, latest edition. The anchor bolts shall be of sufficient length to develop the full strength of the bolt. Hooks or anchor plates may be provided to engage sufficient concrete mass to fully develop the strength of the anchor bolts.

(e) Luminaire Supports

Each mid-mast tower shall include a luminaire support as shown on the Contractor's Drawings. Steel shapes, plates, and pipe shall be constructed of steel meeting the requirements for structural steel in these specifications or for steel meeting the requirements of ASTM A 36. If steel meeting the requirements of ASTM A 36 is used, the support and assembly shall be galvanized in accordance with ASTM A 123. The light standard cap, and luminaire support do not necessarily need to be constructed of the same material as the light standard.

The basic requirements for the luminaire supports are as follows:

1. The luminaire supports shall be capable of supporting the specified loads and loading conditions.
2. The electrical contacts shall be located at the base of the light standard.

(f) Mid-Mast Luminaire

Luminaires shall have a precision cast aluminum, rain-tight housing with an adjustable slipfitter, for use with a 2 inch horizontal pipe, which will permit a plus/minus 3 degree adjustment above and below the bracket axis.

Asymmetrical luminaire distributions shall have an aimable reflector with 360 degree orientation markings. Luminaires shall be pre-aimed by the manufacturer according to the Contractor Drawings and labeled for corresponding pole number and position on the ring assembly, or aimed in the field by the manufacturer's service representative.

Luminaire assemblies shall be constructed to allow "breathing" during the time of energizing and de-energizing of the lamp.

Ballasts shall be enclosed in a rain-tight cast aluminum housing constructed for direct mounting to the luminaire and shall be serviceable without removing the luminaire from its bracket. Ballasts shall be of the auto-regulator type specifically manufactured for use with high pressure sodium lamps, and shall be high power factor to operate at a minimum of 90 percent average power factor. Operation shall be suitable with a line voltage variation of plus/minus 10 percent. Satisfactory starting operation shall be obtained with an ambient temperature of -20 degree Fahrenheit.

Certified photometric data shall be included in the Project files for the luminaries proposed for use on this Project.

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Luminaires shall be furnished complete with ballast and lamp. The lamp shall be a 1,000-watt High Pressure Sodium Type providing 140,000 initial lumens. The lamp shall be rated for an average life of at least 24,000 hours, during which time the lumen output does not fall below 70 percent of the initial output. Supply voltages shall be 240 volts.

The photoelectric control shall be of weatherproof construction and be mounted on the control unit as indicated in the plans. Photo cells shall be of the cadmium sulfide type providing an operating range of 10.8 lux to 53.8 lux and operate at a nominal 120 volts to ground. The unit shall operate at temperatures of -40° F to +120° F. It shall include a built-in lightning arrester and be equipped to mount in a standard three-prong twist-lock receptacle. The photocell shall be mounted by the Contractor on the cabinet. Necessary wiring and hardware required for mounting and connection shall be furnished by the Contractor. The photocell shall be shielded, where required, to prevent artificial light from interfering with its normal operation. If necessary, a control transformer may be used to convert the line voltage to lower voltage to operate the controls. Photo control shall be of the cadmium sulfide type providing a turn-on point of 11 lux and a turn-off point of 72 lux. It shall contain a built-in 100 joule MOV shape arrestor wired to the neutral.

All luminaire assemblies shall be of the same type.

The housing for the lighting control center shall be of a manufactured type, clean-cut in design and appearance, and of the approximate size and dimensions shown in the Contractor's Drawings. The housing shall be factory painted green and shall be equipped with a three-point catch and lock. These locks shall be furnished with two keys for each box, and all locks shall be master keyed. Prior to Highway Acceptance, the Contractor shall distribute the keys to XCEL ENERGY. The handle shall have a provision for a padlock. Housing shall be weatherproof and conform to the contract requirements.

Circuit breakers shall be used in lieu of fuses and shall be the sizes shown on the Contractor's Drawings. Each circuit shall have its own breakers and a fault on one circuit shall not affect the operation of any other circuit. The selector switch shall be a three-position, key-operated switch with legend marked "Hands off Auto." Two keys shall be furnished with each switch. The Contractor shall be used for switching the current to the lamps. Its contacts shall be capable of handling the load at 600 volts AC without undue pitting or burning of the contacts. The coil shall be capable of operating continuously.

The control center shall contain a 120 volt ground fault interrupter outlet wired to a 15 amp breaker for operation of the portable drive unit.

The cabinet shall be mounted 12 inches above the grade on a concrete foundation per the plans. The location shall not lie within a 10-foot radius or outside a 25-foot radius of the standard.

Contact material shall be designed for lighting ballast loads and require no maintenance such as filing, burnishing, or dressing at any time the contactor is in service. The cabinet housing for the contactor shall contain a permanent instruction that states that "contacts shall not be filed, burnished, or dressed."

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**CONSTRUCTION REQUIREMENTS**

**613.03 General.** All installations shall be in accordance with these specifications and the National Electrical Code, and shall conform to subsection 107.01.

Each system shall conform as to voltage, cycles and type as shown on the plans or as designated. The Contractor shall furnish and install all incidentals necessary to provide a complete working unit or system, as called for on the plans.

Secondary service pedestal shall be constructed as shown on the plans.

(a) General

Upon receiving NTP, the Contractor shall take possession of and be responsible for the maintenance of all roadway lighting facilities on the Project, as specified in Book 2 Section 10.0. Upon Highway Acceptance, maintenance of the roadway lighting facilities will transfer to CDOT and XCEL ENERGY. The Contractor shall maintain ownership and salvage the existing roadway luminaires, mast arms, and poles.

The Contractor shall notify XCEL ENERGY forty-eight (48) hours in advance of any interruption to the existing service to lighting, signs, ramp metering, signals, or irrigation power feed, or any other potential power line disturbance, and coordinate changes in electric distribution with XCEL ENERGY.

Beginning with the first planned break in a lighting circuit, the Contractor shall coordinate the power source to feed relocated, added, or deleted luminaires to accommodate detours or staged construction with XCEL ENERGY. If the Contractor coordinates all changes to the existing lighting circuits with XCEL ENERGY, the Contractor will not be responsible for lighting power costs. Failure to coordinate with XCEL ENERGY, as determined by the SEC Representative, will result in the installation of metered circuits and power costs being paid by the Contractor, until Highway Acceptance.

The Contractor shall pay for all costs associated with supplying power sources to the lighting system.

(b) Mid Mast Lighting

All circuits shall test clear of faults, grounds, and open circuits.

(c) Cooperation with Utility Companies

The utility company will supply secondary power (metered if necessary) to the points coordinated by the Contractor. The Contractor shall contact the utility company to determine the precise point of connection to the utility company equipment. Control stations shall be furnished and installed as specified on the Contractor's Drawings and approved by the designated utility company.

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**613.04 Foundation Pads.** Light standard concrete foundation pads may be precast or cast-in-place.

All anchor bolts shall be positioned by means of templates, the center of which shall coincide with the center of the base.

Conduits shall be properly positioned and anchored before placing concrete.

Ground wiring cast in the foundation shall have one meter (3 foot) minimum extension at both ends.

a) Conventional Foundations

Light standard foundations for conventional lighting may be precast concrete, cast-in place concrete, or screw-in galvanized steel foundations.

Screw-in foundations shall be of a type and manufacture previously approved by CDOT and XCEL ENERGY. Screw-in foundations shall have a minimum auger helix pitch of 3 inches and be galvanized according to ASTM A 153. Screw-in foundations may be used only where soil testing shows aggregate sizes less than 3 inches in diameter. The Contractor shall be responsible for testing soil conditions as necessary to ensure proper installation of screw-in foundations. The following minimum screw-in foundation sizes are required for 40-foot light standards:

<u>No. of Mast Arms</u>	<u>Foundation Inside Dia.</u>	<u>Length Outside Dia. of Helix</u>
1	8 inch by 7 feet	14 inches

The cableway openings in the screw-in foundation shall be 2.5 inches by 12 inches. The openings shall have rounded ends and run vertically with the top 12 inches below the baseplate. The baseplate shall have a pole-mounting surface free from curvature or other deformity induced by the manufacturing process. The baseplate is to be machine smooth, flame cut on the external edges and on the inner hole providing access to the foundation interior. The baseplate shall be of adequate size to provide actual contact support at outer corners and edges of the lighting structure or a breakaway mounting device. The baseplate is to be permanently marked to indicate the locations of the cableway opening and shall have a thickness as required by the manufacture's design based on the shape of the plate and number of mast arms. Bolt holes shall be provided through the baseplate to allow for the attachment of a breakaway device or light structure as specified in the plans. If tapped holes are used, they shall be center tapped perpendicular to the baseplate plus or minus one degree, and the threads are to be fully cleaned after hot dip galvanizing so a bolt may be hand turned in the threads. Baseplate material shall conform to the requirements of ASTM A 36.

The screw-in foundation shaft shall be flame cut to length; 90 degree square on top and true helical on the bottom. Cableway openings shall be smooth cut on both sides of the shaft 180 degrees apart unless otherwise specified. The sides of the cableway openings shall be parallel to the axis of the shaft plus or minus one-half degree as measured along their full length. Round shaft material shall be new, unused, and mill traceable. The edges are to be mechanically cleaned before welding operation. The shaft shall be fabricated from standard weight pipe meeting the requirements of ASTM A 53, Type E or S, Grade B or ASTM 252, Grade 2.



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The helix on screw-in foundations shall be of true helical form and shall be produced with a matching metal dye from formable weldable 3/8 inch thick steel meeting the requirements of ASTM A29, Grade M 1010. The preformed helix is to be tumbleblasted to remove scale and contaminants before welding.

Screw-in foundation pilot point shall be sheared on a 45 degree angle from 1.25 inch (32 mm) diameter round bar steel meeting the requirements of ASTM A 575. It shall project a minimum of 6 inches (150 mm) below the leading edge of the helix and shall be tumbleblasted prior to welding.

Screw-in foundations shall be supplied with lighting standard to baseplate connection hardware consisting of 1 inch by 10 UNC, 4 inch long Grade 8 hex head bolts, nuts, and washers galvanized in accordance with ASTM A 153.

All welding for construction of screw-in foundations shall be in accordance with Sections 1 through 8 of AWS D1.1.

Completed screw-in foundations shall be hot dip galvanized in accordance with ASTM A153 after fabrication. Minor damage to the coating may be field repaired by thoroughly cleaning the damaged area with a wire brush and removing all damaged and loose coating. The cleaned areas shall be painted with two coats of zinc rich paint meeting the requirements of Federal Specification TT-P-641 or MIL-P-21035. The lot or piece number identifying each screw-in foundation shall be clearly stamped or painted on the foundation where not visible after installation. The foundation will be Accepted on the basis of visual examination at the Site and the manufacturer's Certificate of Compliance. The Contractor shall maintain on file the manufacturer's quality control inspection reports and shall demonstrate the ability to provide certification with regard to:

- Material Application
- Welder Certification
- Weld Quality
- Coating Requirements

Screw-in foundations shall be installed according to the manufacturers recommended procedures and accomplished by either a boom type or a bed-mounted type digger truck. The maximum torque used shall not exceed the manufacturers recommended limits. In the case of extremely difficult soils that cause the torque capacity of the installation equipment or mechanical limit of the foundation to be exceeded, the foundation may be installed in a predrilled hole that is not larger than the foundation shaft diameter. When the foundation is installed in a predrilled hole, minimum recommended torque requirements should be followed. The installation torque may be measured by a torque-measuring device or by calibrating the hydraulic system of the installing equipment.

(b) Mid Mast Foundations

The Contractor shall construct the caisson type foundation at each location according to the details shown on the Contractor's Drawings.

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All foundations shall be constructed to not less than the minimum dimensions shown on the Contractor's Drawings. The size and number of conduit bends shall be installed in each foundation as indicated on the Contractor's Drawings. The caged anchor bolt assembly shall be placed in the foundation so that it remains plumb and with the projection set as specified by the pole manufacturer. Anchor bolts shall be "caged" in a manner specified by the manufacturer. The bolt circle shall be centered over the foundation. The top elevation of the foundation shall be set accurately and leveled.

1. Footing Type. The foundation shall be constructed in accordance with Section 601. All loose dirt shall be removed prior to pouring concrete.
2. Drilled Caisson Type. The foundation construction shall conform to Section 503, Drilled Caissons. All irregularities in the cylindrical surface of the uncased holes outside of the nominal diameter shall be filled with concrete at the Contractor's expense. Forming of the top 12 inches will be required.

**613.05 Light Standards.** A light standard shall consist of a metal light pole, bracket arm or arms, transformer base or approved breakaway device, and connector bolts. In special cases, mountings may be made on the base flange, without transformer base, in which case the pole will require a handhole at the base.

- (a) Pole and bracket arm or arms shall be of the specified type and size shown on the plans.

Poles shall be set plumb on the foundation pad by means of non-corrosive metal shims and the mounting grouted with a non-shrinkable grout. Defects or scratches on galvanized poles shall be given two coats of acceptable zinc-rich paint as directed.

- (b) Transformer base shall be of a frangible breakaway type as shown on the plans and shall accommodate the anchorage and base flange of the light pole supplied.

Each transformer base shall have a 1/2-13 UNC (1/2 inch) bolt or lug fastened inside the base, visible from the door opening, for grounding purposes; also a wire hole for outside grounding, if required.

- (c) Connector bolts and anchor bolts shall accommodate the anchorage of the light pole from its base flange to the transformer base, and from the transformer base to the foundation pad.

- (d) Mid Mast Light Standard Assembly

Light standards shall be installed as shown on the Contractor's Drawings. The assembled lighting standard shall, under dead load and at equal ambient temperatures, be as near to true vertical alignment as practical. Adjustment shall be accomplished by use of leveling nuts, located on the anchor bolts below the baseplate in accordance with instructions furnished by the light standard manufacturer.

After erection and alignment of the light standard, the crack between the foundation and the baseplate shall be filled with grout. A drain sump shall be installed at this time using a 1 inch PVC conduit.

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The end of this 1 inch conduit shall be fitted with a screen to keep foreign objects from entering the light standard base. While the grout is still fresh, a depression, which shall serve as a sump for the drain pipe, shall be made within the light standard base.

Luminaires and ballast assemblies shall be securely fastened to the 2 inch mast arms located on the luminaire ring and each light shall be adjusted so as to hang vertically when erection is complete. The Contractor shall be responsible for the correct placement and alignment of the luminaires with respect to the roadway. To ensure this correct alignment, the Contractor shall procure the assistance of a representative of the manufacturer supplying the luminaires.

Wherever the electrical cable passes through any metal or pulley, a bushing or other approved method shall be used to protect the cable from abrasion.

All splices required for distribution of power from portable cable to the individual ballasts shall be made in the junction box. Two conductors shall be trained to each ballast from the splice made in the junction box. These conductors may be of a smaller size, but not smaller than No. 12 AWG or than cable required elsewhere within the system to facilitate their installation. The cable used may be in compliance with Article 402, Fixture Wires, of the National Electrical Code.

A fused switch or breaker shall be installed at the base of the light standard as shown on the plans, and be of appropriate size. The switch shall be used to switch power on and off to the twist lock disconnect for the portable power cable and the receptacle for the lowering mechanism.

**Metallic Surfaces.** Any surfaces, except cast iron, galvanized, ASTM-A588 steel, luminaires, ballasts, and lighting control centers shall be painted in accordance with Subsections 509.24 and 509.29, unless otherwise specified.

**Welding.** Welding shall be in accordance with the latest edition of AWS Specification D1.1 and the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Weld Inspection. All transverse butt welds and the weld connecting the pole to the baseplate, shall be inspected by the Contractor using radiographic methods in accordance with AWS D1.1 Section 6.

**613.06 Luminaires and Lamps.** Luminaires shall be mounted on the mast arm by a slipfitter clamp or other approved method, and shall be adjusted vertically and horizontally to provide the required mounting height and maximum light distribution on the roadway.

Each luminaire shall be controlled by an individual photoelectric cell. The photoelectric control shall be positioned northward to minimize sun interference.

After installation and prior to acceptance, refractors shall be cleaned to provide maximum lumen output.

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Lamps of the specified type and size shall be installed in the luminaires. Luminaire or pole shall be marked for the type and size of lamp. Tags will be furnished by the local utility company or the Department, if required.

Wall type luminaires for use under overpass structures shall be mounted as shown on the plans. Beam angle setting shall be adjusted to meet illumination requirements.

**613.07 Conduit and Direct Burial Cable.** Electrical conduit, including conduit for traffic signals, shall be installed in accordance with the applicable requirements described in the Department of Transportation's, "A Policy on the Accommodation of Utilities on Colorado Highways Rights-of-way," as amended, and to the following:

Conduit runs on structures or underground are shown on the plans only for information. Locations will be established during construction. Conduit and cable shall be so located as to avoid any interference with known present or known future construction installations. All underground conduit runs and conduit risers on poles shall be installed as needed even though they may not be shown on the plans.

All conduit, including conduit for traffic signals, installed under the roadway shall be 50 mm (2 inch) minimum diameter (ID), unless otherwise designated on the plans. The Contractor may, at no expense to the Department, use conduit of larger size than specified. If larger conduit is used, it shall be for the entire length of the run from outlet to outlet. Reducer couplings will not be permitted. All conduit runs shall be sloped a minimum of 25 mm per 10 meters (3 inches per 100 feet) for drainage.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air.

Where new conductors are to be added to existing conductors in a conduit, all conductors shall be removed and the conduit cleaned as provided above. Both old and new conductors shall be pulled into the conduit as a unit.

Conduit terminating in standards or pedestals shall extend approximately 50 mm (2 inches) vertically above the foundations and shall be sloped towards the handhole opening. Conduit, including conduit for traffic signals, entering pull boxes shall terminate 50 mm (2 inches) inside the box wall and not less than 50 mm (2 inches) nor more than 125 mm (5 inches) above the bottom, and shall be sloped toward top of box to facilitate pulling of conductors. Conduit entering through the bottom of a pull box shall be located near the end walls to leave the major portion of the box clear. At all outlets, conduits shall enter from the direction of the run.

The ends of all conduits, whether shop or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made square and true so that the ends will butt or come together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used for coupling metal type conduit, an approved threaded union coupling shall be used. All threads on all ferrous metal conduit, not previously treated with a corrosion preventative, shall be painted with rust preventive paint before

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couplings are made up. All couplings for metal type conduit shall be tightened until the ends of the conduit are brought together, providing a metal conduit has been damaged in handling or installing, such damaged places shall be painted with rust continuous electrical connection throughout the entire length of the conduit run. Where the coating on ferrous preventive paint. Non-metallic type conduit shall be cut with a hacksaw or other approved tool. Nonmetallic type conduit connections shall be of the solvent weld type.

All metal type conduit ends shall be threaded and shall be capped until wiring is started. When caps are removed, the threaded ends shall be provided with conduit bushings. Non-metallic type conduit ends shall be capped until wiring is started.

Conduit connections at junction boxes shall be tightly secured and water proofed. Conduit entering controller cabinets shall be sealed by the use of paraffin or other sealing compound as approved by the Engineer.

When specified, conduit shall be installed under existing pavement by jacking or drilling operations. Where plans show that existing pavement is to be removed, jacking the conduit will not be required. Jacking or drilling pits shall be kept a minimum of 0.6 m (2 feet) clear of the edge of pavement whenever possible. Water will not be permitted as an aid in the jacking or drilling operations.

When trenching is specified to place conduit under existing pavement that is not to be removed, the trench shall not be wider than 100 mm (4 inches) for 50 mm (2 inch) conduit or 125 mm (5 inches) for 75 mm (3 inch) conduit. Trenches shall be filled to within 50 mm (2 inches) of the existing grade with Class B concrete, or as directed. The remaining 50 mm (2 inches) shall be filled to match existing grade and surfacing materials with concrete or hot asphalt mix within 48 hours after cutting roadway.

Underground conduit or cable shall be buried a minimum of 0.6 m (2 feet) without sag between boxes. Conductor, regardless of type, shall be placed in conduit when crossing under roadway. Conduit placed under roadways shall be located at a depth of not less than 0.75 m (30 inches).

Rigid metallic conduits on bridges shall have an expansion fitting at every expansion joint of the bridge.

Pull boxes shall be constructed as shown on the plans. With either direct burial cable or wiring in conduit, pull boxes shall be installed at all wiring splices, all conduit ends, all conduit angle points, and at all other locations which are shown on the plans. Pull box locations which are shown on the plans are approximate.

It shall be the option of the Contractor, at no expense to the Department, to install additional pull boxes to facilitate the work.

Where practical, pull boxes shown in the vicinity of curbs shall be placed adjacent to the back of curb, and pull boxes adjacent to standards shall be placed along the side of foundations as shown on the plans.

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Unless otherwise shown on the plans, pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The bottoms of pull boxes installed in the ground or sidewalk areas shall be bedded in crushed rock.

In-ground pull boxes, and wherever possible, pull boxes in structures shall be a minimum of 10 inches by 10 inches.

Where a "stub out" is called for on the plans, a sweeping ell shall be installed in the direction indicated and properly capped. The locations of ends of all conduits in structures or terminating at curbs shall be marked by a "Y" at least 75 mm (3 inches) high cut into the face of curb, gutter or wall directly above the conduit.

Electrical Conduit (Jacked) shall be installed using a trenchless technology of either jacked conduit or directional boring. Open trenching will not be allowed except as shown on the Contractor's Drawings, or as directed by the Engineer.

Plastic PVC conduit shall be certified by the manufacturer as meeting ANSI/UL 6 and 651. The manufacturer shall be ISO 9000 compliant.

If the Contractor is unable to jack or bore the conduit at the lengths shown on the Contractor's Drawings, all splice couplings and associated work to splice the conduit shall be included in the cost of this item. Also included in the cost of this item is all landscape repairs, which will be required after excavation of conduit at all splice locations. All splice couplings shall be water and air tight and installed at a depth to match the remaining run of conduit. No elevation difference will be allowed. Splices shall be kept to a minimum and all locations shall be approved by the Engineer. Additional pull boxes shall not be substituted for splices.

Conduit plugs for sealing conduit shall also be supplied and installed. Plugs shall be durable, fabricated from no metallic parts, be of the split design to allow removal and reinstallation around in-place cables and be easily removable and reusable. Plugs shall be capable of being installed by hand without any tools and shall provide a water and air tight seal of at least 100 psi, and shall cause no damage to the cable when installed.

At some locations, as directed by the Engineer, new conduits shall be installed in an existing pull box. At these locations, the Contractor shall carefully excavate around the pull box and install the new conduit in the pull box in a manner that meets the requirements of the Contract. The Contractor shall not damage the existing pull box. If the existing pull boxes or concrete collars are cracked or damaged during conduit installation, the Contractor shall replace either or both conforming to the requirements of the Contract at no additional cost to the Project.

**613.08 Wiring.** Unless otherwise authorized, the multiple system of electrical distribution shall be used. Conductors of the size and material required either single or in cable shall include but not be limited to: control wiring, luminaire wiring, main circuit wiring, ground wiring and service entrance wiring.

Each metal light standard shall be wired with a breakaway fused connector of proper capacity rating. The fused connector shall be located in the transformer base, or, if the pole has no transformer base, in the pole at the hand hole.

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**REVISION OF SECTION 613  
LIGHTING**

Luminaires may be selected which operate at either 120 volts 60 Hz or 240 volts 60 Hz. Selection, however, must be consistent with utility company requirements. When 120 volt luminaires are utilized, 120/240 volts shall be brought to the base of each light standard and individual luminaires shall be connected to one leg or the other in such a manner as to minimize overall voltage drop.

A complete grounding system shall be provided for the entire lighting installation. Grounding shall consist of: ground cables, conduits, ground rods, wire or strap, and ground fittings, as required by the National Electrical Code.

Cross feeds between distribution circuits and luminaires on the opposite side of I-25 will not be allowed.

Grounding. A grounding electrode shall be installed at each high-mast lighting standard. The electrode shall consist of either two 8 foot by 5/8 inch driven ground rods, or a metal plate with a minimum surface area of 2 square feet located near the bottom of the caisson. The grounding electrode conductor shall be a minimum of No. 6 AWG solid copper. This conductor, the neutral conductor (if present), the grounding conductor, and the metal case of the mast shall be electrically connected together as required by the National Electrical Code. Exposed metal parts of the luminaire support system shall be electrically connected to the grounding conductor of the portable cable.

All electrical conductors shall be tagged as follows:

Electrical conductor cable tags shall be located below the termination in the base of the street light, in the pull box, in the pedestal, and at the point of termination to existing facilities of the local utility company supplying the electrical service. The tags shall be attached with a cable tie. The information written on the tag shall include the direction and approximate length of cable, feeds running where and to, etc.

Each incoming conductor shall be individually color coded with one tape mark, while outgoing conductors shall have two tape marks.

Uniform tags are available in a Tag Kit. The Tag Kit consists of: 100 tags, 3 part yellow with one hole, 100 black nylon ties, and one black Sharpie pen.

Size	63.5 mm x 127 mm
Standard	Package Kit
Weight,	Kit approx. 0.68 kg
Color	Yellow
Stock Unit of Measure	Kit

Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

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**REVISION OF SECTION 613**  
**LIGHTING**

**613.09 Testing.** Prior to final acceptance, the Contractor shall demonstrate to the Engineer's satisfaction that all electrical and lighting equipment installations are in proper condition. Temporary power and all required cable connections, for purpose of testing, shall be provided by the Contractor at no expense to the Department.

The Contractor shall operate the lighting system from sunset to sunrise for ten consecutive days. If lamps, ballast or photoelectric cells fail, they shall be replaced immediately. However, this will not require a restart of the test.

The records of all testing shall be submitted to the Engineer for approval.

After satisfactory completion of all tests specified, the illumination system shall be placed in operation. Acceptance will not be made until the system has operated satisfactorily for a period of not less than 14 Days.

Operation of the system shall not in any way be construed as an Acceptance of the system or any part of it, or as a waiver of any of the provisions of the Contract.

The Contractor shall be fully responsible for the system during this period of operation and shall make any adjustment or repairs which may be required, and remedy any defects or damages which may occur, at the Contractor's expense.

Tests. Prior to Acceptance, the Contractor shall test to verify that all the electrical and lighting equipment installations are in proper condition in accordance with the Contractor Drawings. The Contractor shall furnish all equipment and appliances to make the tests.

Voltage and ampere readings shall be taken ahead of the contactor and below the contactor, and at the base of each tower with the entire system in operation.

All lighting circuits and equipment shall be given an initial operational test, consisting of having the entire system energized for seventy-two (72) consecutive hours without any failures of any type occurring anywhere in the system.

The Contractor shall test street light cable as follows:

- (a) Both ends of the cable shall be completely cleared (i.e., remove all ballasts, transformers, fuses, etc.)
- (b) Three to four inches of insulation shall be cleaned on both ends of the cable.
- (c) Six inches of insulation shall be peeled from the test end of the cable.
- (d) Continuity shall be read (one end to the other end) on all insulated wires to verify that there are no open wires.
- (e) Each insulated wire shall be tested to ground and to every other insulated wire in the run of cable being tested.



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**REVISION OF SECTION 613**  
**LIGHTING**

- (f) Each wire shall be tested by applying 2 kv DC (with a megger or hi-pot tester) for one (1) minutes to one (1) insulated wire in the test run of cable while grounding all other insulated wire in the same run. Each insulated wire in the run shall be tested until all have been tested.

The Contractor shall take all safety precautions when voltage is applied to the wires using qualified personnel.

Acceptance of the cable is predicated on passing the above described test.

The Contractor shall coordinate with XCEL ENERGY prior to testing the cable.

## **REVISION OF SECTION 613 ELECTRICAL CONDUIT - GENERAL**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

### **DESCRIPTION**

This work includes furnishing and installing either HDPE or PVC electrical conduit. All materials furnished, assembled, fabricated and installed under this item shall be new, corrosion resistant and in strict accordance with the plan sheets and these Special Provisions.

Subsection 613.02 shall include the following:

### **MATERIALS**

All conduits shall be Schedule 80 in the diameters, quantities, depths, and colors as shown on the project detail sheet and shall be compliant with all ASTM requirements.

HDPE and PVC conduit shall be certified by the manufacturer as meeting ANSI/UL 651 and 651B. The manufacturers shall be ISO 9000 compliant.

All HDPE conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin high-density polyethylene resin. HDPE conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation, without affecting its properties or performance.

The coefficient of friction on the internal walls of the conduit shall not exceed 0.15 when pulling cable.

Each individual conduit shall be equipped with a pull tape or rope as described below. Each bore or trench shall have a copper tracer wire of at least 12 gage in one of the conduits. In trenches containing multiple conduits, the tracer wire shall be installed in an empty conduit.

Each individual conduit shall be equipped with either a pull rope or a pull tape, depending on the length of conduit between pull boxes as follows:

1. Each conduit with a length greater than 400' between pull boxes shall be equipped with a pull tape in the final product. The pull tape shall have a minimum tensile strength of 1250 lbs. and be of a design and manufacture that prevents cutting or burning into the conduit during cable installation.
2. Each conduit with a length of less than 400' between pull boxes shall be equipped with a pull rope in the final product. The pull rope shall have a minimum tensile strength of 1250 lbs.

The Contractor has the option of using pull tape in all conduit installations, irrespective of length. Splices in the pull tape and tracer wire will not be permitted.

### **CONSTRUCTION REQUIREMENTS**

Subsection 613.03 shall include the following:

All conduit installation shall conform to the National Electrical Code.

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**REVISION OF SECTION 613**  
**ELECTRICAL CONDUIT – GENERAL**

Electrical Conduit (Plastic) shall be HDPE and installed using a trenchless technology such as directional boring for any segments under existing or new pavement or sidewalk.

Electrical Conduit (Plastic) may be installed by direct burial methods such as plowing, open trenching, or other approved excavation methods for short segments or other segments outside of paved areas.

Prior to construction, the Contractor shall submit a trenching and boring plan to the Engineer for approval. The plan shall show the limits of the planned work areas and the areas of anticipated disturbance. All disturbances outside the planned work areas created by the Contractor's operations shall be restored to their original condition at the Contractor's expense.

During construction operations, the Contractor shall maintain boring logs that include the depth at specific distances along the bore. Boring logs shall be submitted on a weekly basis.

Excavations and conduit installation shall be performed in a continuous operation. All trenches shall be backfilled by the end of a shift. The material from trenching operations shall be placed in a location that will not cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.

The Contractor shall be responsible for over-excavating a trench or heaving damage to the existing asphalt or concrete mat, whether caused by equipment directly or by dislodging rocks or boulders. Any such over-excavation or heaving shall be repaired at the Contractor's expense. The Contractor shall bear the cost of backfilling all over-excavated areas with the appropriate backfill material as approved by the Project Engineer.

The Contractor shall restore all surface materials to their preconstruction condition or better, including but not limited to pavement, sidewalks, sprinkler systems, landscaping, shrubs, sod, or native vegetation that is disturbed by the conduit installation operation. All repairs shall be included in the cost of the conduit.

The Contractor shall use splice couplings if a boring varies from the access points shown on the plans. All associated work to splice the conduit shall be included in the cost of this item. The coupling technology used to connect the conduit ends shall require no special tools and form a watertight, airtight seal. The breaking force between segments shall exceed 250 pounds of force. No metal fittings shall be allowed. No elevation difference between the conduit run and the splice location will be allowed. Conduit splices shall be kept to a minimum and all locations shall be approved by the Project Engineer. Additional pull boxes shall not be substituted for splices.

Conduit plugs shall be supplied and installed in all conduit ends as soon as the conduit is installed. Conduit shall be plugged at all termination points such as pull boxes, manholes, controller cabinets, and node buildings. Conduits containing cable shall be plugged with durable and reusable split type plugs, fabricated without metallic parts, and allow easy removal and reinstallation around in-place cables. Split type plugs shall provide a water and air-tight seal of at least 22 psi. They shall be installable by hand without using special tools and without damaging the cable. All plugs shall be correctly sized to fit the conduit being plugged. Empty conduits shall be sealed with removable, mechanical type duct plugs, that are watertight and equipped with a rope tie on the inside end for connection of the pull rope/tape.

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**REVISION OF SECTION 613  
ELECTRICAL CONDUIT – GENERAL**

All conduits shall use sweeps to elevate the buried conduits to the final grade within a pull box or manhole, as shown in the project special details. The sweeps shall be terminated within the pull boxes and manholes to allow for easy installation and removal of the conduit plugs. The sweeps shall be set above the ground surface within the pull box at a height that does not interfere with the coiling of the fiber optic cable.

All conduit runs for fiber optic cable use shall have a limited number of bends. The sum of the individual conduit bends, both horizontal and vertical, on a single conduit run between two pull boxes shall not exceed 360 degrees. The preferred limit is 270 degrees. No individual bend shall be greater than 90 degrees. All conduit bends shall have a minimum acceptable radius, The minimum radius for 90 degrees bends is 48 inches, and the minimum radius for all other bends is 24 inches.

If new conduits are installed in existing pull boxes, manholes or cabinet bases, the Contractor shall carefully excavate around them and install the new conduit as shown in the plans. The Contractor shall not damage the existing pull box, manhole or their contents. If the existing conduit, pull box, lid, or the concrete collars are damaged during conduit installation, the Contractor shall restore the damaged section to preconstruction condition at no additional cost.

**METHOD OF MEASUREMENT**

Electrical Conduit will be measured by the actual linear feet of conduit installed and accepted. It shall include all electrical wires, signal conductors or telephone wire per end equipment requirements. Conduit shall also include lubricants, anchors, bands, skids, sweeps, pull rope, pull tape, copper tracer wire, adapters, fittings, conduit plugs, foam sealant, installation equipment, splice couplings, mounting brackets and hardware, structure anchors, adhesives, labor, and all other items necessary to complete the work.

Subsection 613.11 shall include the following:

The Electrical Conduit contract unit price shall be full compensation for work described above, specified in the plans, and complete and in place.

Subsection 613.11 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
2 Inch Electrical Conduit (Plastic)	Linear Feet
3 Inch Electrical Conduit (Plastic)	Linear Feet

**REVISION OF SECTION 613**  
**PULL BOXES - GENERAL**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.07 shall include the following:

Pull boxes shall be made of fiberglass reinforced polymer concrete designed to support a minimum service load of 20,000 pounds over a 10 inch by 10 inch square. The pull box shall have a detachable cover with a skid-resistant surface and have the words "TRAFFIC SIGNAL" or "TRAFFIC COMM" cast into the surface. Painting the words shall not be accepted. The cover shall be attached to the pull box body by means of screw-in bolts and shall have two lift slots to aid in the removal of the lid. Non-standard bolts shall not be used.

All Denver Traffic pull boxes shall be Type D with City standard inside dimensions of 17.5" wide by 30.5" long by 24" deep. All associated Electric pull boxes shall be Type A with City standard inside dimensions of 13.75" wide by 23.25" long by 12" deep. "Type D" and "Type A" pull boxes shall be paid for as Pull Box (24x36x24) and Pull Box (16x24x12), respectively.

All concrete collars, footings and location marker supports shall be Portland Cement Concrete Class B and shall be in accordance with Section 601.

Pull boxes that are to be in traveled ways shall be outfitted with traffic bearing lids rated for HS 20-44 loads. The pull boxes shall have a special concrete footing extending 8 inches around the outside and 6 inches around the inside of the pull box bottom, as shown in the plans. Pull boxes installed in dirt or landscape areas shall have a 12 inch wide by 6 inch thick concrete collar placed around the top in lieu of the concrete footing, as shown in the plans.

When the plans call for a fiber optic cable location marker to be installed at the pull box location, the concrete foundation support for the location marker shall be placed monolithically with the concrete collar.

Pull Box (Surface Mounted) shall be metal type with a hinged front door and have at least a NEMA 3R rating. The hinged door shall be provided with both a weather tight seal and a key lock mechanism. Surface mounted pull boxes shall be of the dimensions shown in the plans, and shall be mounted on or embedded into hard surfaces such as bridge decks, concrete barriers, retaining walls, or buildings, as shown on the plans. Surface mounted pull boxes shall be attached using 3/8-inch epoxy anchors or other methods, as approved by the Engineer. Surface mounted pull boxes shall not be used for ground installations.

Subsection 613.10 shall include the following:

Pull Boxes will be measured by the actual number that are installed and accepted, and will include base, lid, complete installation, excavation, backfill, concrete collars, marker supports, and footings. Pull Boxes will also include the removal and patching of pavement, sidewalks, curb and gutters and their replacement in kind to match existing grade. Concrete will not be measured and paid for separately, but shall be included in the work.

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**REVISION OF SECTION 613**  
**PULL BOXES - GENERAL**

Subsection 613.11 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Pull Box (16x24x12)	Each
Pull Box (24x36x24)	Each
Pull Box (30x48x18) Deep	Each

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**REVISION OF SECTION 613  
ELECTRICAL CONDUCTOR IDENTIFICATION**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

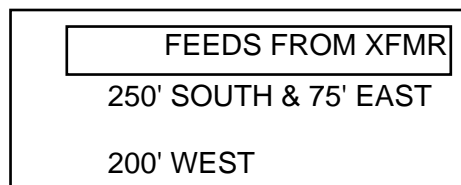
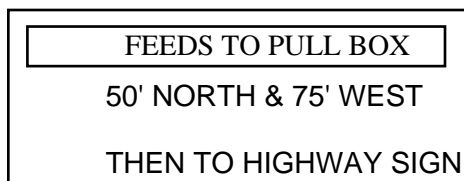
Section 613.08 shall include the following:

All electrical conductors shall be tagged as follows:

Electrical conductor cable tags shall be located below the termination in the base of the street light, in the pull box, in the pedestal and at the point of termination to existing facilities of the Local Utility Company supplying electrical service. The tags shall be attached with a cable tie. The information written on the tag shall include the direction and approximate length of cable feeds running from where to, etc.

Each incoming conductor shall be individually color coded with 1 tape mark, while outgoing conductors shall have 2 tape marks.

Example:



Uniform tags are available in a Tag Kit. The Tag Kit consists of: 100 tags, 3 part yellow with 1 hole, 100 black nylon ties and 1 black sharpie pen.

Size	2-1/2" X 5"
Standard Package	Kit
Weight, Kit, Approx.	1.5 Pounds
Color	Yellow

Electrical conductor tagging will not be paid for separately, but shall be included in the cost of the Electrical Conduit and all associated equipment installation.

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## REVISION OF SECTION 614 TRAFFIC SIGNAL CONTROLLER CABINET

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work shall consist of the complete installation of a traffic signal controller cabinet assembly with NEMA ASC3/1000 type controller unit and concrete base per City and County of Denver standards.

Delete Subsection 614.08 (c), and replace with the following:

Traffic signal cabinets shall comply with NEMA TS2 specifications and shall be compatible with the ICONS distributed traffic signal system. Unless otherwise noted in the plans and specifications, all components, connections, and cables shall be supplied with the cabinet.

### 1. Cabinets

- 1.1 General – Traffic signal controller cabinets shall conform to the requirements for NEMA 3R rating, NEMA TS2-1992 Section 7, and this specification. Where differences occur, this specification shall govern. The traffic signal cabinets shall be the M1-Stretch size only.
- 1.2 Materials – Cabinets shall be fabricated from sheet aluminum alloy, 0.125 inch thick, meeting the requirements of ASTM 5052-H32.
- 1.3 Dimensions – Size MSX cabinets outside of dimensions shall nominally be 60 inches high, 18 inches deep, and 30 inches wide. Size “P” cabinets shall be 57 inches high, 27 inches deep and 38 inches wide. Unless noted otherwise, cabinets shall be size MSX.
- 1.4 Construction – The cabinet top shall be constructed with a one inch slope from front to back. Cabinet seams shall meet all requirements for NEMA Type 4 enclosures. All seams shall be sealed with an approved sealant on the interior of the cabinet. The main door opening shall be double flanged on all four sides.
- 1.5 Doors – Cabinet main doors shall be full width, hinged on the right side when facing the cabinet. The main door opening shall be a minimum of 90% of the width and 80% of the height of the front surface of the cabinet. A stiffener plate, at least 15 inches long, 6 inches high and on-half inch deep, shall be welded across the inside of the main door. (The bottom of the door opening shall be at least 3 inches above the bottom of the cabinet.)

The main door hinge shall be continuous and bolted to the cabinet door using 1/4-20 stainless steel carriage bolts and lock nuts. The hinge shall be attached so that no bolts or rivets are exposed. The hinges shall have a 0.120 inch diameter stainless steel hinge pin, capped top and bottom to render it tamper proof. The main door shall include a door restraint capable of holding the door open at approximately 90, 120, and 150 degrees under windy conditions. The door restraint shall be attached to the main door and pivot to placement holes in the bottom flange of the door opening.



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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

A three-point draw-roller type door latch shall be provided with push rods of at least 0.25 inch by 0.75 inch steel. Rollers shall be a minimum of 0.875 inches in diameter, be made of nylon, and have a 0.150 inch steel center. The handle on the main door shall be stainless steel with a three-quarter inch diameter shank. The handle shall rotate clockwise to open. The handle shall include a hasp for attachment of a padlock. The main door shall be equipped with a Corbin lock, No. 1548-1, or equivalent, and shall be provided with two keys. The lock shall be positioned so that the key shall not interfere with operation of the handle. The key shall turn counter-clockwise to unlock the door. The hinged police door compartment shall be provided with a Corbin lock, No. R357SGS, provided with one key.

The main door and the police door shall close against weatherproof and dustproof closed-cell neoprene gasket seals. The gasket material for doors shall be a minimum of 0.250 inches thick. The main door gasket shall be a minimum of 1.00 inch wide; the police door gasket shall be a minimum of 0.50 inch wide. Both gaskets shall be permanently bonded to the cabinet.

- 1.6 Shelves – Unless noted otherwise, cabinets shall be provided with two adjustable “C” channels mounted vertically on the interior of the back and both side walls. All channel nuts used in the cabinet shall be the spring-loaded type. Mounting channels shall extend at least 3 inches from bottom to at least 3 inches from the cabinet top.

Cabinets shall be provided with two adjustable shelves, fabricated of 5052-H32 aluminum. Shelves shall be at least 11 inches deep and extend the full width of the cabinet.

The top shelf shall be mounted as high as possible in the cabinet with the Detector Rack attached to the top of the shelf. There shall be 13.75 inches between the bottom shelf and the mounting flange of the top shelf.

- 1.7 Finish & Surface Preparation – Cabinets shall be provided with a natural aluminum finish meeting Federal Specification QQA-250/18. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, and free from cracks, blow holes, and other irregularities. Any sharp edges or burrs shall be ground smooth. Care shall be taken during handling to prevent scratches or dents. All walls of cabinet shall be folded wider the cabinet at the base and each flange created.
- 1.8 Mounting – Cabinets shall be provided with internal mounting flanges for mounting on a base. All walls of the cabinet shall be folded under the cabinet at the base and each flange created shall be equal to or greater than 2”.
- 1.9 Ventilation – The lower portion of the main cabinet door shall be louvered for ventilation intake. The air inlet shall be large enough to accommodate the air flow of the rated fan. Louvers must meet the NEMA rod entry test for 3R ventilated enclosures. A heavy duty, non-corrosive, vermin and insect proof, air filter shall be mounted on the inside of the main door. The air filter must be held firmly in place by a fixed bottom bracket and a spring loaded top bracket that allow easy removal for cleaning. The top of the cabinet shall include an exhaust air plenum with a vent screen having perforations no greater than 0.125 inches in diameter. A removable fan plate shall be mounted in the top of the cabinet.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

- 1.10 Equipment Outlet – A 15-amp equipment outlet fused at 5-amps shall be mounted on the left side of the cabinet just below the upper shelf. The fuse shall be mounted on the power or main panel.
- 1.11 Pull Out Drawer - A pull-out, hinged-top drawer, having sliding tracks, with lockout and quick-disconnect feature, such as a Vent-Rak Retractable Writing Shelf, #D-4090-13 or equivalent - shall be installed under the lower shelf. It shall be possible to lift this hinged platform in order to gain access to the interior of the drawer. Minimum interior dimensions of the drawer shall be 1 inch high, 11 inches deep and 13 inches wide.

**2. Terminals and Facilities**

- 2.1 General – Cabinets shall be assembled and wired to accommodate the following:

Main panel with 12/16 load switches, 6/8 flash transfer relays, 1 flashers, and 2 bus interface units.

- Power distribution panel on lower right side panel
- Detector rack for 8 channels of detection, 4 channels of preemption, and 1 bus interface unit mounted on the top right side of the upper shelf
- Power supply for bus interface units mounted on the top left side of the upper shelf
- One TS2 Type 2 controller and Type 16 malfunction management unit on lower shelf
- Police switch compartment on inside of main door
- Detector I/O panel mounted on the lower left side
- A ventilation fan mounted in the cabinet top with an adjustable thermostat
- An incandescent lamp with a 15 inch arm mounted on the door of the cabinet
- A fluorescent light mounted on the inside top of the cabinet
- Loading capacitor/resistor circuit
- Equipment outlet

- 2.2 Main Panel – The main panel shall be constructed from 5052-H32 brushed aluminum of 0.090 inches minimum thickness and formed so as to minimize any flexing when plug-in components are installed.

Main panels shall be hinged at the bottom to allow easy access to all wiring on the rear of the panel. The panel shall be designed so it can easily be move from vertical to a minimum of 60 degrees of vertical. The bottom of the panel shall be five to eight inches above the base of the cabinet. The exact distance will depend on the spacing of other cabinet components.

The main panel shall be fully wired in the following configuration:

Twelve/sixteen load switch sockets, (6/8) flash transfer relay sockets, one flasher socket, two main panel BIU rack slots, one detector rack each with one BIU, and one Type-16 MMU. Power to flashers shall be terminated on a separate easily accessible terminal strip mounted on front of the panel.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

Loadswitches 1, 3, 5, & 7 – green, yellow & red outputs and loadswitch 9, 10, 11, & 12 or 13, 14, 15 & 16 yellow outputs shall be loaded with 2.2 microfarad 400VDC (275VAC) Metalized Polypropylene capacitors with a 100k 2 watt resistor in parallel. The capacitor/resistor circuit shall be mounted on the back of the load switch connectors. They shall be secured to the harness with cable ties.

All load switch and flash transfer relay socket shall be labeled on the front of the main panel to match drawing designations.

All load switches shall be supported by a bracket extending at least half the length of the load switch.

Rack style mounting shall be provided to accommodate the required BIUs per the configuration listed. A dual-row, 64-pin female DIN 41612 Type B connector shall be provided for each BIU rack position. Card guides shall be provided for both edges of the BIU. Terminal and facilities BIU mounting shall be an integral part of the main panel. Detector rack BIU mounting shall be an integral part of the detector rack.

All BIU rack connectors shall have prewired address pins corresponding to the requirements of the TS2 specification. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.

Main panels should have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row should be wired for the phase 9-12 vehicle 02, 4, 6, 8 pedestrian field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.

All field output circuits shall be terminated on an unfused screw type (#10 screw) terminal block with a minimum rating of 10 amps.

All field input/output (I/O) terminals shall be accomplished at the field terminals with the use of a screwdriver only. It shall also be possible to program which flasher circuit the phase shall be programmed to. It shall not be necessary to debus field terminal blocks for flash programming.

The main panel shall contain 1 labeled flasher socket capable of operating 25-amp, 2-pole, NEMA solid-state flashers. The flasher shall be supported by a bracket that extends at least half its length.

One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils.

All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

At a minimum, five 20-position terminal blocks shall be provided at the top of the main panel to provide access to the BIU/controller unit's programmable and non programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as a minimum. All twelve or sixteen green/yellow/red load switch inputs, vehicle detector channel outputs one through twelve or sixteen and pedestrian detector inputs one through eight shall be terminated on the terminals and facilities panel. They shall be easily accessible.

The main panel shall incorporate a relay to remove +24 VDC from the common side of the load switches when the intersection is placed into flash. The relay shall have a momentary push-button to apply power to the load switch inputs for ease of troubleshooting.

- 2.3 Wiring and Cables – All main panel wiring shall be the size indicated below and shall be color-coded. As a minimum, colors shall be used to distinguish between different equipment. The following color code is provided as an example:

Green/Walk load switch output	brown wire (14 gauge)
Yellow load switch output	yellow wire (14 gauge)
Red/Don't Walk load switch output	red wire (14 gauge)
MM (other than AC power)	violet wire (22 gauge)
AC Line (power panel to main panel)	black wire (8 gauge)
AC Line (main panel)	black wire (10 gauge)
AC Neutral (power panel to main panel)	white wire (8 gauge)
AC Neutral (main panel)	white wire (10 gauge)
Earth ground (power panel)	green wire (8 gauge)
Logic ground	gray wire (22 gauge)
Flash programming	orange wire to flasher terminal, black wire to red or yellow field terminal (14 gauge)

All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600 V, 0.020 inches thick PVC insulation and clear nylon jacketed.

Both "A" and TS2 controller power harnesses and connectors shall be included.

All cabinet configurations shall be provided with enough RS-485 Port 1 communication cables to allow full capabilities of that cabinet. One additional RS-485 port cable, capable of reaching any RS 485 device, shall be supplied for testing. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be shielded cable suitable for RS-485 communications. The additional port cable connector shall be cupped to prevent dirt or moisture contamination. The RS-485 port cables shall be as small as possible and remain flexible throughout the NEMA temperature range of operation.

All main panels shall be prewired for a Type-16 Malfunction Management Unit.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

Standard soldering and termination practices shall be followed. Wires soldered to .025 inch square posts shall be wrapped 270 degrees around the post. It is recommended that printed circuit boards or connectors be used with .025 inch squared posts. Great care shall be taken to prevent cold solder joints, solder bridges or shorts. Soldering shall be of the highest quality obtainable.

All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.

All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.

The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point, using removable jumpers, as outlined in the NEMA TS2 Standard.

All pedestrian push-button inputs from the field to the controller shall be optoisolated through the BIU and operate at 12 VAC.

- 2.4 Power Panel – The power panel shall consist of a separate, wholly enclosed module, securely fastened to the right side wall of the cabinet. The power panel shall be wired to provide the necessary power to the cabinet, controller, Malfunction Management Unit, cabinet power supply and auxiliary equipment. It shall be manufactured from 0.090-inch, 5052-H32 aluminum with a removable plastic front cover. The panel shall be of such design so as to allow a technician to access the main and auxiliary breakers without removing the front cover.

*The power panel shall house the following components:*

- a. A 5-amp equipment breaker which also functions as an on/off switch. This breaker shall supply power to the controller, MMU, cabinet power supply and auxiliary panels. The equipment breaker shall be wired after the main breaker, transient protection and filtering.
- b. A 30 amp main breaker, which shuts off all power to the equipment breaker and all signal lights.
- c. A 15-amp auxiliary breaker. This breaker shall supply power to the fan, light and GFI outlet and shall be wired directly to the incoming power.
- d. All breakers shall be thermal magnetic type, UL listed for HACR service, with a minimum of 10,000 amp interrupting capacity.
- e. An EDCO model SHA 1210 or exact approved equivalent surge arrester.
- f. A 50 amp, 125 VAC radio interference line filter.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

- g. A normally-open, 60-amp, mercury connector Durakool model BBC-7032 or exact equivalent.
- h. A 15-position neutral bus bar capable of connecting three #12 wires per position. There shall be at least 13 positions, with no wires connected, available for field connections.
- i. A 7-position ground bus bar capable of connecting three #12 wires per position.
- j. A NEMA type 5-15GFI convenience outlet.
- k. A two-position 15amp non-GFI protected outlet shall be provided on the cabinet wall to provide power for telemetry units and other external devices. Fused at 5 amps, fast-blow, protected with an EDCO FAS120C surge protector or approved equivalent and mounted on the left side of the cabinet just below the upper shelf.

2.5 Auxiliary Cabinet Equipment – The cabinet shall be provided with a thermostatically controlled (adjustable between 80-150 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute.

A R14 intermediate screw base (E17) 25 watt lamp protected in a metal housing and connected to a 15 inch flexible arm. Arm shall be attached to the door of the cabinet at an optimum location for lighting the controller and other panels. A fluorescent lighting fixture shall be mounted on the inside top of the cabinet near the front. The lamps shall be wired to door activated switch mounted near the top of the door.

Two sets of complete and accurate non-fading cabinet drawings shall be supplied with each cabinet.

All equipment supplied with the cabinet shall include one set of operating and service manuals per unit up to a maximum of ten sets per order.

2.6 Vehicle Detection Rack – A vehicle detector amplifier rack shall be provided in each cabinet. Detector racks shall support up to 8 channels of loop detection, two 2-channel preemption devices and one BIU and mounted on top of the upper shelf. The detector rack shall be mounted on the top right side of the top shelf.

Each cabinet shall contain detector interface panels for the purpose of connecting field loops and vehicle detector amplifiers. One 8-position interface panel shall be provided. The interface panel shall be secured to a mounting plate and attached to the left sidewall of the cabinet.

Interface panels shall allow for the connection of eight independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

Interface panels shall provide a 10-position terminal block to terminate the field wires for up to two 2-channel preemption devices.

Lightning protection devices shall be provided (EDCO SRA-16C, or EDCO SRA-6, or EDCO LCA-6 EDCO SRA 6LCA, or equivalent lightning protection device).

A cable consisting of 20 - 22 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color. All termination points shall be identified by a unique number and labeled on the panel.

Each detector rack shall accommodate rack mountable preemption devices such as Opticom™.

The detector rack shall be mounted as high as possible in the cabinet.

2.7 Cabinet Test Switches and Police Panel – The police door switch panel shall contain the following:

- a. **SIGNALS ON/OFF SWITCH.** In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
- b. **AUTO/FLASH SWITCH.** In the flash position, power shall not be removed from the controller and stop time shall not be applied. When the switch is returned to the Auto position the controller shall restart.
- c. **AUTO/MANUAL SWITCH.** Cabinet wiring shall include an AUTO/MANUAL switch and a terminal strip with a momentary push-button and 24” coiled hard cord, which is extendable to 12 feet. Terminal strip shall be accessible only from the inside of the cabinet.
- d. **MANUAL PUSH BUTTON SWITCH.** An additional manual advance momentary push button switch mounted on and accessible through the police panel door shall operate with the Auto/Manual switch.
- e. A door open/closed switch, connected to the BIU on Alarm 1, shall be provided. All toggle type switches shall be rated 5 amps. Single-(all the time) or double-pole switches may be provided, as required.

Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.

All switch functions must be permanently and clearly labeled.

All wire routed to the police door-in-door switch panel shall be adequately protected against damage from repetitive opening and closing of the main door.

All test switch panel wiring shall be connected to the main panel via a 15-pin AMP type connector.

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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

**3.0 Auxiliary Devices**

- 3.1 Load Switches – Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.

Signal load switches shall have a minimum rating of 20 amperes at 120 VAC for an incandescent lamp load. They shall be capable of handling a one cycle surge of 250 amperes at 125 degrees centigrade.

The front of the load switch shall be provided with three LED indicators to show the input signal from the controller to the load switch.

Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.

The full complement of load switches shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

- 3.2 Flashers – The flashers shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard.

Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher.

The flasher shall be rated at 25 amperes, double pole with a nominal flash rate of 60 FPM.

- 3.3 Flash Transfer Relays – All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.

The coil of the flash transfer relay must be de-energized for flash operation. Contacts shall be rated at 30 amps resistive.

The full complement of relays shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

Flash Transfer Relays shall be a Struthers Dunn 21XBXP-120VAC or an approved equal.

- 3.4 Cabinet Power Supply – The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard. The power supply shall be a standalone type. The power supply shall be mounted on top of the upper shelf at the left end.

The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.

The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.



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**REVISION OF SECTION 614  
TRAFFIC SIGNAL CONTROLLER CABINET**

- 3.5 24V Load Switch Control Relay – The relay used to control the 24VDC to the load switcher shall have a push button, which allows it to be mechanically energized.

**4.0 Testing and Warranty**

- 4.1 Testing – Each controller and cabinet assembly shall be tested as a complete entity under signal load for a minimum of 48 hours.

Each assembly shall be delivered with a signed document detailing the cabinet final tests performed.

The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.

- 4.2 Warranty – The controller and Malfunction Management Unit shall be warranted by the manufacturer against mechanical and electrical defects for a period of 5 years. The manufacturer’s warranty shall be supplied in writing with each cabinet and controller. Second party extended warranties are not acceptable.

The cabinet assembly and all other components shall be warranted for a period of one year.

Any defects shall be corrected by the manufacturer or supplier at no cost to the owner.

Manufacturer’s warranty shall be submitted to the Engineer for transfer to the City and County of Denver.

Subsection 614.10 shall include the following:

Cabinet base installation shall include all labor and materials to completely install a new foundation for the controller cabinets specified in the plans. This is to include the concrete foundation, all conduit modification work, back-filling, and concrete repair.

Subsection 614.13 shall include the following:

The traffic signal controller unit will not be measured and paid for separately, but shall be incidental to the Traffic Signal Controller Cabinet.

The cabinet foundation will not be measured and paid for separately, but shall be incidental to the Traffic Signal Controller Cabinet installation.

UPS units and associated enclosures/cabinets will be paid for separately as Uninterrupted Power Supply, Each.

Subsection 614.14 shall include the following:

<b>Pay Item</b>	<b>Unit</b>
Traffic Signal Controller Cabinet	Each

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**REVISION OF SECTION 614  
CLOSED CIRCUIT TELEVISION CAMERA (TRAFFIC MONITORING)**

Section 614 of the Standard Specifications is hereby revised to include the following:

Subsection 614.01 shall include the following:

This work consists of the installation of a closed circuit television camera at the locations shown on the plans.

Subsection 614.08 shall include the following:

(m) Closed Circuit Television Camera (Traffic Monitoring)

Closed circuit television camera shall be the Panasonic WV-CS954 Camera or equivalent as approved by the City and County of Denver Traffic Engineering Services. The following accessories, or approved equivalents, shall be provided for each camera: Panasonic PAPM3 Pole Mount Bracket; Panasonic POD9CW Dome Housing (wall mount); IFS VT1930WDM Fiber Optic Modem SM Transmitter (standalone unit); IFS VR1930WDM-R2 Fiber Optic Modem SM Receiver (rack mount); 250' CDOT Composite Camera Cable from Soliton; and Camera Transformer Altronix T2428100 24 VAC from Soliton.

Subsection 614.10 shall include the following:

The closed circuit television camera shall be installed in accordance with the details shown in the plans and in accordance with manufacturer's recommendations. The Contractor shall deliver the camera and accessories to the City and County of Denver's Traffic Operations Department at 5440 Roslyn, Denver, Colorado at least 4 weeks prior to installation for the camera calibration and set up. The Contractor shall pick up the camera and shall install it at the proper location. The Contractor shall make arrangements for a City and County of Denver Traffic Operations' representative to be on-site to ensure proper installation.

Subsection 614.13 shall include the following:

Closed circuit television cameras will be measured by the actual number of closed circuit television cameras and associated equipment that are installed and accepted. All accessories shall not be measured separately.

Subsection 614.14 shall include the following:

Payment will be under:

<b>Pay Item</b>	<b>Pay Unit</b>
Closed Circuit Television	Each

Payment will be full compensation for all labor, materials, accessories, and equipment required to complete the work.

**REVISION OF SECTION 614  
BUFFER TUBE FAN OUT KIT**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

For this project, Buffer Tube Fan-Out Kits shall be furnished and installed on fiber lateral cables ends in field communications cabinets.

**MATERIALS**

The Contractor shall use fiber optic fan outs on the fiber lateral cable in the communication cabinets. Fanned out cables shall be installed on the ends of lateral fiber cable strands. Buffer tubes for lateral fiber strands shall be 9mm minimum and shall be neatly coiled and secured within the field termination panels with tubes matching the lateral fiber strand color. Bulkhead connectors shall be terminated on the ends of the lateral cable strands and installed on the back side of the termination panels.

**BASIS OF PAYMENT**

Buffer Tube Fan-Out Kit will not be measured and paid for separately, but shall be incidental to the fiber optic cable items.

## **REVISION OF SECTION 614 FIBER OPTIC PRE-CONNECTORIZED CABLE**

Section 614 of the Standard Specifications is hereby revised to include the following:

### **DESCRIPTION**

This work consists of the installation of a fiber optic pre-connectorized cable which shall be used inside communications cabinets and regeneration node buildings for connection of optical devices to fiber termination panels.

### **MATERIALS**

The pre-connectorized cables shall be jacketed for extra protection and shall be provided with pre-connectorized connectors on both ends to match the optical connectors to which they connect. Connectors shall be pre-terminated by the manufacturer.

The cables shall contain the exact number of loose tube fibers and connectors to connect the optical equipment. If the optical equipment transmits and receives data on a single fiber, the pre-connectorized cable shall contain only a single fiber, (simplex). When the optical device transmits and received data on two or four fibers, a pre-connectorized cable shall be provided with 2 (two) fibers per cable, (duplex), for each bulkhead pair, (transmit and receive).

The measured attenuation of the connector (inclusive of coupler and mated test connector) shall not exceed an average of 0.3 dB for all connectors provided. Any connector found in excess of 0.5 dB shall be rejected. Reflectance shall be less than -40 dB from -10°C to +60°C (14° F to 140° F). The manufacturer shall have a program that periodically tests connectors to ensure that after 1000 rematings, the attenuation will not change more than 0.2 dB.

The connector shall be able to withstand an axial pull of 25 lbs. with no physical damage to the connector and no permanent optical degradation more than 0.3 dB.

### **CONSTRUCTION REQUIREMENTS**

Fiber optic pre-connectorized cables are to be provided inside communications cabinets and regeneration node buildings for connection of optical devices to the fiber termination panels. Connectors shall be compatible with both the bulkhead connectors on the optical devices and the termination patch panel. Appropriate cable management and labeling shall be used after installation of the cables.

Labeling for the cables in field equipment cabinets shall be as shown in figure 1. Each individual cable shall have its own individual label indicating the devices, lateral fiber color and the data transmitting description, (example: Tx or Rx).

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**REVISION OF SECTION 614  
FIBER OPTIC PRE-CONNECTORIZED CABLE**

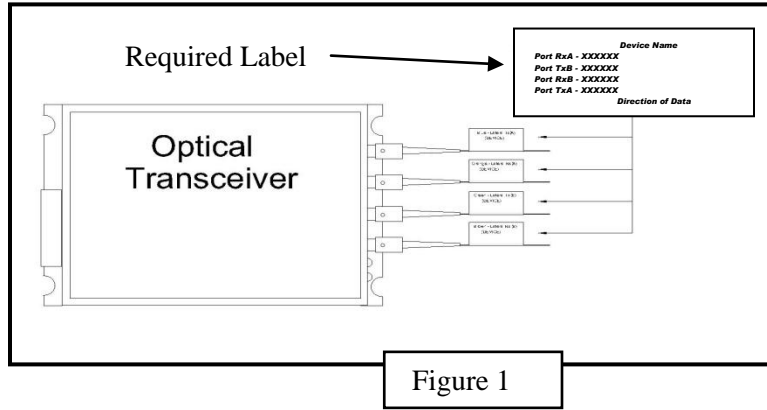


Figure 1

Labeling for the cables in regeneration node buildings shall have identification labels at each end indicating corresponding patch panel number.

The per-connectorized cables shall be provided in the following lengths.

Pole mounted equipment cabinets.....1 Foot - 6 Inches maximum

Ground cabinets.....3 Feet – 0 Inch maximum

Regeneration Node Buildings.....Patch cable shall be of equal lengths for each individual equipment rack

Lengths have been set so excess cable does not interfere with equipment in field cabinets and to maintain proper cable management in the regeneration node buildings.

**METHOD OF MEASUREMENT**

Fiber optic pre-connectorized cables and labeling shall not be measured or paid for separately but will be considered subsidiary to the fiber optic cable and termination panels installed in regeneration node buildings and shall include all information labeling.

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## REVISION OF SECTION 614 FIBER OPTIC SPLICE CLOSURE

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

Fiber optic splice closures are to be used to splice fiber optic cables together at lateral fiber device locations or at cable-end splice locations specified in the plans within pull boxes or manholes.

Subsection 614.08 shall include the following:

(u) *Fiber Optic Splice Closure*. The fiber optic splice canister shall be furnished and installed by the Contractor. It shall be sized to provide capacity for splicing the total number of strands in all cables entering the canister.

The optical fibers shall be fusion spliced and shall meet the following minimum requirements:

- Splice loss <0.20 dB
- Reflection <50 dB
- Stable from -40°C to +85°C (-40° F to +185° F)

The splice closure shall be a stand-alone closure that does not require an outer closure and shall meet the following minimum requirements:

- The closure shall seal, anchor and protect fiber optic cable splices.
- The closure shall provide for a minimum of two additional spare entries in addition to the required number of cables being spliced up to a maximum of six total cable entries.
- The closure shall be suitable for underground applications and shall be water and airtight.

The closure shall be sized to provide the capacity equal to the total number of strands in all cables entering the closure. All fiber optic cables shall be secured per the manufacturer's recommendations. All remaining access holes not utilized shall be plugged to prevent water from entering closure.

The only fibers to be cut are those shown to be spliced on the splicing schematics shown in the plans, or furnished by CDOT and City ITS personnel. All unused buffer tubes and fiber strands shall remain uncut. After splicing is complete, the fiber strands shall be routed into, coiled and secured in splice trays. All remaining uncut strands from the buffer tube shall also be coiled in the tray. Remaining buffer tubes shall be neatly coiled and secured within the closure per the manufacturer's recommendations.

If an existing closure, or a closure provided by the Contractor requires re-entry and resealing, it shall be conducted per the manufacturer's recommendation for re-entry. The Contractor shall use caution not to damage the fiber strands or buffer tubes existing inside.

It is the Contractor's responsibility to ensure that the fiber optic splice enclosure and associated fiber cable coil fit adequately within the pull box specified on the plans. No additional payment shall be made for modifications to the pull box.

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**REVISION OF SECTION 614**  
**FIBER OPTIC SPLICE CLOSURE**

The Contractor shall contact the Engineer four hours prior to sealing the closure and installation in the pull box or manhole. In the event that the Engineer or the CDOT / CITY representative cannot be on site, eight digital pictures shall be taken at varying angles showing all completed splice work within the splice closure. These pictures shall include exposed fiber stands, (both spliced and uncut) in all splice trays, and remaining buffer tubes showing appropriate coiling. One picture shall also include the complete re-assembly of all interior parts prior to final re-assemble and sealing. Once the canister and fiber coil are installed in the pull box or manhole, two pictures shall be taken of the installation utilizing the fiber management hardware.

**BASIS OF PAYMENT**

Subsection 614.13 shall include the following:

Fiber Optic Splice Closure will not be measured or paid for separately, but shall be incidental to the fiber optic cable items.

**REVISION OF SECTION 614  
FIBER OPTIC CABLE AS-BUILT DOCUMENTATION**

Section 614 of the Standard Specifications is hereby revised for this project as follows:

The Contractor shall complete and forward to the Project Engineer the Fiber Optic Cable As-Built Documentation Sheet as part of their final submittals on the project. Since numerous fiber cables exist around the state, The Department requires as-built information for routine maintenance and repair work when needed. This form is an aide to document that information as it pertains to the installation of fiber optic cable along the Interstate 25 corridor as part of this project.

At each pull box and manhole location, information to be provided shall include the cable sequential foot marking measurements stamped on the cable jacket as the cable enters and exits the pull box or manhole, type of splices where they exist, number of lateral cables at the location and documentation of the cable ID at locations of cable end splices. Identification of pull boxes and manholes shall be by manhole numbers as they are shown on the fiber optic splice plan sheets and by milepost of those that are not listed in the plans.

Revised fiber optic splices shall also be provided as marked up copies of the splice diagrams in the plans. If changes are made during the splicing procedures, those changes shall be documented by the Contractor's splice technicians and submitted to the Project Engineer as final as-built drawings.

**BASIS OF PAYMENT**

This work will not be paid for separately, and shall be incidental to the fiber optic cable items.



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**REVISION OF SECTION 614**  
**FIBER OPTIC CABLE AS-BUILT DOCUMENTATION**

**FIBER OPTIC CABLE AS-INSTALLED DOCUMENTATION SHEET**

TO NEXT PULL BOX or  
MANHOLE

CABLE MEASUREMENT OUT \_\_\_\_\_

PULL BOX LOCATION _____	CABLE ID NUMBER _____
MANHOLE NUMBER _____	

CABLE MEASUREMENT IN \_\_\_\_\_

SPLICE POINT YES \_\_\_ NO \_\_\_  
CABLE END SPLICE YES \_\_\_ NO \_\_\_  
NUMBER OF LATERAL CABLES \_\_\_\_\_

CABLE MEASUREMENT OUT \_\_\_\_\_

PULL BOX LOCATION _____	CABLE ID NUMBER _____
MANHOLE NUMBER _____	

CABLE MEASUREMENT IN \_\_\_\_\_

SPLICE POINT YES \_\_\_ NO \_\_\_  
CABLE END SPLICE YES \_\_\_ NO \_\_\_  
NUMBER OF LATERAL CABLES \_\_\_\_\_

CABLE MEASUREMENT OUT \_\_\_\_\_

PULL BOX LOCATION _____	CABLE ID NUMBER _____
MANHOLE NUMBER _____	

FROM PREVIOUS PULL BOX or  
MANHOLE

CABLE MEASUREMENT IN \_\_\_\_\_

SPLICE POINT YES \_\_\_ NO \_\_\_  
CABLE END SPLICE YES \_\_\_ NO \_\_\_  
NUMBER OF LATERAL CABLES \_\_\_\_\_

**REVISION OF SECTION 614**  
**FIBER OPTIC CABLE INSTALLATION - GENERAL**

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.08 (a) shall include the following:

Fiber optic cable installed on this project will be installed in electrical conduits, pull boxes, manholes and equipment communication cabinets containing existing fiber optic cable, electrical cable or electronic equipment currently carrying communication data from existing roadway devices. The new fiber cable shall be installed in a manner which will not interfere with the integrity of the existing cable and/or equipment. Slack fiber cable shall be coiled in pull boxes, manholes and communications cabinets using proper fiber management. All OTDR and power meter testing shall be conducted as stated in this specification and in accordance with the Project Special Provision, Test Fiber Optic Cable, included herein.

The Contractor shall install all backbone and lateral fiber optic cables in accordance with the splicing diagrams shown in the project plans, or as furnished by CDOT and City ITS personnel. The Contractor shall conduct an on-reel test prior to installing any fiber cables. After the on-reel test the Contractor shall provide the Project Engineer with all result documentation prior to actual cable installation. No installation shall commence until the Project Engineer reviews and accepts all test results showing all fibers in the cables are undamaged, containing no breaks or micro bends. Once the results are accepted, the fiber cable may be installed. If the test results show damage to any strand or strands within a reel, that reel shall be rejected, replaced and retested at no additional cost to the project.

Once the fiber cable is accepted by the Project Engineer, the cable may be installed. The backbone cable is to be installed in reel lengths long enough to minimize cable end splices, in turn minimizing fiber cable loss. Once the entire backbone cable is installed and all cable-end splices are complete, testing shall be conducted in each direction of light travel from each of the regeneration sites and equipment rooms.

Fiber tests for the backbone cable shall be submitted to the Project Engineer for approval prior to any lateral cable splicing. As with on-reel tests, if any strand or strands show damage from the Contractors installation, that entire section of fiber cable shall be removed, re-installed and re-spliced from cable end splice to cable end splice manholes at no additional cost to the project. A second set of tests shall be performed after any reinstallation.

After backbone cable test acceptance, the Contractor may begin the lateral cable splicing for all devices. Once the lateral cables are installed, spliced and terminated in the communications cabinets, fiber cable tests shall be conducted from the Regeneration Building patch panels to all devices. Test results must conform to the Project Special Provisions. If any results show greater loss than the Special Provision allows, a new splice or termination shall be conducted.

If any strand(s) of the lateral cables show damage from the Contractors installation, that entire section of fiber cable shall be removed, re-installed and re-spliced from the splice point to the device communications cabinet at no additional cost to the project.

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**REVISION OF SECTION 614  
TEST FIBER OPTIC CABLE**

Section 614 of the Standard specifications is hereby revised for this project as follows:

Subsection 614.08 shall include the following:

Test fiber Optic Cable. For this project this work shall consist of the testing of Fiber Optic Cable as shown and tabulated in the plans. The testing procedures involve an OTDR test and an Optical Power Meter Test.

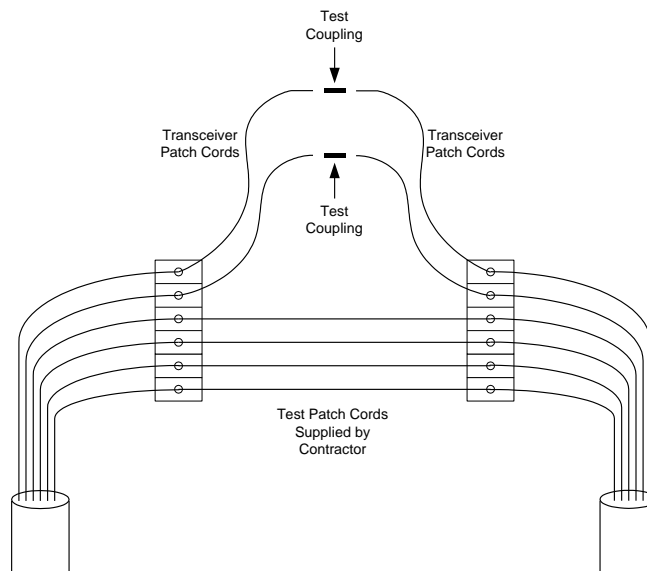
The guidelines for fiber optic cable testing include:

- (1) Test jumpers and patch cords must be of the same fiber core size and connector type as the cable system:
  - i) Single Mode fiber 8.3/125  $\mu$ m
- (2) The light source and OTDR must operate with the range of 1310 $\pm$ 10 nm or 1550 $\pm$ 20 nm for Single Mode testing in accordance with ANSI/EIA/TIA-526-7.
- (3) The power meter and the light source must be set to the same wavelength during testing.
- (4) The power meter must be calibrated and traceable to the National Institute of Standards and Technology (NIST).
- (5) All system connectors, adapters and jumpers must be cleaned as per manufacturer's instructions before measurements are taken.
  - A) Fiber Optic Cable Testing Equipment. The following is required to perform fiber optic cable tests:
    - (1) An OTDR
    - (2) A test reel, of at least 900 feet
    - (3) A light source at the appropriate wavelength
    - (4) Optical Power Measurement Equipment
    - (5) Test Jumpers as specified below
      - i) Single Mode Fiber Testing
      - ii) CPR Test Jumper-1 and Test Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested.
  - B) Optical Fiber Cable Testing with OTDR. The Contractor shall perform an OTDR test of all fibers in all tubes on the reel prior to installation of the fiber. The test results shall be supplied to the Engineer prior to installation of the cable.

If the fiber is specified as "Install Only", the Contractor shall test the fiber on the reel and provide the test results to the Engineer prior to accepting the cable. After installation, if there are unused portions of cable remaining on the reel, the Engineer may request the Contractor or other qualified technician to perform a reel test. The Contractor shall provide the Engineer the test results prior to delivering the cable to the Engineer. Any cable damaged while in the Contractor's possession shall be replaced at the Contractor's expense.

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**REVISION OF SECTION 614**  
**TEST FIBER OPTIC CABLE**

All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end-to-end OTDR trace performed per TIA/EIA-455-61. The system margin loss measurements shall be provided at 1310 nm and 1550 nm for Single Mode fibers. If the Plans require installation of a fiber optic patch panel, the Contractor shall supply patch cords to patch all terminated fibers through the panel for all fiber testing. If patch cords are specified in the Plans for final equipment installation, these patch cords shall be connected using a test coupling for the end-to-end test.



OTDR readings will be used to ensure proper installation and to troubleshoot faults. OTDR signature traces will be used for documentation and maintenance. An OTDR provides an indirect estimate of the loss of the cable plant, generally, more accurate or reliable values will be obtained by using an Optical Power Meter. For fibers that are identified in the Plans to be left unterminated, an OTDR shall be used to test end-to-end attenuation.

Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.

The Contractor shall use an OTDR that is capable of storing traces electronically and shall save each final trace.

To ensure the traces identify the end points of the fiber under test and the fiber designation, the Contractor shall use a test reel, if required, to eliminate the “dead zone” at the start of the trace so that the start of the fiber under test can be identified on the trace. Indicate the length of the test reel for all test results.

If the fiber designation is not indicated on the trace itself, the Contractor shall provide a cross-reference table between the stored trace file name and the fiber designation.

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**REVISION OF SECTION 614**  
**TEST FIBER OPTIC CABLE**

In compliance with EIA/TIA-455-61 "Measurement of Fiber or Cable Attenuation Using an OTDR" the Contractor shall record the following information during the test procedure:

- (1) Names of personnel conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
- (3) Date test is being performed.
- (4) Optical source wavelength and spectral width.
- (5) Fiber identification including tube color and fiber color
- (6) End point locations
- (7) Launch conditions
- (8) Method of calculation for the attenuation or attenuation coefficient.
- (9) Acceptable link attenuation
- (10) Identify loss event
- (11) Test direction

C) Optic Fiber Cable Testing with Optical Power Meter. The Contractor shall conduct an Optical Power Meter Test for each fiber installed.

Single Mode segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.

Fiber Cable Plant" and TIA/EIA-526-7 "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant," the following information shall be recorded during the test procedure:

- (1) Names of personnel conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
- (3) Date test is being performed.
- (4) Optical source wavelength, spectral width, and for multimode, the coupled power ratio (CPR).
- (5) Fiber Identification including tube color and fiber color.
- (6) Identify loss event
- (7) End point locations.
- (8) Test direction.
- (9) Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- (10) Method of calculation for the attenuation or attenuation coefficient.
- (11) Measured attenuation of the link segment.
- (12) Acceptable link attenuation.

The minor attenuation differences due to test direction are on par with the accuracy and repeatability of the test method. Lateral segments within a building are limited to 90 meters. Therefore, attenuation differences caused by wavelength are insignificant, and as a result, single wavelength testing is sufficient.

D) Acceptable Attenuation Values. Acceptable attenuation values shall be calculated for each fiber tested. These values represent the maximum acceptable test values.

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**REVISION OF SECTION 614**  
**TEST FIBER OPTIC CABLE**

A connection is defined as the joint made by mating two fibers terminated with re-mateable connectors (e.g. ST, SC, LC).

(1) Singlemode Fiber. The general attenuation equation for any Single Mode link segment is as follows:

$$\text{Acceptable Link Attn.} = \text{Cable Attn.} + \text{Connector Attn.} + \text{Splice Attn.}$$

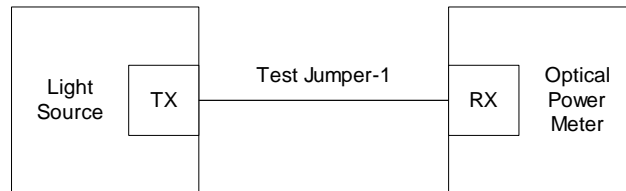
8.3  $\mu\text{m}$  Single-mode Attenuation Coefficients:

- i) Cable Attn. = Cable Length (km) x (0.34 dB/km@1310 nm or 0.25 dB/km@1550 nm)
- ii) Connection Attn. (ST or SC connectors) = (# Connections x 0.39dB) No more than 0.75dB per connector
- iii) Splice Attn. (Mechanical or Fusion) = Splices x 0.10dB

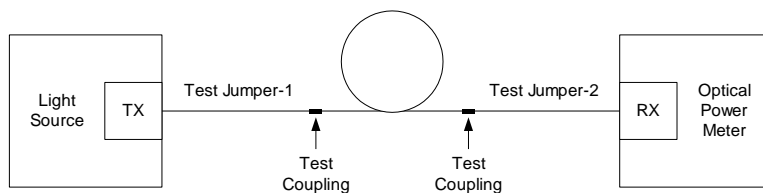
E) Test Procedures. All fiber testing shall be performed on all fibers in the completed end-to-end system.

(1) Single Mode Fiber. The Single Mode Optical Power Meter fiber test shall be conducted as follows:

- i) Clean the test jumper connectors and the test coupling per manufacturer's instructions.
- ii) Follow the test equipment manufacturer's initial adjustment instructions.
- iii) Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4 inches) in diameter.



- iv) If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement ( $P_{ref}$ ). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
- v) Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.
- vi) Attach Test Jumper-1 to one end of the cable plant to be measured and Test Jumper-2 to the other end.



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**REVISION OF SECTION 614  
TEST FIBER OPTIC CABLE**

vii) Record the Power Measurement ( $P_{sum}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the true value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:

a) If  $P_{sum}$  and  $P_{ref}$  are in the same logarithmic units (dBm, dBu, etc.):

$$CPR (dB) = P_{sum} - P_{ref}$$

b) If  $P_{sum}$  and  $P_{ref}$  are in watts:

$$c) CPR (dB) = 10 \times \log_{10} [O_{sum}/P_{ref}]$$

F) Test Acceptance. The Contractor shall demonstrate that each Optical Power Test results in acceptable attenuation values.

The Contractor, solely at the Contractor's cost, shall remake any fusion splices and/or connectors that have test results exceeding acceptable attenuation values.

The Contractor, solely at the Contractor's cost, shall retest any fiber links that have been re-spliced.

The Contractor, solely at the Contractor's cost, shall bring any link not meeting the requirements of this specification into compliance.

G) Submittals. The Contractor shall submit test results documentation as both a hard copy and electronic copy.

After each reel test, the Contractor shall submit four (4) hard copies of the OTDR trace for every fiber on the reel. After installation, the Contractor shall submit four (4) hard copies of the OTDR trace for every spliced fiber. Hard copy traces shall be organized and bound in logical order in an 8 1/2" x 11" 3 ring hard cover binder in addition to other documentation listed in this Special Provision and other splicing documentation listed in the project Special Provision package.

The Contractor shall submit, after approval of the hard copy traces, electronic copies of all traces and appropriate software to allow reading the traces.

The Contractor shall submit four (4) copies of all Optical Power Test results.

The Contractor shall submit four (4) copies of the complete contract Plans, including additional drawings issued as part of any change orders, with any deviations clearly marked in color. Deviations to be noted and shall include but not be limited to the following:

Fiber Splice location

- (1) Fiber Splice configuration
- (2) Termination layout

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**REVISION OF SECTION 614**  
**TEST FIBER OPTIC CABLE**

Subsection 614.13 shall include the following:

The complete end-to-end OTDR test on one fiber, including document submission, represents one OTDR test.

The complete end-to-end optical power meter test on one fiber, including document submission, represents one optical power meter test.

The accepted quantities will be paid for at the contract price per pay unit of measurement for the work completed.

Subsection 614.14 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Test Fiber Optic Cable	Lump Sum



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## REVISION OF SECTION 614 FIBER OPTIC CABLE (SINGLE MODE)

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

### DESCRIPTION

This work consists of furnishing, installing, and testing single mode fiber optic cable at the locations shown on the plans. Construction requirements of this special provision shall also apply to Fiber Optic Cable (Special).

### MATERIALS

**Fiber Optic Cable:** All fiber optic cable runs installed shall be either main backbone cable or lateral cables. The main backbone cable shall be terminated in the Communications Node. The lateral fiber cables shall be terminated with a fan-out kit at the termination block in the field equipment cabinet.

Main backbone and lateral cables shall be suitable for conduit installation. Lateral cables that connect the main backbone cable to the equipment controller cabinets shall be completed with continuous runs of cable. All lateral cable shall include a maximum of three locations of appropriate strain relief within the field equipment cabinets.

Fiber optic cable shall be loose tube non-armored outdoor cable consisting of low water peak single-mode fibers and complying with the following specification for fiber optic cable.

All fiber optic cable characteristics shall be compatible with proposed and existing cables.

The Contractor shall ensure that the material provided by the manufacturer meet the following requirements:

(a) General

1. The fiber optic cable shall be an accepted product of the United States Department of Agriculture Rural Electrification Administration (REA) as meeting requirements of 7CFR1755.900
2. All optical cables shall meet all fiber optic standards and specifications of the International Municipal Signal Association (IMSA).
3. All optical cables shall meet all fiber optic standards, specifications and testing procedures as specified by EIA/TIA.
4. All optical cables shall comply with International Telecommunications Union (ITU-T).
5. All optical cables shall be new, unused and of current design and manufacture.

(b) Fiber Characteristics

1. All optical fibers must be usable fibers and shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical and environmental requirements of this Special Provision.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.
3. The dispersion un-shifted single-mode fiber utilized in the cable specified herein shall conform to the following specifications:
  - A. Typical Core Diameter: 8.2 $\mu$ m.
  - B. Cladding Diameter: 125.0  $\pm$  0.7  $\mu$ m.
  - C. Core-to-Cladding offset:  $\leq$  0.5  $\mu$ m.

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**REVISION OF SECTION 614  
FIBER OPTIC CABLE (SINGLE MODE)**

- D. Cladding Non-Circularity:  $\leq 0.7\%$  Defined as:  $[1 - (\text{min. Cladding dia.} \div \text{max. Cladding dia.})] \times 100$
- E. Coating Diameter:  $245 \pm 5 \mu\text{m}$ .
- F. Colored Fiber Diameter: nominal  $250 \mu\text{m}$ .
- G. Attenuation Uniformity - No point discontinuity greater than  $0.10 \text{ dB}$  at either  $1310 \text{ nm}$  or  $1550 \text{ nm}$ .
- H. Attenuation at the Water Peak - The attenuation at  $1383 \text{ nm}$  shall not exceed  $0.35 \text{ dB/km}$ .
- I. Cutoff Wavelength – The cabled fiber cutoff wavelength ( $\lambda_{\text{ccf}}$ ) shall be  $\leq 1260 \text{ nm}$ .
- J. Mode-Field Diameter:
  - $9.20 \pm 0.40 \mu\text{m}$  at  $1310 \text{ nm}$
  - $10.40 \pm 0.50 \mu\text{m}$  at  $1550 \text{ nm}$
- K. Zero Dispersion Wavelength ( $\lambda_0$ ): ( $1313 \text{ nm}$ )  $1302 \text{ nm} \leq (\lambda_0) \leq 1322 \text{ nm}$ .
- L. Zero Dispersion Slope ( $S_0$ )- $\leq 0.089 \text{ ps} \div (\text{nm}^2 \bullet \text{km})$
- M. The maximum dispersion for single-mode optical fibers shall be  $\leq 3.2 \text{ ps}/(\text{nm} \bullet \text{km})$  for  $1285 \text{ nm}$  through  $1330 \text{ nm}$  and shall be  $\leq 18 \text{ ps}/(\text{nm} \bullet \text{km})$  at  $1550 \text{ nm}$ .
- N. Polarization Mode Dispersion (PMD) for Maximum Individual Fiber:  $0.2 \text{ ps} \div \sqrt{\text{km}}$
- O. Fiber Curl:  $\geq 4.0 \text{ m}$  radius of curvature
- P. All optical fibers shall be proof tested by the manufacturer to a minimum load of  $0.7 \text{ GN/m}^2$  ( $100 \text{ ksi}$ ).
- Q. The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically strippable without damaging the fiber.

(c) Specifications for Outdoor Cable Construction

1. Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be  $3.0 \text{ mm}$
2. Each buffer tube shall contain 6 or 12 fibers as appropriate for the respective size cable.
3. The fibers shall not adhere to the inside of the buffer tube.
4. Each fiber and buffer tube shall be color coded with distinct and recognizable colors in accordance with EIA/TIA-598-A, Optical Fiber Cable Color, as shown in the plans. Coding shall be colored with ultraviolet (UV) curable inks.
5. In buffer tubes containing multiple fibers, the coloring shall be stable during temperature cycling as stated in this specification and shall not be subjected to fading or smearing onto each other or into the buffer tube gel filling material. Colorings shall not cause fibers to stick together.
6. Buffer tubes shall be of a dual-layer construction with the inner layer made of polycarbonate and the outer layer made of polyester.
7. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
8. The central anti-buckling member of the cable shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling.
9. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.
10. Buffer tubes shall be stranded around a central member of the cable using a reverse oscillation stranding process. Water blocking yarns shall be applied longitudinally along the central member during stranding.
11. Water blocking tape shall be used as stated in this specification. Gel filled water-blocking compound shall not be allowed in the cable core interstices in either the backbone cable or the lateral cables.

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**REVISION OF SECTION 614  
FIBER OPTIC CABLE (SINGLE MODE)**

12. For single layer cables, a water blocking tape shall be applied longitudinally around the outside of the strand tubes, fillers, or both. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus, electrically non-conductive homogenous. It shall also be free from dirt and foreign matter.
13. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.
14. The cable shall contain at least one ripcord under the sheath for easy sheath removal.
15. Tensile strength shall be provided by high tensile strength dielectric yarns.
16. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.
17. All-dielectric cables, (non-armored) shall be sheathed with medium density polyethylene, (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The MDPE shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
18. The cable jacket shall be free of holes, splits and blisters.
19. The cable jacket shall contain no metal elements and shall be of a consistent thickness.
20. Cable jackets shall be marked with sequential foot markings, year of manufacture and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within 0 to 1% of the length markings. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be easily readable.
21. The maximum pulling tension shall be 2700 N (608 lbs) during installation (short term) and 890 N (200 lbs) long term installed.
22. The shipping, storage and operating temperature range of the cable shall be -40o C to +70oC. The installation temperature range of the cable shall be -30o C to +70oC.
23. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink requirements of 7 CFR 1755.900.

**(d) Quality Assurance Provisions**

1. All optical fibers shall be 100% tested in accordance with the project special provision, revision of section 614 Test Fiber Optic Cable.
2. The cable manufacturer shall be ISO 9001 registered.

**(e) Packaging**

1. The complete cable shall be packaged for shipment on non-returnable wooden reels.
2. Top and bottom ends of the cable shall be available for testing.
3. Both ends of the cable shall be sealed to prevent the ingress of moisture.
4. Each reel shall have a weatherproof reel tag attached identifying the reel and cable information.
5. Each cable shall be accompanied by a cable data sheet that contains significant information on the cable.

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**REVISION OF SECTION 614**  
**FIBER OPTIC CABLE (SINGLE MODE)**

**CONSTRUCTION REQUIREMENTS**

The Contractor shall provide the Engineer with two copies of the cable manufacturer's installation instructions for all fiber optic cable. All installation shall be in accordance with these practices except as otherwise directed by the Engineer. At the Engineer's discretion, all fiber optic cable that is damaged due to the Contractor's failure to meet recommended materials handling and installation requirements, shall be replaced at Contractor's expense.

Fiber optic cable shall be installed in continuous runs. The manufacturer's recommended limits for cable pull lengths shall not be exceeded. If fiber installation operations meet the manufacturer's recommended limits, the remaining cable shall be laid in a figure eight pattern prior to installation. Only active (lit) fibers need to be terminated in field equipment cabinet locations. All (dark) fibers, both backbone fiber optic cable and lateral fiber optic cables shall be sealed in a manner recommended by the manufacturer.

Prior to installing the fiber optic cable, the Contractor shall submit a fiber-interconnect schematic diagram to the Engineer for approval. The diagram shall clearly indicate cable routing, splice points and fiber connections including identifying the color-coded fibers and buffer tubes. Installation of the cable will not be permitted until the schematic diagram has been approved by the Engineer.

(a) **Fiber Optic Cable Installation.** Under no conditions shall the fiber optic cables be cut or spliced at intermediate points without express written direction from the Engineer.

All installation shall be done in conformance with EIA/TIA standards and fiber optic cable manufacturer's installation guidelines. The Contractor shall ensure that the cable bends maintain the proper radius during installation. The fiber optic cable shall be pulled in the conduit with a split mesh cable grip designed to provide a firm hold on the exterior covering of the cable.

The Contractor shall use a pulley system with a numerical readout indicating the cable tension. The pulley system shall be capable of alerting the installer when the cable pulling tension approaches the manufacturer's maximum allowable tension. The Contractor may supplement this procedure with a breakaway tension limiter set below the lowest recommended tensile limit of the cables being pulled.

Blowing cable is an acceptable alternative. If the Contractor chooses this alternative a detailed method statement for cable installation shall be submitted for approval. This method shall include complete information on fiber installation equipment that will be used.

If the cable cannot be installed completely from the shipping reel and installation requires the cable to be pulled in two directions from the mid-point of a run, the Contractor shall first pull one-half of the cable from the reel at the mid-point through the conduit to one end of the run. The other half of the cable shall be removed from the reel and carefully placed on the ground. The cable shall be coiled in a figure eight with a minimum loop diameter of 10 feet. The coiled cable shall then be pulled with a minimum amount of dragging on the ground, through the conduit to the other end of the run. The Contractor shall not kink, twist or bend the cable during installation coiling or uncoiling.

During pulling, the cable shall be continuously lubricated as it enters the conduit. The Contractor shall only use pulling lubricants recommended by the cable manufacturer. Liquid detergent shall not be used.

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**REVISION OF SECTION 614**  
**FIBER OPTIC CABLE (SINGLE MODE)**

If the Contractor must install new cable in existing conduits over existing cables or wiring, the Contractor shall be responsible for any damage to the existing cables or wires caused by this operation. The Contractor shall perform a function test of all the equipment connected to the existing cables or wiring to ensure they are in proper working condition. If an existing fiber optic cable is damaged during construction, it shall be removed from both points of termination and replaced, at no cost to the project.

In no case shall the fill of any new conduit exceed the requirements of the National Electrical Code. The Contractor shall provide documentation to the Engineer supporting the conduit fill requirements. All costs associated with equipment testing and repairs shall be included in the cost of the Fiber Optic Cable.

All fiber optic cables shall include identification labels attached to the cable in each pull box, manhole or field equipment cabinet. The label shall be provided with information as shown on the Project Special Details.

1. **Splices and Splice Closures:**

The Contractor shall break out the main fiber optic cable and splice individual fibers to the lateral cable fibers that run into the field equipment cabinet as shown in the project plans. All splices shall be enclosed within a splice closure as approved by the Engineer. Following successful splicing, the splice closure shall be placed inside the pull box or manhole. The Contractor shall be required to accomplish the work using splicing tools and hardware recommended by the cable manufacturer.

2. **Main Backbone Fiber Optic Cable:**

Main fiber optic cable shall be installed in continuous runs from pull box or manhole to each proceeding pull box or manhole. The Contractor shall be required to leave 100 feet of slack cable in manholes and 50 feet of slack in pull boxes.

3. **Lateral Fiber Optic Cable:**

Lateral fiber optic cable shall be installed in continuous runs from the backbone cable to the field equipment cabinet. The Contractor shall be required to leave 25 feet of slack cable in all manholes and pull boxes.

4. **Buffer Tube Fan-Out:**

The Contractor shall terminate the lateral cable at the field equipment cabinet using a buffer tube fan-out kit. Fanned-out cables shall be terminated in a termination block with appropriate connectors.

**METHOD OF MEASUREMENT**

Subsection 614.13 shall include the following:

Fiber Optic Cable will be measured by the Linear Foot including coils in manholes, pull boxes and equipment cabinets, for both backbone and lateral cable, and shall include all labor and materials required to install and terminate the cable to make a complete and operational system.

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**REVISION OF SECTION 614  
FIBER OPTIC CABLE (SINGLE MODE)**

**BASIS OF PAYMENT**

Subsection 614.14 shall include the following:

Payment will be full compensation for materials and equipment required to properly install the fiber cables including, but not limited to the following:

1. Fiber Optic Cable will not be paid until final testing is completed and accepted in accordance with section 614.
2. All Identification labels for each pre-connectorized cable.
3. All identification labels for fiber optic cable in manholes pull boxes, field cabinets and communication nodes.
4. All other work necessary to complete the item.
5. All required splice enclosures, splice kits, ancillary hardware, use of splicing tools and labor to accomplish the splices.
6. All required fan-out kit tools, ancillary hardware and labor to accomplish the fan-out.
7. All termination panels (including specified features), connectors, adapters, jumpers, pigtails, ancillary hardware and labor required to accomplish the termination in field cabinets and communication nodes.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Fiber Optic Cable (Single-Mode) (12 Strands)	Linear Feet
Fiber Optic Cable (Single-Mode) (96 Strands)	Linear Feet

All testing will be measured and paid in accordance with Section 614.

**REVISION OF SECTIONS 614 AND 713**  
**SIGN PANEL (CLASS III) (DG3)**

Sections 614 and 713 of the Standard Specifications are hereby revised for this project as follows:

In subsection 614.04, delete the first paragraph and replace with the following:

Sign panel materials for permanent signing shall conform to Section 713 and to the details shown on the plans. Retroreflective sheeting shall be ASTM D4956 Type XI (DG3) as defined in the *CDOT Retroreflective Sheeting Materials Guide*, and shall conform to subsections 713.04 and 713.06.

In subsection 713.06, delete the fourth paragraph and replace with the following:

For all permanent signs, the legend, borders, and background shall be Type XI (DG3).

Subsection 614.14 shall include the following:

<b>Pay Item</b>	<b>Unit</b>
Sign Panel (Class III)	Square Feet

## **REVISION OF SECTION 614 IMPACT ATTENUATOR**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

### **DESCRIPTION**

This work consists of furnishing and installing impact attenuators. This work shall be done in accordance with these specifications and in conformity with the lines and details shown on the plans or established.

### **MATERIALS**

The impact attenuator shall be one of the following:

- (1) QUADGUARD System, as manufactured by Energy Absorption Systems, Inc., One East Wacker Drive, Chicago, IL 60601
- (2) Smart Cushion, as manufactured by SCI Inc., 2500 Production Drive, St. Charles, IL 60174

The design speed of this portion of the roadway is 65 miles per hour.

The impact attenuator shall meet the following design parameters:

NCHRP Report 350 Test Level: TL-3

Hazard Width: varies 2 to 4 feet

Bi-directional: no

Object to be shielded: Concrete barrier

### **CONSTRUCTION REQUIREMENTS**

The site shall be prepared to receive the impact attenuator by filling, excavating, smoothing, constructing the concrete foundation pad, installing approved transition and anchoring, and all other work necessary for the proper installation of the attenuator. The foundation pad shall be 6 inch thick reinforced concrete or 8 inch thick non-reinforced concrete. Other foundations may be used, if recommended by the impact attenuator manufacturer, and approved by the Engineer. The impact attenuator shall be fabricated and installed in accordance with the manufacturer's recommendations. The Contractor shall provide a copy of the manufacturer's installation instructions and parts lists to the Engineer prior to installation of the device.

Each installation shall be supervised and certified as correct upon completion by a representative of the device manufacturer or by an employee of the Contractor who is a certified installer. The Contractor shall submit all appropriate documentation to validate that the certified installer has completed device training and has been registered with the manufacturer as a certified installer.



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**REVISION OF SECTION 614  
IMPACT ATTENUATOR**

**METHOD OF MEASUREMENT**

Impact attenuators will be measured by the actual number of attenuators that are installed and accepted.

**BASIS OF PAYMENT**

The accepted quantities will be paid for at the contract unit price for the pay item listed below.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Impact Attenuator	Each

Payment will be full compensation for all work and materials required to furnish, install, and certify the impact attenuator. Site preparation, foundation pad and all necessary hardware including anchors and transitions will not be measured and paid for separately, but shall be included in the work.

All costs associated with either having a manufacturer's representative on-site, or training and certifying an employee of the Contractor as a certified installer, will not be measured and paid for separately, but shall be included in the work.

## **REVISION OF SECTION 615 WATER CONTROL DEVICES**

Section 615 of the Standard Specifications is hereby revised to include the following:

Subsection 615.01 shall include the following:

This work consists of the installation of a 48 Inch Flap Gate to be paid for as a 48" Automatic Drain Gate in accordance with these specifications, details shown on the plans, to the lines and grades established, and to the manufacturer's recommendations. The gate shall be designed to cover a 48-inch round opening and to allow free outflow and prevent backflow for a minimum seating head of 20-feet.

Subsection 615.02 shall include the following:

### **Frame/Seat**

The frame shall be cast iron of flatback or spigotback design, with machined seating surface inclined from vertical to assure positive closure. For flatback gates mounted to thimbles or flanges, the gate flange shall be machined and drilled to match.

### **Cover**

The cover shall be cast iron, cast in one piece, with reinforcing ribs, designed to withstand the seating head specified. An integral cast on lifting eye shall be provided for manual operation.

### **Seating Faces**

Seating surfaces for the frame and cover shall be bronze. All machined seats shall have a minimum 63 microinch finish.

### **Gate**

The gate shall be provided with adjustable, double pivoted hinge links so designed to permit complete seating, full opening, and with stops or other arrangement to prevent cover from rotating sufficiently to become wedged in the open position. Pivot lugs mounted to frame shall be adjustable to allow adjustment of hinge links without having to remove cover from gate. The hinge links shall be bronze-bushed, structural steel. All assembly hardware shall be stainless steel of the type recommended by the manufacturer.

### **Fasteners**

All anchor bolts, assembly bolts, screws, studs and nuts shall be of ample size to safely withstand the forces created by operation of the gate under the required heads. Quantity and size of the fasteners shall be of recommended by the manufacturer. Anchor bolts shall be furnished with two nuts each to facilitate installation and alignment of the gates when attached to concrete.

### **Finish**

All cast iron shall be painted with the manufacturer's standard shopcoat paint.

Structural steel hinge links shall be galvanized. All bronze and stainless steel parts do not require further finish.

**Drawings for Approval**

Drawings showing the dimensions and details required to locate and install the component assemblies shall be submitted for the engineer's approval prior to fabrication.

**Materials**

Frame and Cover	Cast Iron per ASTM A-126, Class B
Seating Faces	Commercial Bronze
Pivot Lug	Ductile Iron per ASTM A-536, Gr. 65-45-12 or Gr. 80-55-06
Hinge Link	Structural Steel per ASTM A-36, galvanized per ASTM A-123 or Ductile Iron per ASTM A-536 Gr. 80-55-06
Bronze Bushings and Washers	Commercial Bronze
Assembly Hardware	Stainless Steel

Subsection 615.03 shall include the following:

Installation of the 48 Inch Flap Gate (paid for as a 48" Automatic Drain Gate) shall be in accordance with the manufacturers recommendations.

Subsection 604.05 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
48" Automatic Drain Gate	Each

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**REVISION OF SECTION 624  
DETOUR DRAINAGE PIPE**

Section **624** of the Standard Specifications is hereby revised for this project as follows:

Subsection **624.01** shall include the following:

This work consists of designing, furnishing, installing, maintaining and removal of a temporary highway drainage system on I-25 and Santa Fe for all phases of I-25 and Santa Fe reconstruction.

Subsection **624.02** shall include the following:

Detour **drainage** pipe and inlets may be new or used approved materials.

Detour **drainage** pipe and inlets will remain the property of the Contractor.

Subsection **624.03** shall include the following:

A temporary drainage system shall:

- (a) Provide a drainage capacity equivalent to, or greater than, the existing or new permanent I-25 drainage system in place at the time of the temporary drainage system installation
- (b) Not outfall directly into the South Platte River

Inlet grates for the temporary drainage system that extend into traffic lanes shall be designed and constructed to carry highway loading.

Subsection **624.04** shall include the following:

The completed and accepted work for detour **drainage** pipe **and inlets** will not be measured but will be paid for on a lump sum basis. The lump sum price will be full compensation for all work required to complete the item.

Subsection **624.05** shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
<b>Detour Drainage Pipe (Class 0)</b>	Lump Sum

The design, completed and accepted work for the detour **drainage** pipe **and inlets**, maintenance of the detour **drainage** pipe **and inlets**, removal of the detour **drainage** pipe **and inlets**, and removal and replacement of appurtenances required to construct and operate the detour **drainage** pipe **and inlets**, will be paid for at the contract lump sum price. This price includes all labor, equipment and materials to complete the work.

**REVISION OF SECTION 618  
PRESTRESSED CONCRETE**

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

In Subsection 618.02 second paragraph delete the first sentence.

Delete Subsection 618.02(a)3.

In Subsection 618.04(b) include the following in the first paragraph:

For combination tensioned members, the contractor shall coordinate the post-tensioning ducts, anchorages and other hardware between the precast yard and bridge site to ensure compatibility for the post-tensioning system selected.

In Subsection 618.04(b) add the following:

- (10) Shop drawings for combination tensioned members shall show all the items required for pretensioned and post-tensioned members.

In Subsection 618.04(c)(7) delete the last sentence.

In Subsection 618.04(c)(14) delete the first two paragraphs.

In Subsection 618.04(c) add the following:

- (15) Locations of grout inlets and outlets and all details and materials related to the grouting of the tendons.

Subsection 618.06(a) shall include the following:

Any structural or rejectable defect, as determined by the QC Manager, QA Representative, or the Engineer shall cause all fabrication to cease. The QC Manager shall produce a written Corrective Action Report addressing the cause of the defect and the proposed method for correcting precasting procedures and materials such that the defect will not occur on members yet to be cast. This report is in addition to the written proposal for repair required in Subsection 618.13. The Corrective Action Report shall be submitted to the Engineer. Only after the Engineer accepts in writing the report and the proposed method for correction of precasting procedures, will precasting operations resume. Any member fabricated prior to acceptance of the Corrective Action Report will not be accepted by the Department. The expense for the report, corrective actions and any loss of time shall be borne by the Contractor.

Acceptance of the Corrective Action Report in no way relieves the Contractor from the responsibility of producing members that meet the requirements of the Contract Documents. The suitability and final success of the corrective actions proposed in the report is the responsibility of the contractor. If the proposed corrective actions do not adequately address the cause of the defects, as evidenced by recurrence of defects, the Contractor shall cease precasting operations until a revised Corrective Action Report is written by the QC Manager and approved by the Engineer

In Subsection 618.07(c)2 delete item (1).

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**REVISION OF SECTION 618  
PRESTRESSED CONCRETE**

Delete Subsection 618.08 and replace with the following:

618.08 Post-Tensioning Anchorages and Distribution. Prestressing steel shall be secured at the ends by means of approved permanent type anchoring devices. Anchorages, anchor zones and couplers shall be in accordance with the AASHTO LRFD Bridge Design Specifications, 4<sup>th</sup> Edition, 2007, with interims through 2010 and the AASHTO LRFD Bridge Construction Specifications, Third Edition, 2010.

In Subsection 618.09(a) delete the second paragraph and replace with the following:

The duct for a post-tensioning tendon shall be grouted within 7 days of stressing the tendon. The exception to the seven day grouting requirement is during cold weather when heating would be required to allow the ducts to be grouted in accordance with (e) below. If the Contractor chooses not to heat the structure, the ducts, anchorages grout inlets and outlets shall be sealed to keep water, ice, dirt and other substances out of the ducts until such time that they can be grouted. The ducts shall be grouted within 7 days after weather permits grouting in accordance with (e) below.

In Subsection 618.09(d) delete the sixth paragraph and replace with the following:

Grout shall be pumped through the duct and continuously wasted at the outlet until all visible slugs of water and air are ejected. A minimum of two gallons of grout shall be wasted at the outlet for each tendon. To insure that the tendon remains filled with grout, the outlet shall be closed and the pumping pressure allowed to build to a minimum of 50 psi and maximum of 100 psi and held for one minute before the inlet vent is closed.

**Subsection 618.14 (c) shall include the following:**

**The Contractor's Engineer shall consider and design for all girder stresses induced from lifting, storing, shipping and erection of the girders. Additional girder reinforcement or pre-stressing (monostrand) shall be provided, as required, to prevent cracking or other damage of the girder due to handling. The Contractor's Engineer shall provide the fabricator a plan for lift points and support points for storage and shipping, which correspond with the Engineer's calculations. For curved girders, the Contractor's Engineer shall provide lift point offsets required to prevent torsional rolling of the girder due to its curvature. The Contractor's Engineer shall provide the Engineer with a copy of the completed calculations, lift points and support plan for record purposes only.**

Delete Subsection 618.16 and replace with the following:

618.16 Prestressed units will be measured as follows:

- (1) Prestressed girders will be measured by the linear foot.
- (2) Prestressing steel for post-tensioning tendons will not be measured, but shall be the quantities shown in the plans, completed and accepted. MKFT equals the jacking force, in thousands of kips, multiplied by the length in feet.

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**REVISION OF SECTION 618**  
**PRESTRESSED CONCRETE**

- (3) Concrete and reinforcing for those elements cast at the bridge site, including closures, pier diaphragms and end diaphragms will be measured and paid for in accordance with Sections 601 and 602 respectively.

Precast panel deck forms that are required by the plans will be measured by the square foot. The quantity will not be remeasured, but will be the quantity shown on the plans, except when a plan change is ordered or when it is determined that there are discrepancies in an amount of plus or minus 2 percent of the plan quantity.

In Subsection 618.17, add the following Pay Item:

<b>Pay Item</b>	<b>Pay Unit</b>
Precast Concrete U Girder (Precast and Post-Tensioned)	Linear Foot

Subsection 618.17 shall include the following:

Payment for Precast Concrete U Girder (Precast and Post-Tensioned) shall include all items incorporated into the girder at the precast yard, including but not limited to concrete, reinforcing, pretensioning strand and other embedded hardware.

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**REVISION OF SECTION 620  
FIELD FACILITIES**

Section 620 of the Standard Specifications is hereby revised for this project as follows:

Delete Subsection 620.02 and replace with the following:

The Field Office (Special) will be located in the building at 135 South Kalamath St., which is owned by CDOT. It shall be made equivalent to a Field office (Class 2) as approved by the Project Engineer. All equipment and services provided by the Contractor for the Field Office shall remain the property of the Contractor. Rental fees will not be charged to the Contractor for use of this building.

The following shall be provided for the above mentioned office:

- (a) *Initial Cleaning.* The office shall be thoroughly cleaned and disinfected prior to the start of the project. This shall include complete cleaning of rest rooms, and shampooing of all carpet. Labor for cleaning will not be paid for separately, but shall be included in the work.
- (b) *Interior Painting.* The Contractor shall prepare and paint the interior walls of the Field Office building with a name brand, satin, paint of neutral color. Preparation shall include patching any holes and cracks with joint compound, and wiping all wall surfaces clean with a product specified for this purpose.
- (c) *Office Furniture.* The office shall be provided with partitions, desks, chairs, trash cans, and associated office furniture and equipment for eight (8) CDOT personnel for the duration of the project. In addition, the office shall be provided with folding chairs and tables to accommodate a meeting of up to twenty (20) individuals.
- (d) *Copy Machine Installation and Maintenance.* The copy machine shall be Wi-Fi compatible, and shall be connected and programmed to operate as the office's shared printer. It shall have the capacity to copy, and to scan, color or black/white documents. The Contractor shall install and maintain the copy machine in the field office building. The copy machine shall be capable of producing a minimum of twenty five copies per minute. Maximum size of the original shall be 11" X 17". The copy machine shall have a minimum of two standard paper cassettes accommodating paper sizes 5 1/2" X 8 1/2" to 11" X 17". Each cassette shall accept a minimum of 250 sheets for a total of 500 sheets of paper capacity. Copy machine shall have a single sheet bypass for manual copying onto special stock, not in paper cassettes and capable of using paper sizes of 5 1/2" X 8 1/2" to 11" X 17". Copy paper and toner ink shall be supplied by the Contractor. The copy machine shall have an automatic exposure control to automatically control exposure level for each original with a manual light/dark exposure control and shall be capable of copying original documents of both sheet and bound documents. The copy machine shall be capable of making 1 to a minimum of 99 continuous copies and shall be capable of copying onto light weight paper of 16# or onto heavier paper of 32#. The copy machine shall be capable of zoom magnification/reduction from 70% to 150% in 1% increments. The copy machine shall be equipped with a sorter attachment with a minimum of ten sort bins.
- (e) *Small Laptop Computers.* The Contractor shall provide and maintain two (2) small laptop computers, commonly known as netbooks, for the Project Engineer and Assistant. They shall be loaded with all pertinent software and applications for use on CDOT construction. The small laptops shall have high speed wireless internet capability, and also be able to connect to the router in the field office. They will be returned to the Contractor following final acceptance and closing of the project. The Contractor shall maintain the small laptops, including anti-virus software, and repairs.



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**REVISION OF SECTION 620  
FIELD FACILITIES**

- (f) *Microcomputer Router.* The Contractor shall provide and maintain a router that is capable of handling at least eight (8) CDOT staff IBM type computers. All hardware components provided shall function as a fully integrated and complete system. All hardware shall be installed for use in accordance with the manufacturer recommended installation and use. The Contractor shall provide a high-speed, 5 MBps or faster, connection and modems. Nine jacks, or Wi-Fi antennae, shall also be provided for connection to the microcomputer router. The jacks shall be located throughout the building and one to the field laboratory, as directed by the Engineer. The Contractor shall provide communication cords for the microcomputer jacks.

A wireless network is preferred, and if chosen, shall be secured from outside interference or signal theft.

- (g) *Facsimile Machine.* The Contractor shall provide and maintain a facsimile machine that prints on plain paper and is capable of sending documents of all sizes up to and including 11 inch x 17 inch. It must be able to perform sequential broadcast, polling and delayed transmission with a minimum ten page memory. The Contractor shall install and maintain the fax machine in the Engineer's field office. The Contractor shall provide communication cords for the facsimile machine.
- (h) *Office Phone Service.* The Field office (Special) shall be provided with the minimum of four (4) private lines. A minimum of eight (8) cordless telephones shall be provided, with roll-over capability for incoming calls. Each of the telephones provided shall be fully capable of utilizing any of the lines, and of transferring calls. One jack shall be located in field laboratory, and three jacks shall be located in the main building, two in the center of the field office, including the fax line, and one each in two of the walled offices. The system shall provide the capability to retrieve messages from any touch-tone telephone. Automatic electronic voice messaging shall be provided for the three field office telephone lines. If one or more additional phone lines and jacks are required for computer internet service, they shall be provided in addition to those listed above, and all cables for service to/from computers.
- (i) *Mobile Telephones.* The Contractor shall provide up to eight (8) handheld portable telephones with two-way capabilities for use by the Engineer and CDOT staff. The telephones shall be equipped with charging units and adapters for both AC and DC charging. The telephones shall each be provided with a private number, call forwarding, call conferencing, call waiting, and a pager with voice message capabilities. In addition, the Contractor shall provide the Traffic Control Supervisor(s) with a handheld portable telephone with two-way capabilities that is able to communicate with the telephones provided to the Engineer.
- (j) *Heating and Air Conditioning.* An adequate heating and air conditioning system capable of maintaining a uniform temperature of 80 degrees F (max) and a cooling temperature of 70 degrees F (min) shall be provided for the office areas within the Field office (Special). The system shall be capable of maintaining a uniform temperature of 60 to 85 degrees F throughout the remainder of the building. These systems shall be maintained by the Contractor at no additional cost to the project. It is advised that the Contractor inspect the existing heating and air conditioning systems prior to the beginning of the project to ensure the adequacy of the existing system. If the existing system is not adequate this system shall be upgraded to meet the above requirements. Filters shall be provided and changed by the Contractor every three (3) to six (6) months.
- (k) *Fire Extinguisher.* Four twenty pound dry chemical fire extinguishers for Field office (Special) shall be provided by the Contractor. Fire extinguishers shall be maintained by the Contractor in good working order, with appropriate fire department authorization.

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**REVISION OF SECTION 620  
FIELD FACILITIES**

- (l) *Locks & Keys.* The Contractor shall supply eight (8) sets of keys to the field office.
- (m) *Parking Spaces.* The Contractor shall provide a minimum of eight (8) parking spaces exclusively for CDOT personnel within lockable security fence.
- (n) *Restrooms.* Restrooms shall be included with the Field office (Special), and shall consist of the three toilets and three lavatories, located in the Field office building, which the Contractor shall maintain in good operating condition throughout the duration of the project. Supplies, weekly cleaning and hot/cold water services for this facility shall be provided by the Contractor.
- (o) *Utilities for Field Facilities.* The Field Facilities shall be equipped with utility services necessary to meet all requirements herein, including but not limited to; electricity and natural gas provided by Xcel Energy or equivalent source approved by the Engineer, ground communication lines for phone, fax and internet access provided by Qwest Communications or equivalent vendor approved by the Engineer, hot and cold tap water and sanitary sewer services. All systems must meet current codes; any deficiencies shall be brought up to code prior to the start of the project. Any labor and materials required to bring said utilities to current code will not be paid for separately, but shall be included in the work.

Subsection 620.03 shall include the following:

The site and access for the field laboratory shall be located in the same lot as the field office at 135 South Kalamath Street within the fenced CDOT yard. The field laboratory shall include the following:

- (a) *Fire Extinguisher.* One twenty pound dry chemical fire extinguishers for Field Lab (Class 2) shall be provided by the Contractor. Fire extinguishers shall be maintained by the Contractor in good working order, with appropriate fire department authorization.
- (b) *Parking Spaces.* The Contractor shall provide a minimum of two (2) designated parking spaces exclusively for CDOT personnel within lockable security fence.

Subsection 620.05 shall include the following:

The Field Office shall be provided with weekly scheduled cleaning and all typical supplies, such as toilet tissue, paper towels, cleaning supplies and cleaning equipment. All necessary maintenance equipment and work shall be included, such as light bulbs, window replacement and worker time.

Subsection 620.06 shall include the following:

Field facilities shall be fully functional for the Engineer's use from the Notice to Proceed until 45 calendar days after final project acceptance or until the Engineer requests removal in writing, whichever time is least.

In Subsection 620.06 delete the first paragraph and replace with:

- (a) *Location.* The location for the field facilities will be on CDOT property at 135 South Kalamath Street located between I-25 and South Santa Fe Drive, North of Alameda Ave.

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**REVISION OF SECTION 620  
FIELD FACILITIES**

- (b) *Permits.* The Contractor shall obtain any required permits from the City of Denver for the installation of the field facilities.
- (c) *Site Preparation.* The site and access area for the field facilities is paved and shall be maintained, including but not limited to snow removal, asphalt patching of potholes and occasional sweeping as directed by the Engineer.
- (d) *Site Maintenance.* The Contractor shall be responsible for maintaining and restoring the area to its initial, project ready condition, during and at the conclusion of the project.
- (e) *Fencing.* The site with the field facilities shall be securely fenced with a locking gate. The gate must function properly so that it is easy to maneuver, by one average person, and it is operational during inclement weather. Eight (8) sets of keys for the locking gate shall be provided to the Engineer.
- (f) *Outside Lighting.* The site with the field facilities shall be thoroughly lit. All facility door locations, gate(s), and parking locations shall be lit. Electrician time, Fixtures and wiring shall be included in the Field Facility (Special), as needed.
- (g) *Security.* The Field Facilities shall be equipped with the following security systems or an approved equal:  
  
Continuously monitored surveillance or silent watchman type electronic security system installed in each of the field facilities and in the fenced yard.
- (h) *Use by the Department.* The site and field facilities are for the exclusive use of Department personnel and shall be separate from the Contractor's facilities.

As approved by the Engineer, the Contractor may use remaining space on the property, or adjacent CDOT property, for staging, stockpiling, trailer and vehicle parking. The CDOT yard must be separated from the Contractor's yard by lockable security fencing.

Subsection 620.07 shall include the following:

- Insurance:** The Contractor shall provide insurance against theft or damage for all Department owned inventory stored in the Field Facility (\$50,000 minimum).
- Maintenance:** The Contractor shall maintain all furnished equipment in good working condition and shall replace or repair any non-functional equipment within five working days.
- Drinking Water:** Drinking water shall be provided in the field office; it shall be dispensed from an acceptable cooling device with both hot and cold capabilities; one (1) device shall be supplied for the field office.
- Trash Receptacle:** The Contractor shall provide a dumpster at the field office site with weekly trash removal service.

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**REVISION OF SECTION 620**  
**FIELD FACILITIES**

Replacement Equipment: The Contractor shall provide and maintain field facilities in good working condition. Critical replacement equipment due to breakdown, damage, or theft, shall be replaced within two (2) working days. Non-critical equipment, as directed by the Engineer, shall be replaced or repaired within five working days.

Subsection 620.08 shall include the following:

Facilities payment for above items will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Field office (Special)	Each
Field Laboratory (Class 2)	Each
Sanitary Facility	Each

## **REVISION OF SECTION 621 DETOUR**

Section 621 is hereby added to the Standard Specifications for this project and shall include the following:

### **DESCRIPTION**

**621.01** This work consists of constructing detours as shown in the plans for all phases of construction on Santa Fe and I-25; maintenance of the detours; removal of the detours; and removal and replacement of appurtenances required to construct and operate the detours including but not limited to guardrail, curb and gutter, detour pavement, embankment material and unclassified excavations.

### **MATERIALS**

**621.02** All materials required for detour shall comply with project standard specifications and special provisions.

Detour pavement shall conform to Hot Mix Asphalt (Grading S)(100)(PG64-22).

The Contractor shall be responsible for quality control required to assure adequate quality of embankment material, aggregate base course, hot mix asphalt used in the construction of the detour.

### **CONSTRUCTION REQUIREMENTS**

**621.03** The detour locations and dimensions for all phases of construction shall be as shown on the plans.

If the materials and thickness furnished for the detour pavement result in an inadequate detour structure, the Contractor will provide additional thickness, materials, or other measures necessary to provide a satisfactory pavement for the life of the detour. These additional improvements shall be furnished at no additional cost.

All necessary signs, pavement markings and other traffic control devices shall be provided in accordance with the traffic control plan.

### **MAINTENANCE OF DETOUR**

**621.04** The Contractor shall maintain the detour for the entire period that it is open to traffic. Any distress that affects the ride, safety, or serviceability of the detour roadway shall be corrected to the satisfaction of the Engineer at the expense of the Contractor.

### **METHOD OF MEASUREMENT**

**621.05** Detour will be measured by the square yard of detour pavement completed and accepted. Detour shall include, but is not limited to, design, materials, construction, maintenance and removal of the detour; and required removal and replacement of appurtenances described above.

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**REVISION OF SECTION 621**  
**DETOUR**

**BASIS OF PAYMENT**

**621.06** The accepted quantities will be paid for at the contract unit price for the pay item listed below that appears in the bid schedule.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Detour	Square Yard

Payment will include full compensation for all labor, equipment, materials and all other work to complete the work.

Signs, pavement markings and other traffic control devices for the detour will be paid for in accordance with Sections 614 and 630.

## **REVISION OF SECTION 621 TEMPORARY BRIDGE**

Section 621 is hereby added to the Standard Specifications for this project as follows:

### **DESCRIPTION**

**621.01** This work consists of the complete design, construction, maintenance and removal of a temporary bridge at the location as shown in the plans for NB I-25 over NB Santa Fe. A preliminary layout and design has been included in the plans for information only, and is hereafter referred to as the “default design”. The Contractor has the option of completing the default design, or providing the design for another structure type which satisfies the requirements of this Project Special Provision. The temporary bridge shall:

- (1) Comply with all applicable design and construction requirements of this Project Special Provision; and provide the roadway section widths, live load capacity, horizontal and vertical alignment, minimum lateral and vertical clearances, as described herein and as shown on the plans for the default design; and
- (2) Include all material, labor and equipment necessary to design, construct, maintain and remove the temporary bridge, as described herein and as shown on the plans for the default design.

### **DESIGN**

**621.02 General.** Design of the temporary bridge shall be accomplished under the direct supervision and responsible charge of a Professional Engineer registered in the State of Colorado; and who is hereafter referred to as the Contractor’s Professional Engineer.

### **621.03 Qualifications, Requirements and Responsibilities of the Contractor’s Professional Engineer.**

The Contractor’s Professional Engineer shall have minimum qualifications as follows:

- (1) The Contractor’s Professional Engineer shall have been in responsible charge of the design of the type of temporary bridge being proposed within the past five years, and shall provide to CDOT examples and references for projects successfully completed by the Contractor’s Professional Engineer which are similar in nature, and which include the proposed type of structure.
- (2) The Contractor’s Professional Engineer may be a professional engineer employed by the Contractor, or a consulting engineer under contract to the Contractor. If the Contractor’s Professional Engineer is not an employee of the Contractor, then the Contractor’s Professional Engineer shall be employed by a firm which is pre-qualified by the CDOT for bridge design. The Contractor may utilize more than one person or firm to provide these services.
- (3) The Contractor’s Professional Engineer, or his employer, shall have Professional Liability insurance in an amount not less than \$1,000,000; and provide to the Engineer a certificate of insurance attesting to this coverage at the time of the Preliminary Design Submittal.
- (4) If there is any change in the Contractor’s Professional Engineer, the Contractor shall submit to the Engineer for review and acceptance the replacement personnel qualifications at least 30 calendar days prior to beginning construction or changing personnel. Construction shall not begin, or continue, until the Engineer has reviewed and accepted the proposed change in qualified personnel.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

- (5) Acceptance by CDOT or the Engineer of the Contractor's Professional Engineer proposed for the design of the temporary bridge shall in no way relieve the Contractor of full responsibility for the work of all design and construction personnel and full compliance with the Contract Documents.

The Contractor's Professional Engineer shall be responsible for carrying out all engineering services required to design the temporary bridge in accordance with this specification and the Contract Documents.

The Contractor's Professional Engineer shall be responsible for observing and monitoring the Contractor's work, as necessary, during construction of the temporary bridge to ensure conformance with the bridge design and design intent; and to ensure the requirements of the Contract Documents are being met for all aspects of the work for which the Contractor's Professional Engineer is responsible.

The Contractor's Professional Engineer, or a designated representative shall be available on-site and/or by telephone as deemed necessary by the Engineer.

The Contractor shall authorize the Contractor's Professional Engineer to stop or suspend construction operations and / or work for which the Contractor's Professional Engineer is responsible, if in the opinion of the Contractor's Professional Engineer, the temporary bridge is not being constructed in conformance with the design or the Contract Documents. The Engineer shall be notified in writing by the Contractor of any work stoppage or suspension authorized by the Contractor's Professional Engineer. Such work shall not re-commence until the Contractor's Professional Engineer agrees and certifies in writing that the work deficiency has been remedied / corrected.

**621.04 Design and Construction Requirements.** The following specifications shall be applicable to the design and construction of the temporary bridge. Unless noted otherwise, the most current edition, with applicable interims, shall be used;

- (1) CDOT 2005 Standard Specification for Road and Bridge Construction, including all applicable Standard Special Provisions
- (2) CDOT Project Special Provisions
- (3) American Association of State Highway and Transportation Official (AASHTO) LRFD Bridge Design Specifications 4<sup>th</sup> Edition
- (4) Colorado Department of Transportation M & S Standards
- (5) Colorado Department of Transportation Bridge Design Manual
- (6) Colorado Department of Transportation Bridge Rating Manual
- (7) CDOT Staff Bridge Design Worksheets



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**REVISION OF SECTION 621**  
**TEMPORARY BRIDGE**

- (8) CDOT Bridge Detailing Manual
- (9) CDOT Staff Bridge Technical Memorandums
- (10) ANSI/AASHTO/AWS Bridge Welding Code
- (11) Colorado Department of Transportation (CDOT) Field Materials Manual
- (12) CDOT Survey Manual
- (13) MUTCD, latest edition
- (14) CDOT Procedural Directive 508.1 Professional Engineer's Stamp

In addition to the above requirements and specifications, the following minimum requirements shall be met:

- (1) Live Load. The structure shall be designed for an HL-93 live load, with permit vehicle combinations as specified by the AASHTO specifications and the CDOT Bridge Design Manual.
- (2) Foundations. The maximum allowable service load bearing capacity for spread footings placed on the MSE fill shall be 4000 psf. The Contractor shall coordinate all aspects the temporary bridge design with the MSE wall system supplier. In lieu of those recommendations, the Contractor may provide a foundation analysis by an independent geotechnical consultant. Costs for an independent foundation analysis shall be borne by the Contractor.
- (3) The superstructure shall be a constant depth.
- (4) A single consistent girder type shall be used throughout the structure. Use of multiple types of girders is not allowed.
- (5) Horizontal and vertical alignment, and cross slope of the roadway surface finished grade shall be the same as the default design.
- (6) The number of spans shall remain the same as the default design.
- (7) Upon completion of construction, the horizontal and vertical clearances as provided by the default design shall be maintained.
- (8) Provide for and accommodate temporary roadway lighting as shown or specified in the Contract Documents for the default design.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

- (9) *Resulting Changes to Other Project Elements.* Any changes or impacts to other project elements as a result of the temporary bridge design and construction, such as, but not limited to: retaining walls, roadway, drainage, utilities, environmental clearances and permits, phasing, and traffic control, shall be the responsibility of the Contractor; and the cost of such changes or impacts shall be included in the temporary bridge cost.
- (10) *Use of Default Design, Details and Plan Sheets for the Temporary Bridge.* The Contractor's Professional Engineer shall take full responsibility for default design elements, details or plan sheets utilized in the temporary bridge design or plans.
- (11) *Independent Design Check.* The temporary bridge design shall include an independent design check, as required by Section 19 of the CDOT Bridge Design Manual, by a professional engineer who did not participate in the design work being checked. The professional engineer conducting the design check shall possess the same qualifications as listed in subsections 621.03 for the Contractor's Professional Engineer.
- (12) *Claims for Design Errors.* Claims by the Contractor for design errors made by the Contractor's Professional Engineer will not be allowed for any portion of temporary bridge design.

**621.05 Submittals**

*Preliminary Design Submittal.* The Contractor shall prepare and submit the preliminary design submittal to the Engineer at the Preconstruction Conference. The preliminary design submittal shall have the endorsement seal and signature of the Contractor's Professional Engineer, registered in the State of Colorado, who will be responsible for the temporary bridge design. The submittal shall be in accordance with Section 105.02(b). At a minimum, this preliminary submittal shall include:

- 1. Preliminary drawings. At a minimum, the preliminary drawings shall include a general layout and elevation for the entire structure; typical superstructure sections; and erection scheme. The drawings shall be consistent with the plan format shown for the default bridge.
- 2. Preliminary design calculations, demonstrating the conformance of the temporary bridge design with these specifications.
- 3. Preliminary design and construction schedule.
- 4. Resume and qualifications of the Contractor's Professional Engineer who will be responsible for the design of the temporary bridge, along with required insurance certificate(s), as required by Section 621.03.
- 5. Outline or draft of the Contractor's Quality Control Plan for the temporary bridge, as required by Sections 621.07 – 621.13

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

*Final Design Submittal.* The Contractor shall prepare and submit the final design submittal to the Engineer for review and acceptance at least 90 days prior to fabrication or construction of the temporary bridge. The review by CDOT will be only for completeness and conformance with the Contract Document requirements. All designs, plans, specifications and details for the temporary bridge, as well as the completeness and accuracy of the plans, are the Contractor's sole responsibility. Final design submittals that are not in compliance with the Contract Documents shall be corrected by the Contractor and resubmitted.

The submittal shall have the endorsement seal and signature of the Contractor's Professional Engineer, registered in the State of Colorado responsible for the temporary bridge design. The submittal shall be in accordance with Section 105.02(b). At a minimum, this submittal shall include:

- (1) *Plan Format.* The Contractor shall submit complete original hardcopy plans in 11"x17" format, as well as in Adobe Acrobat (PDF) format, utilizing CDOT's latest CAD configuration.
- (2) *Structure Number.* Since this structure is not a permanent structure, no structure number has been assigned by CDOT.
- (3) *Contractor Signature.* The temporary bridge final design submittal shall also include the Contractor's signature in ink, the date signed, a business name, and business address.
- (4) *Design Calculations.* The final design submittal package shall include complete design calculations, and independent design check calculation. All calculations shall be submitted on CD in Adobe Acrobat (PDF) format. A bridge rating package is not required.
- (5) *Calculations for Other Project Elements.* The final package for submittal shall also include, if necessary, complete design calculations for other project elements that were changed due to the temporary bridge design.
- (6) *Falsework.* Submittals for falsework shall be in accordance with Section 601.11.
- (7) *Girder Erection.* Submittals for erection of steel girders shall be in accordance with Standard Special Provision 509 Erection of Steel Structures. Submittals for pre-cast concrete members shall be in accordance with Standard Special Provision 618 Erection of Pre-Cast Concrete members.
- (8) *Record Plans.* Record plans are not required.

**621.06 Design Computations.**

- (1) *Design Computation Set.* The complete set of design computations for the temporary bridge design shall include both substructure and superstructure and all appurtenances required.
- (2) *Design Check Computation Set.* The complete set of independent design check computations for the temporary bridge design shall include both substructure and superstructure and all appurtenances required.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

- (3) *Engineering Identification.* The design and independent design check computations shall clearly identify the firm and individuals who performed the computations. The plans for the temporary bridge shall show the names of the design firm, designer and detailer in the title block; and each plan sheet shall bear a completed initial block in the left margin, as shown in the CDOT Bridge Manual, for the persons who performed the design, detail, and quantity functions.
- (4) *Discrepancies Between Design and Design Check Computations.* Discrepancies between the design and the design check shall be resolved by the Contractor and all corrections shall be reflected in the design computations.

In the event of a conflict or difference in interpretation of the design criteria, standards, or specifications that cannot be resolved, the decision of the Engineer shall be final.

**QUALITY CONTROL / QUALITY ASSURANCE**

**621.07 Quality Control - Quality Assurance Responsibility** Quality control and quality assurance responsibilities shall be in accordance with the following table:

	<i>Quality Control</i>	<i>Quality Assurance</i>
Temporary Bridge	Contractor	CDOT

**621.08 Quality Control**

- (1) Quality Control for all temporary bridge elements is the responsibility of the Contractor. The Contractor shall perform all quality control sampling, testing, and inspection during all phases of the work at a rate sufficient to assure that the work conforms to the contract requirements.
- (2) *Quality Control Documentation.* The Contractor shall maintain current records of quality control operation activities, and tests performed for the temporary bridge, including the work of vendors and subcontractors. These records shall be in the form shown in the Quality Control Plan. Documentation of aspects of the QC process for which the Contractor is responsible shall be kept by the Contractor and submitted to the Engineer and to the Contractor's Professional Engineer on a weekly basis.

**621.09 Quality Control Standards.** Except as amended herein, all sampling, testing, inspection and acceptance of materials shall conform to the following standards:

- (1) Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, 2005, including project Standard Special Provisions and Project Special Provisions, as applicable.
- (2) CDOT Field Material Manual (2006)
- (3) AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, latest edition.
- (4) AASHTO/AWS Structural Welding Code D1.1, latest edition.
- (5) AASHTO/AWS Bridge Welding Code D1.5, latest edition.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

**621.10 Quality Control Personnel.**

- (1) *Qualification.* The Contractor shall provide qualified personnel for sampling, testing and inspection of materials and construction activities. The Contractor shall ensure that qualifications are maintained during the course of sampling, testing and inspection. The Engineer's continued acceptance of Contractor personnel qualifications over the course of the project is subject to satisfactory results from periodic independent assurance evaluations.
- (2) *Conformance to Contract Documents.* Personnel and laboratories performing sampling and testing of materials shall conform to the requirements of the Contract Documents, and the applicable standards as listed above.
- (3) *Personnel.* The Contractor shall have at least one person qualified to perform quality control on the project during all times that work is being performed. Qualifications for QC personnel shall, as a minimum, consist of ACI Level I certification and AWS QC1 certification.

All Quality Control personnel shall be dedicated to the QC process and shall not be utilized in any other capacity. They shall have sufficient independence to be focused on quality alone, without regard to schedule and budget, and shall have the authority to stop unsatisfactory work until quality has been improved such that the requirements of the Contract Documents and the Contractor's Quality Control Plan have been met to the satisfaction of the QC personnel and the Engineer.

- (4) *Minimum Documentation by QC Personnel.* As a minimum, each Quality Control person shall fully document each day's QC activities by filling out a daily inspection report and submitting a copy to the Engineer or his representative. This report shall become part of the documentation described below.

**621.11 Quality Control Plan (QCP).**

- (1) *General.* For all materials and construction operations included in the Contract, the Contractor shall submit to the Engineer a QCP prepared in accordance with the requirements of this specification and the Contract Documents. No materials shall be incorporated into the project or construction operations commenced prior to the Engineer's written approval of the Quality Control Plan.
- (2) *QCP Submittal.* The Contractor shall submit the QCP to the Engineer for review and approval within 30 days following Award. The Engineer will review the QCP and respond to the Contractor within 30 calendar days following receipt of the QCP. The Contractor's QC personnel shall work diligently with the Engineer to correct any deficiencies in the QCP as noted by the Engineer.
- (3) *Contractor Compliance with the QCP.* If, at any time, the Contractor is not in compliance with any portion the Contract Documents or the approved QCP, affected portions of the work may be disapproved. The Contractor shall cease work of the affected operation(s) and submit a revision to the Engineer for approval. The Engineer will review the revision and respond within seven (7) calendar days of receipt. Work may continue on operations that are still in compliance with the Contract Documents and the approved sections of the QCP.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

- (4) *QCP Guidelines.* The QCP shall include all construction operations and materials, both on site and at off-site production facilities. The QCP shall be sufficient to ensure that the requirements of the Contract Documents are being met for all aspects of the work.

The following guidelines shall be used for development of the QCP:

1. Personnel.
  - A. *Qualifications.* Submit a list of technicians that will be performing sampling, testing and inspection, with resumes and their qualifications, for both field and laboratory testing. Include employed and subcontracted technicians. Submitted personnel shall be dedicated to quality control and shall not be used for any other construction operations.
  - B. *Level of Responsibility and Authority.* Identify the primary QC contact for the Engineer. Identify roles, responsibilities and authority of various personnel involved in the quality control process.
2. Documentation.
  - A. *Types of Documentation.* Submit what specific documentation, including quality control charts, qualification / accreditation records, inspection reports, mill certifications, test results and other pertinent / supporting documents, will be kept by the Contractor to verify that the QCP has been properly implemented and followed throughout the project. Include method of documentation of test results.
  - B. *Submittals to Engineer.* Copies of all documentation as identified in the QCP shall be submitted to the Engineer on a weekly basis. Documentation shall be in a clear, orderly, and in a neat manner acceptable to the Engineer.
3. Materials.
  - A. *Source.* Identify the sources of materials.
  - B. *Certification.* Describe methods for verifying compliance of certification with the specifications.
  - C. *Disposition of Failing Materials.* Describe the system for controlling non-conforming materials, including procedures for identification, isolation and disposition.
4. Storage Facilities for Materials.
  - A. *Protection from Environment.* Describe means, measures, and methods for protecting all materials from environmental conditions (rain, snow, temperature, etc.) while in storage.
  - B. *Integrity of Materials.* Describe means, measures, and methods for preventing segregation, contamination and degradation.

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**REVISION OF SECTION 621  
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- C. *Material Identification.* Describe methods of identifying individual materials. Where applicable, submit a site plan showing the locations of various materials.
- 5. Construction and Testing Equipment.
  - A. *Calibration.* Describe calibration frequencies, maintenance schedule and procedures for all construction and testing equipment.
- 6. Construction Operations.
  - A. *Substructure Construction.* Describe means, measures and methods for control of substructure construction operations, including location, plumbness, dimensional requirements, field welding, and reinforcing placement requirements.
  - B. *Superstructure Construction.* Describe means, measures and methods for control of superstructure construction operations including, but not limited to: dimensional requirements, reinforcing placement, concrete cover, post-tensioning duct and hardware placement and stressing operations.
- 7. Plant Requirements.
  - A. *Plant Identification and Certification.* Provide the mailing address, physical address including county, telephone and fax numbers, E-mail address, primary contact at the plant, responsible person in charge, Owner information and other information as required. Plant certifications, if applicable, shall be provided.
  - B. *Process Control System.* Describe the methods and measures established to ensure Contract compliance for the produced materials. These methods and measures shall include, but are not limited to, inspection schedule, sampling and testing, maintenance schedule, etc.
  - C. *Loading and Shipping Control.* Describe the methods and measures for preventing segregation, contamination and degradation as applicable during loading and shipping operations. Describe the methods and measures for keeping elements within allowable stresses and preventing damage as applicable during loading and shipping. Describe the methods established for materials to be in compliance with the Project Specifications at the point of use.
- 8. Manufactured Product.
  - A. *Manufacturing / Fabrication.* Describe the methods and identify the type of equipment used in the manufacture and / or fabrication of the products.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

- B. *Storage.* When storage of the produced materials is required at the plant or the construction site, describe the methods and duration of storage. Include measures and methods as applicable for preventing segregation, contamination and degradation during storage. Include measures and methods as applicable for protection from environmental conditions and the controlling of deformations and stresses.
  - C. *Transportation.* Describe the method of delivery from the point of production / storage to the point of placement. Include methods for keeping elements within allowable stresses and preventing damage as applicable during loading and shipping. Describe the methods established for materials to be in compliance with the Contract Documents at the point of use.
  - D. *Placement.* Describe the methods and identify the type of equipment used to incorporate the product into the project. Describe the methods to control geometry, stresses and prevent damage during placement and erection.
  - E. *Identification and Disposition of Failing Materials.* Describe the methods and measures for identifying and controlling the failing materials. Include preventive and corrective measures. Describe disposition of failing materials.
9. Damaged Materials.
- A. *Criteria for Damaged Material.* Describe criteria for determining if damaged materials, components and products may be repaired, or shall be disposed.
  - B. *Repair, Restoration of Damage Material.* Describe methods for repairing damaged materials, components and products as applicable. Describe restoration/correction criteria for damaged or flawed materials, components and products that are to be repaired to such extent that they will conform to the requirements of the Contract Documents.
10. Testing Laboratories
- A. *Identification of Testing Laboratories.* Identify all laboratories performing testing and include certification documentation. All testing shall be performed by qualified laboratories and/or equipment in accordance with the Contract Documents and the applicable standards listed above.

**621.12 Testing Equipment.**

- (1) *General.* The Contractor shall furnish and maintain, throughout the project, the equipment necessary to implement the QCP. All equipment shall be in good condition and calibrated in accordance with applicable ASTM specifications and the requirements specified herein. Backup testing equipment shall be kept on-site at all times and be kept in good condition and calibrated as above.
- (2) *Concrete Cylinder Curing and Testing.* The Contractor shall furnish and maintain, throughout the required work, facilities suitable for curing and testing concrete test cylinders.



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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

**621.13 Non-Conformance.** If, at any time, any construction operation or material is found not to be in conformance with the Contract Documents, or the Contractor's QCP, all non-conforming work shall cease immediately. The Contractor's Quality Control personnel shall develop and submit a Non-Conformance Report to the Engineer. The report shall detail the specific nature and causes of the non-conformance, as well as the means and methods that will be undertaken to bring the non-conforming work, or materials back into conformance with the Contract Documents and the Contractor's Quality Control Plan. The Engineer will review the report and proposed corrective procedures within five (5) working days of receipt. Work that was found to be non-conforming may not continue until the Engineer has approved the Non-Conformance Report. An approval of the report by the Engineer in no way relieves the Contractor from conforming to the Contract Documents and the Contractor's Quality Control Plan for all future work, regardless of whether or not the approved corrective procedures are successful.

**MATERIALS**

**621.14 General.** All materials used in the construction of an temporary bridge structure must meet the requirements of subsection 621.04. Materials that do not meet these requirements are subject to rejection.

**CONSTRUCTION**

**621.15 General, Survey and Traffic Control.**

- (1) *General.* Construction shall strictly conform to the applicable sections of the Standard specifications.
- (2) *Survey.* Construction survey shall be in accordance with Section 625, as revised for this project.
- (3) *Traffic Control.* Traffic control shall conform to the intent of the Traffic Control Plans and Specifications included in the Contract.

**621.16 Maintenance.** Upon completion of the temporary bridge construction, the Contractor is responsible for the maintenance of the temporary bridge during the period of time it is in service. All cost associated with maintenance of the temporary bridge will not be paid for separately, but the cost shall be included in the cost of Temporary Bridge.

**621.17 Removal of Bridge.** Removal of the temporary bridge shall be in accordance with the applicable sections of Project Special Provision Revision of Section 202, Removal of Bridge. Removal of the temporary bridge will not be paid for separately, but the cost shall be included in the cost of Temporary Bridge.

**621.18 Contractor's Responsibility.** The presence of the Contractor's Professional Engineer, or his designated staff, on the project shall in no way act to relieve the Contractor of the full responsibility for: conformance of the work to the requirements of the contract documents; the structural adequacy of the erection scheme he chooses; or the safety of workers or the general public.

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**REVISION OF SECTION 621  
TEMPORARY BRIDGE**

**METHOD OF MEASUREMENT**

**621.19** The temporary bridge design, construction, maintenance and removal will not be measured, but will be paid for on a lump sum basis, and will include all work and materials required to design, construct, maintain and remove the temporary bridge.

The work will include, without limitation: design calculations and documentation, the independent design and detail check, preparation of plans, details, and drawings as required to fabricate and construct the temporary bridge.

By submitting a bid for temporary bridge, the Contractor agrees to accept the amount of that bid, as a lump sum basis, for the complete and satisfactory performance of the work.

**BASIS OF PAYMENT**

**621.20** The accepted quantities for construction of the temporary bridge will be paid for at the contract lump sum bid as follows:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Temporary Bridge	Lump Sum

Partial Payments: Partial payment will be made upon completion of the following milestones:

Completion of design and construction of the temporary bridge	50%
Termination of maintenance and use of the temporary bridge	30%
Removal of Bridge	20%

The lump sum bid price shall be full compensation for the cost of all the work, materials, tools, equipment, and incidentals required to complete the design, construct, maintain and remove the temporary bridge, including but not limited to: design, independent design check, bridge rating, and plan preparation for the temporary bridge; supplemental survey and foundation investigation work required by the Contractor for the temporary bridge; the Contractor's construction oversight; the cost of preparing and implementing the Quality Control Plan; and all costs associated / required for Quality Control personnel, equipment, sampling, testing, inspections and documentation for the temporary bridge.

Any design or construction costs resulting from changes or impacts to other project elements as a result of the temporary bridge design and construction, which were not required by the default design, such as, but not limited to: roadway, drainage, utilities, environmental clearances and permits, phasing, and traffic control, shall be the sole responsibility of the Contractor; and the cost of such changes or impacts shall be included in the temporary bridge lump sum cost.

## **REVISION OF SECTION 626 PUBLIC INFORMATION SERVICES**

Section 626 of the Standard Specifications is hereby revised for this project as follows:

Subsection 626.01 shall include the following:

The Contractor shall provide the following public information services on an ongoing basis throughout the duration of the project:

At the preconstruction conference the Contractor shall introduce the Public Information Manager (PIM) for the project and present a public information plan and strategies or methods for communicating project activities. The Contractor shall prepare and submit a preliminary list of stakeholder groups and specific stakeholders that need to receive ongoing communication about the project.

The Contractor's PIM shall be a professional, having graduated from an accredited college or university with a bachelor's degree in Public Relations, Communications, or a closely related field of study. In addition, the PIM shall have two years experience in community outreach and partnership development or a comparable field. Related work experience may be substitute for the type of degree. The Engineer, after consulting with the Region Public Relations Manager, will approve the Contractor's PIM prior to the preconstruction conference. The identity of the PIM and the PIM'S qualifications shall be submitted to the Engineer five days in advance of the preconstruction conference.

The PIM shall be available on every working day, accessible and on call by cell phone or pager at all times and available upon the request of the Engineer at other than normal working hours. The PIM shall communicate with the Engineer daily.

The Contractor shall establish a Public Information Office (PIO) equipped with a telephone and an answering machine or answering device with the capability to record a message from the caller. This may be a cell phone, but must be a local number. The PIO shall be equipped with a computer and an e-mail account. The PIO may or may not be located within the Contractor's regular office provided that the telephone has a local call number. The PIM shall record a friendly greeting on the project's published phone line each week, updating the message throughout the week, as necessary, depending on changes in work schedule, activities and traffic impacts. The recording shall include each week's forthcoming activities including work days, hours and expected traffic delays, posted detours, project completion date, and office hours. The PIM shall check the answering machine at least twice every calendar day, including weekends. The PIM shall respond to callers and e-mail inquiries as soon as possible, but at least within 24 hours. The PIM shall keep a logbook of all calls including the contact name, date of contact, date responded, the contact's comments, and the action the PIM took. A copy of this log shall be submitted to the Engineer every two weeks or more frequently, as requested by the Engineer.

The PIM shall maintain communications with businesses and individual residences, commuters, local government entities and all other stakeholders that are directly adjacent to and affected by the project. Using a communications method or strategy approved by the Engineer, the Contractor shall notify stakeholders about the project two weeks prior to beginning any lane restrictions or project activities. Depending upon project impacts, contact with stakeholders may be required daily, weekly, monthly or periodically throughout the duration of the project. Communications tools could include hand flyers, door hangers, newsletters, mailers, using e-mail distribution lists, etc. All public information correspondence and subsequent updates must be approved by the Engineer 48 hours before distribution.

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**REVISION OF SECTION 626  
PUBLIC INFORMATION SERVICES**

Each communication tool shall include contact information, PIM's name, office phone, CDOT Web-site address with CDOT logo. Cell phone numbers and e-mail addresses shall be provided where service is available. The communication shall include the description of work, lane restrictions, a detour map if warranted, the anticipated start and completion dates, hours of operation and work schedule, and a Slow for the Cone Zone message.

The Contractor shall erect construction traffic signs with the dates the Contractor expects to initiate and complete construction and with the Contractor's public information office's or PIM's phone number at each major approach to the project. The signs shall conform to the requirements of Section 630 and shall be erected at least one week prior to the beginning of construction.

An individual project web-site will be developed and will be hosted on CDOT's web site using the CDOT template. The Contractor shall coordinate with the Region Public Relations Manager to develop the website in accordance with the CDOT standard template. The site will be revised as directed by the Engineer. The web site shall also conform to the CDOT Web-site Standards which can be found at:  
<http://www.dot.state.co.us/WebStandards>.

CDOT's Region Public Relations Manager will write and distribute all News Releases to the media and handle all media relations and outreach unless otherwise directed by the Engineer.

The Contractor superintendent or PIM shall submit weekly lane closure reports using the template provided by the Engineer for transmittal to the CDOT PR Region Manager, the CDOT PR Web-site Manager, and the CDOT Traffic Operations Center

The Public Information Services Contact Sheet shall include the following:

**Owners:**

Colorado Department of Transportation Project Engineer  
Name: Terrie McKinney,  
Address: 2000 S. Holly Street, Denver, CO 80222  
Phone: 303-972-9112 Email: Terri.Mckinney@dot.state.co.us

Colorado Department of Transportation, Region Public Relations Manager  
Name: Mindy Crane  
Address: 4201 East Arkansas Avenue, Denver, CO 80222  
Phone: 303-757-9469 Email: Mindy.Crane@dot.state.co.us

Colorado Department of Transportation, Colorado Traffic Management Center  
425-C Corporate Circle, Golden, CO 80401  
Phone: 303-512-5830 Fax: 303-274-9394

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**REVISION OF SECTION 626  
PUBLIC INFORMATION SERVICES**

**Other Contacts:**

City and County of Denver  
Phone: 720-913-1311

Denver Fire Department  
Phone: 720-913-3473 (Headquarters) 720-913-3421 (Division 1 – Operations)

Denver Police Department  
Phone: 720-913-2000

Denver Public Works Department:  
Phone: 720-913-1311

Colorado State Patrol  
Phone: 303-239-4501 (Denver Regional Communication Center)

Subsection 626.02 shall include the following:

The Engineer will monitor the PIM and all public information services. When the Contractor provides acceptable public information services in accordance with these specifications, partial payments for the pay item Public Information Services will be made as the work progresses. These partial payments will be made as follows:

When 5 percent of the original Contract amount is earned, 25 percent of the amount bid for this item will be paid.

When 10 percent of the original Contract amount is earned, 40 percent of the amount bid for this item, less all previous payments, will be paid.

When 25 percent of the original Contract amount is earned, 50 percent of the amount bid for this item, less all previous payments, will be paid.

When 75 percent of the original Contract amount is earned, 75 percent of the amount bid for this item, less all previous payments, will be paid.

When 100 percent of the original Contract amount is earned, 100 percent of the amount bid for this item, less all previous payments, will be paid.

Failure to provide acceptable public information services will result in withholding of progress payment for this item. Continued failure to provide the services required will result in non-payment of the corresponding percentage of the original bid item and may result in suspension of the work in those areas affected until acceptable public information services are provided by the Contractor.

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**REVISION OF SECTION 626  
PUBLIC INFORMATION SERVICES**

For the purpose of public information services, the term “original Contract amount” as used above, shall mean the amount bid for the construction items on this Contract, not including the amounts bid for Public Information Services and Mobilization.

Payment for Public Information Services will be full compensation for all fliers, public information office, telephone lines, and all other labor and materials required to complete the item, except signs. Signs will be measured and paid for in accordance with Section 630.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Public Information Services	Lump Sum

**REVISION OF SECTION 630  
IMPACT ATTENUATOR (TEMPORARY)**

Section 630 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work consists of furnishing, installing, certifying, moving, repairing, maintaining, and removing temporary impact attenuators in accordance with these specifications and in conformity with the lines and details shown on the plans or established.

**MATERIALS**

If the posted speed limits of the construction zone are 45 miles per hour or less, the impact attenuator shall meet the requirements of NCHRP Report 350 TL-2. For posted speed limits in the construction zone greater than 45 miles per hour, the attenuator shall meet the requirements of TL-3.

**CONSTRUCTION REQUIREMENTS**

The site shall be prepared to receive the impact attenuator by filling, excavating, smoothing, constructing the paved foundation pad, installing approved transition and anchoring, and all other work necessary for the proper installation of the attenuator.

The impact attenuator shall be fabricated and installed in accordance with the manufacturer's recommendations. The Contractor shall provide a copy of the manufacturer's installation instructions and parts list to the Engineer prior to installation of the device.

Each installation shall be supervised and certified as correct upon completion by a representative of the device manufacturer or by an employee of the Contractor who is a certified installer. The certified installer shall have completed device training and shall be registered with the manufacturer as a certified installer. The Contractor shall submit all appropriate documentation to validate that the certified installer has completed device training and has been registered with the manufacturer as a certified installer.

**METHOD OF MEASUREMENT**

Impact Attenuator (Temporary) will be measured by the number of attenuators shown on the plans, installed, certified, and accepted.

**BASIS OF PAYMENT**

The accepted quantities will be paid for at the contract unit price for the pay item listed below:

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**REVISION OF SECTION 630**  
**IMPACT ATTENUATOR (TEMPORARY)**

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Impact Attenuator (Temporary)	Each

Payment will be full compensation for all work and materials required to furnish, install, certify, move, repair, maintain, and remove the impact attenuator. Site preparation, foundation pad, epoxy painting, and all necessary hardware including anchors and transitions will not be paid for separately, but shall be included in the work.



**REVISION OF SECTION 630  
TRUCK MOUNTED ATTENUATOR**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

In Subsection 630.01 shall include the following:

This work shall consist of furnishing, operating, and maintaining a truck with a mounted attenuator.

Subsection 630.08, shall include the following:

Truck Mounted Attenuator. The Contractor shall supply a vehicle with a truck mounted attenuator approved by the FHWA to meet NCHRP 350 criteria for level TL-3 collisions. The attenuator shall be mounted to a suitable truck in a manner meeting the Manufacturer's specifications. The truck shall also be furnished with a roof mounted Advance Warning Flashing or Sequencing Arrow Panel (B Type). The trucks may be used when setting up the work Zone and shall be parked in the activity area protecting the construction work when work begins.

Subsection 630.12 shall include the following:

Maintenance, storage, operation, and all repairs of Truck Mounted Attenuator and vehicle shall be the responsibility of the Contractor.

Subsection 630.14, shall include the following:

Truck Mounted Attenuators shall be measured by the Unit. The Contractor will be paid for the number of trucks required in the plans and available for use.

Subsection 630.15 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Impact Attenuator (Truck Mounted Attenuator) (Temporary)	Each

Payment will be full compensation for all labor, materials and equipment required to operate and maintain this truck for the duration of the project, including the attenuator and flashing panel.

**REVISION OF SECTION 630**  
**PORTABLE MESSAGE SIGN PANEL**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work includes furnishing, operating, and maintaining a portable message sign panel.

Add subsection 630.031 immediately following subsection 630.03 as follows:

**630.031 Portable Message Sign Panel.** Portable message sign panel shall be furnished as a device fully self contained on a portable trailer, capable of being licensed for normal highway travel, and shall include leveling and stabilization jacks. The panel shall display a minimum of three - eight character lines. The panel shall be a dot-matrix type with an LED legend on a flat black background. LED signs shall have a pre-default message that activates before a power failure. The sign shall be solar powered with independent back-up battery power. The sign shall be capable of 360 degrees rotation and shall be able to be elevated to a height of at least five feet above the ground measured at the bottom of the sign. The sign shall be visible from one half mile under both day and night conditions. The message shall be legible from a minimum of 750 feet. The sign shall automatically adjust its light source to meet the legibility requirements during the hours of darkness. The sign enclosure shall be weather tight and provide a clear polycarbonate front cover.

Solar powered message signs shall be capable of operating continuously for 10 days without any sun. All instrumentation and controls shall be contained in a lockable enclosure. The sign shall be capable of changing and displaying sign messages and other sign features such as flash rates, moving arrows, etc.

Each sign shall also conform to the following:

- (1) In addition to the onboard solar power operation with battery back-up, each sign shall be capable of operating on a hard wire, 100-110 VAC, external power source.
- (2) All electrical wiring, including connectors and switch controls necessary to enable all required sign functions shall be provided with each sign.
- (3) Each sign shall be furnished with an operating and parts manual, wiring diagrams, and trouble-shooting guide.
- (4) The portable message sign shall be capable of maintaining all required operations under Colorado mountain winter weather conditions.
- (5) Each sign shall be furnished with an attached license plate and mounting bracket.
- (6) Each sign shall be wired with a 7-prong male electric plug for the brake light wiring system.

Subsection 630.12 shall include the following:

The portable message sign panel shall be on the project site at least fourteen calendar days prior to the start of active roadway construction. Maintenance, storage, operation, relocation to different sites during the project, and all repairs of portable message sign panels shall be the responsibility of the Contractor.

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**REVISION OF SECTION 630**  
**PORTABLE MESSAGE SIGN PANEL**

Subsection 630.14 shall include the following:

Portable message sign panels will be measured one of the two following ways:

- (1) By the actual number of days each portable message sign is used on the project as approved by the Engineer.
- (2) By the maximum number of approved units in use on the project at any one time.

Subsection 614.15 shall include the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Portable Message Sign Panel	Each

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**REVISION OF SECTION 630  
UNIFORMED TRAFFIC CONTROL  
(LOCAL AGENCY)**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

**DESCRIPTION**

This work includes furnishing a uniformed police agency officer from the City and County of Denver to perform uniformed traffic control. **Uniformed Traffic Control will be required during all signal down times and as approved by the Engineer.**

When called for in the Contract, this work includes furnishing a vehicle for the officer to use in performing uniformed traffic control.

**MATERIALS**

- (a) *Qualifications.* The local agency officer shall have completed "The Safe and Effective Use of Law Enforcement Personnel in Work Zones" Training Course. The Contractor shall provide copies of documentation certifying the officer's successful completion of this course.
- (b) *Traffic Control Vehicles.* When called for in the Contract, the Contractor shall furnish white sedans to be used by uniformed police agency officers in the performance of Uniformed Traffic Control duties. The Contractor shall be responsible for licensing, insuring, servicing, and fueling the vehicle.

For each Traffic Control Vehicle furnished by the Contractor, the Contractor shall furnish Class 1 SAE certified light bar and control panel for exclusive use by uniformed police agency officers while performing Uniformed Traffic Control. The light bar shall have the following configuration:

Configuration:

- (1) minimum of 44 inches in length, and shall be either permanently or temporarily attached to the top of the vehicle.
- (2) flash red on the driver side and blue on the passenger side
- (3) equipped with an amber-colored directional device in the rear of the bar.
- (4) have alley and takedown lights.
- (5) The control panel shall be capable of controlling the front of the bar and the rear of the bar separately.
- (6) The traffic advisor shall be controlled separately.

The light bars shall be mounted on traffic control vehicles, and shall be maintained in good operating condition at all times. The Contractor shall obtain a permit from the police or sheriff department, as appropriate, for the use of the light bars. The Contractor shall keep the light bars covered at all times when the traffic control vehicle is being used by someone other than the authorized uniform police agency officer.

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**REVISION OF SECTION 630  
UNIFORMED TRAFFIC CONTROL  
(LOCAL AGENCY)**

**METHOD OF MEASUREMENT**

Uniformed Traffic Control will be measured by the total number of hours that are required for uniformed traffic control including minimum shift hours required by the agency.

Traffic Control Vehicle will be measured by the actual number of vehicles provided by the Contractor and used as authorized by the Engineer, and will include maintenance of each vehicle, light bars, licensing, insurance and fueling.

**BASIS OF PAYMENT**

The accepted number of hours of Uniformed Traffic Control will be paid for at the contract unit price per hour.

Uniformed Traffic Control (Vehicle) will be measured as the contract unit price per hour for the uniformed traffic control officer and traffic control vehicle.

The accepted number of Traffic Control Vehicles will be paid for at the contract unit price for each vehicle.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Uniformed Traffic Control	Hour
Uniformed Traffic Control (Vehicle)	Hour
Traffic Control Vehicle	Each

Hours of Uniformed Traffic Control or Uniformed Traffic Control (Vehicle) that are not authorized or approved will not be paid for. Scheduling of traffic control will not be measured and paid for separately, but shall be included in the work.

Payment for the item Traffic Control Vehicle will be full compensation for all work, light bars, other equipment, and other items necessary to complete the item. Licensing, insuring, servicing, and fueling the vehicle will not be paid separately, but shall be included in the work.

**REVISION OF SECTION 630  
GLARE SCREEN (TEMPORARY)**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work shall consist of furnishing, installing, and maintaining glare screen of the size and type shown on the plans at the locations shown on the plans and in accordance with these specifications. Glare screen installed on this project shall remain the property of the Contractor

Subsection 630.08 shall include the following:

Glare screen shall be Carsonite Modular Glare Screen as manufactured by Carsonite International, 2900 Lockheed Way, Carson City, Nevada 89701, Syro Modular as manufactured by Syro Steel Company, P.O. Box 99, Centerville, Utah 84014, Glare Shield as manufactured by Safe-Hit Corporation, 1930 West Winton Avenue, Building 11, Hayward, California 94545, or an approved equal. Blade height shall be 600 mm (24 inch) minimum.

Subsection 630.12 shall include the following:

Glare screen shall be installed according to the manufacturer's suggested method of installation. The Contractor shall submit to the Engineer for approval, drawings showing the type of glare screen to be used and the method of installation to be implemented.

Subsection 630.14 shall include the following:

Glare screen will be measured by the linear foot.

Subsection 630.15 shall include the following:

The accepted quantity of glare screen will be paid for at the contract unit price per linear foot, which price shall be full compensation for all materials, labor, tools, and equipment necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Glare Screen (Temporary)	Linear Foot

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**REVISION OF SECTION 631  
ALTERNATIVE BRIDGE DESIGN & CONSTRUCTION**

Section 631 is hereby added to the Standard Specifications for this project as follows:

**DESCRIPTION**

**631.01** All bidders on this project have the option of submitting a bid for the design and construction of an alternative bridge structure (“alternative bridge”) for Structure F-16-XR and Structure F-16-XS (one or both structures), in lieu of submitting a bid for the construction of the default design as detailed in the plans, and herein referred to as the “default bridge”.

Bidders are not required to submit a bid for an alternative bridge; rather, it is an option, at their sole discretion. **Pre-qualified bidders electing to provide a design and construction alternate for either or both bridges will not be allowed to also provide a base or default bid for the same bridge or bridges.**

Value Engineering Change Proposals, as described in Section 104.07, will not be accepted for Structures F-16-XR and F-16-XS.

Bidders are hereby notified that CDOT will consider all submitted bids for the default bridge and for the alternative bridge together, and that CDOT will award to the low responsible and responsive bidder regardless of the particular type of bridge structure (default or alternative) bid by that bidder.

CDOT reserves the right, in its sole discretion, to reject the Contractor’s alternative bridge design based upon deficiencies, irregularities or technicalities in considering and evaluating an alternative bridge.

Alternative bridge structure types that are acceptable to CDOT under this Project Special Provision, and for which CDOT will consider a bid include:

- (1) For Structure F-16-XR: horizontally curved steel plate girders, horizontally curved steel box girders or precast concrete horizontally curved U or trapezoidal box girders with fully continuous post-tensioning.
- (2) For Structure F-16-XS: horizontally curved steel plate girders, horizontally curved steel box girders or precast concrete chorded or horizontally curved U or trapezoidal box girders with fully continuous post-tensioning.

Steel or concrete bridge superstructure alternatives shall be continuous over the same piers as shown in the plans for the default bridge, with identical expansion joint locations.

Experimental or demonstration-type design concepts, products, structures, or elements that have not been pre-approved by CDOT, in writing, for general use will not be permitted in the alternative bridge design. No other alternative bridge types will be considered by CDOT. Any bids submitted for alternative bridge types other than the type described above will be automatically rejected and will not be considered.

An alternative bridge submitted by a bidder must be equivalent to the default bridge. To be considered “equivalent”, the alternative bridge:

- (1) Must comply with all applicable design and construction requirements of this Project Special Provision; and provide the roadway section widths, span arrangement and pier locations, aesthetic and safety features, live load capacity, horizontal and vertical alignment, minimum lateral and vertical clearances, as described herein and as shown on the Plans for the default design; and

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**REVISION OF SECTION 631  
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- (2) Must include all work and materials to design and construct foundations, piers, abutments, and superstructure with all appurtenances, as described herein and as shown on the Plans for the default bridge.

Bids for an alternative bridge structure must strictly comply with all terms and conditions of this Special Provision in order to be considered “responsive” and eligible for award.

**DESIGN**

**631.02 General.** CDOT has not provided designs for the alternative bridge. Therefore, if a bidder elects to submit a bid for the alternative bridge structure, the bid must include both the cost of design and construction of the alternative bridge, and that bidder must provide a complete design for the alternative bridge (“alternative design”).

The alternative design must be accomplished under the direct supervision and responsible charge of a Professional Engineer registered in the State of Colorado; and who is hereafter referred to as the Contractor’s Professional Engineer.

**631.03 Minimum Qualifications for the Contractor’s Professional Engineer.** The Contractor’s Professional Engineer shall have minimum qualifications as follows:

- (1) The Contractor’s Professional Engineer shall have been in responsible charge of the design of the type of alternative structure being proposed within the past ten years, and shall provide to CDOT examples and references for projects successfully completed by the Contractor’s Professional Engineer which are similar in nature, and which include the type of structure being proposed for the alternative bridge, as reference.
- (2) The Contractor’s Professional Engineer may be a professional engineer employed by the Contractor, or a consulting engineer under contract to the Contractor. If the Contractor’s Professional Engineer is not an employee of the Contractor, then the Contractor’s Professional Engineer shall be employed by a firm which is pre-qualified by the CDOT for bridge design. The Contractor may utilize more than one person or firm to provide these services.
- (3) The Contractor’s Professional Engineer, or his employer, shall have Professional Liability insurance in an amount not less than \$1,000,000; and provide to the Engineer a certificate of insurance attesting to this coverage at the time of the Preliminary Design Submittal.



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**REVISION OF SECTION 631  
ALTERNATIVE BRIDGE DESIGN & CONSTRUCTION**

**631.04 Alternative Design.**

- (1) *Preliminary Design Submittal.* If a bidder, who elects to submit a bid for the alternative bridge, is the apparent low responsible bidder, that bidder shall provide to CDOT a preliminary alternative design and associated documents to the Resident Engineer (Ron Buck, CDOT Region 6, 2000 South Holly Street, Denver Colorado 80222) for preliminary review and acceptance by CDOT within 18 calendar days of bid opening. The preliminary design submittal shall have the endorsement seal and signature of the Contractor's Professional Engineer, registered in the State of Colorado, who will be responsible for the alternative bridge design. At a minimum, this preliminary submittal shall include:
  1. Preliminary design calculations, demonstrating the conformance of the alternative design with these specifications.
  2. Preliminary design and construction schedule.
  3. Preliminary drawings. At a minimum, the preliminary drawings shall include a general layout and elevation for the entire structure; typical superstructure sections; pier geometry, shape, locations and type; and erection scheme. The drawings shall be consistent with the plan format shown for the default bridge. Two hard copies of reproducible drawings shall be submitted.
  4. Resume and qualifications of the Contractor's Professional Engineer who will be responsible for the design of the alternative bridge, along with required insurance certificate(s).
  5. Outline or draft of the Contractor's Quality Control Plan for the alternative bridge, as required by Section 631.15.
- (2) *Compensation for Preliminary Design.* Bidders will not be compensated by CDOT for any design required to prepare a bid that includes an alternate design. Bidders who will have performed design work before award, but who do not get the award, for any reason, will have performed that work solely at their own cost and that design work will not be reimbursed by CDOT. Compensation to any alternative design work by the successful bidder shall be included in the bid.
- (3) *Preliminary Design Approval.* If CDOT does not approve the preliminary design within 25 calendar days of bid opening (18 calendar days for bidder submittal, plus 7 calendar days for CDOT review), that bid will be rejected. If CDOT requests additional information regarding the alternative bridge and/or the alternative design, the approval time period, may be extended at the discretion of CDOT.

Any delay in the bidder's submittal or CDOT's review and approval of a proposed alternative design, or a revision thereto, shall not extend the contract time.

- (4) *Design Criteria.* The Contractor shall ensure that the alternative design meets all applicable design criteria for strength and serviceability, as described herein and as defined by the Contract Documents. The Contractor shall use the Plans for the default design, the Design Requirements in subsection 631.08, and the Design and construction specifications in subsection 631.09, for the design criteria.

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**REVISION OF SECTION 631  
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- (5) *Alternative Designs Predicated on Errors & Omissions.* Alternative designs predicated on errors or omissions in the Contract will be rejected. If any such error, omission or discrepancy is discovered, the Contractor shall notify the Engineer immediately. Failure to notify the Engineer will constitute a waiver of all claims for misunderstandings, ambiguities, or other situations resulting from error, omission, or discrepancy.
- (6) *Resulting Changes to Other Project Elements.* Any changes or impacts to other project elements as a result of the alternative design, such as, but not limited to: retaining walls, roadway, drainage, utilities, environmental clearances and permits, phasing, and traffic control, shall be the responsibility of the Contractor; and the cost of such changes or impacts shall be included in the alternative design cost.
- (7) *Claims for Design Errors.* Claims by the Contractor for design errors made by the Contractor's Professional Engineer will not be allowed for any portion of alternative design.
- (8) *Use of Default Bridge Design, Details and Plan Sheets for the Alternative Bridge.* The Contractor's Professional Engineer shall take full responsibility for default bridge design elements, details or plan sheets utilized in the Alternative Bridge design or plans.
- (9) *Independent Design Check.* The alternative design shall include an independent design check, as required by Section 19 of the CDOT Bridge Design Manual, by a professional engineer who did not participate in the design work being checked. The professional engineer conducting the design check shall possess the same qualifications as listed in subsections 631.02 and 631.03 for the Contractor's Professional Engineer.

**631.05 Alternative Bridge Plans.**

- (1) *Plan Format.* The Contractor shall submit complete original hardcopy plans in 11"x17" format, along with electronic files for the alternative design entirely in MicroStation format utilizing CDOT's latest CAD configuration; as well as in Adobe Acrobat (PDF) format; plan changes shall be submitted in the same media. All linked and referenced files shall be included.
- (2) *Structure Number.* An alternative bridge design structure shall be identified by the same structure number as the default bridge.
- (3) *Contractor Signature.* Alternative bridge design drawings shall include the Contractor's signature in ink, the date signed, a business name, business address, and the note: "These drawings (Bxxx-Byyy) which supersede drawings (ABwww-ABzzz) were approved (insert date) in the title block.
- (4) *Contractor's Professional Engineer Endorsement.* The record plans for the alternative bridge design drawings shall bear the seal, signature and date of the Contractor's Professional Engineer.

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**631.06 Submittals.**

- (1) *Final Plans and Quantity/Cost Breakdown.* The Contractor shall submit the final plans and an itemized quantity and cost break down, to the Engineer in accordance with the preliminary design and construction schedule. Final bridge geometry, including project coordinates and dead load deflections, shall be included in the alternate field plans.

Final plans shall include details for all bridge superstructure, substructure and foundation elements; and for other project elements changed due to the alternative bridge design and construction.

- (2) *Calculations for Alternative Bridge.* The final package for submittal shall include complete design calculations, quantity calculations, independent design check calculation, quantity check calculations, and the bridge rating. All calculations (design, quantities, and check calculation) shall be submitted on CD in Adobe Acrobat (PDF) format.

The bridge rating shall be completed and submitted in accordance with CDOT's Bridge Rating Manual.

- (3) *Calculations for Other Project Elements.* The final package for submittal shall include complete design calculations and quantity calculations for other project elements that were changed due to the Alternative Bridge Design and Construction.
- (4) *Falsework.* Submittals for falsework shall be in accordance with Section 601.11.
- (5) *Girder Erection.* Submittals for erection of steel girders shall be in accordance with Standard Special Provision 509 Erection of Steel Structures. Submittals for pre-cast concrete members shall be in accordance with Standard Special Provision 618 Erection of Pre-Cast Concrete members.
- (6) *Record Plan Set for Alternative Bridge and Other Project Elements.* The Contractor shall submit two record plan sets in 8 ½ "x14" format; two hardcopy plan sets and shop drawings in 11"x17", with complete design notes, design check notes and computations to the Engineer one week prior to starting construction and fabrication of girders for the alternative bridge. The design notes and computations shall document the conclusions reached during the development of the construction plans. The plans and design computations will be reviewed by CDOT for completeness and spot check conformance with the Contract Document requirements only.

All designs, plans, specifications and details of the alternative design plans, as well as the completeness and accuracy of those plans, are the Contractor's sole responsibility. Designs and computations that are not in compliance with Design Requirements, in Section 631.08 below, shall be corrected by the Contractor and resubmitted. The record plans shall be sealed, in accordance with the bylaws and rules of procedure of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors, by the Contractor's Professional Engineer who was in responsible charge of the design and preparation of the plans.

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**631.07 Design Computations.**

- (1) *Design Computation Set.* The complete set of design computations for the alternative bridge design shall include both substructure and superstructure and all appurtenances required.
- (2) *Design Check Computation Set.* The complete set of independent design check computations for the alternative bridge design shall include both substructure and superstructure and all appurtenances required.
- (3) *Engineering Identification.* The design and independent design check computations shall clearly identify the firm and individuals who performed the computations. The plans for the alternate bridge shall show the names of the design firm, designer and detailer in the title block; and each plan sheet shall bear a completed initial block in the left margin, as shown in the CDOT Bridge Manual, for the persons who performed the design, detail, and quantity functions.
- (4) *Discrepancies Between Design and Design Check Computations.* Discrepancies between the design and the design check shall be resolved by the Contractor and all corrections shall be reflected in the design computations.

In the event of a conflict or difference in interpretation of the design criteria, standards, or specifications that cannot be resolved, the decision of the Engineer shall be final.

- (5) *Structure Rating.* The structure shall be rated in accordance with the CDOT Bridge Rating Manual, the AASHTO Manual for Bridge Evaluation, 1<sup>st</sup> Edition - 2008, and subsection 3.2 of the CDOT Bridge Design Manual.

**631.08 Design Requirements.**

- (1) *General.* The Contract Documents and the CDOT Standard Specifications for construction, including the Department's standard special provisions, along with Project Special Provisions, as applicable, shall apply to the design and construction of the alternative bridge.
- (2) *Live Load.* The structure shall be designed for an HL-93 live load, with permit vehicle combinations as specified by the AASHTO specifications and the CDOT Bridge Design Manual.
- (3) *Foundations.* The foundation design shall be consistent with the recommendations provided in the subsurface exploration and geotechnical recommendations, and load test analysis listed in Revision of Section 102 Project Plans and Other Data. In lieu of those recommendations, the Contractor may provide a foundation analysis by an independent geotechnical consultant. Costs for an independent foundation analysis shall be borne by the Contractor.
- (4) *Minimum Design Requirements.* The alternative bridge design shall, at a minimum, comply with the following design requirements and criteria:

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1. The superstructure shall be a constant depth.
2. A single consistent girder type shall be used throughout the structure. Use of multiple types of girders is not allowed.
3. For Structure F-16-XR, girders cannot be corded. For Structure F-16-XS, girders may be chorded.
4. Maintain aesthetic intent and continuity of the default bridge.
5. Horizontal and vertical alignment, and cross slope of the roadway surface finished grade shall be the same as the default bridge.
6. For aesthetic purposes, the width of the deck overhangs, as measured from centerline of a steel girder web or from the edge of a concrete U or trapezoidal box girder, shall be equal to or greater than that of the default bridge.
7. The number of spans shall remain the same as the default design.
8. The location of the piers and abutments shall be maintained. Minor variation in the transverse offset is permissible assuming all project constraints are satisfied.
9. The minimum size (cross sectional area) of the column cross section shall be as shown for the default bridge. All columns shall be consistent in shape and dimension as the default bridge.
10. For Structure F-16-XR, pier caps shall be uniform in type; an exception will be made for the pier located in the median of I-25. For Structure F-16-XS, pier caps will be allowed.
11. For Structure F-16-XR, the pier shall have a single column supporting the pier cap.
12. Upon completion of construction, the horizontal and vertical clearances as provided in the default design shall be maintained.
13. Construction clearance envelopes for roadways below the structure, as shown on the plans, shall be maintained.
14. The alternative design approach slabs shall be consistent with that of the default design.
15. In accordance with the CDOT Bridge Design Manual, inspection and maintenance access shall be provided for the alternative bridge.
16. Provide for and accommodate all roadway lighting design elements, ITS elements, conduit and attachments for the alternative bridge as shown or specified in the Contract Documents for the default design.

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17. Provide deck drains for the alternative bridge at the general locations, and of the same or greater hydraulic capacity, as shown on the Plans for the default design. Drainage details, routing of the drain piping, and aesthetic considerations shall be the same as the default design.
18. Earthquake restraints or pintels for the alternative bridge shall be provided in accordance with the AASHTO LRFD Bridge Design Specifications, 4<sup>th</sup> Edition.
19. Bearings, expansion devices, bridge rail and fence screening of the alternative bridge shall be in accordance with the Contract Documents for the default design, and CDOT Staff Bridge Design Manual and Staff Bridge Design Worksheets.
20. For Structure F-16-XR, expansion piers shall be post-tensioned similar to the default bridge.
21. Lightweight concrete shall not be used for any portion of the alternative bridge.
22. The texture finish and color scheme of the alternative bridge shall be as shown on the Plans for the default design.

**631.09 Design and Construction Specifications.** The following specifications shall be applicable to the design and construction of an alternative bridge. Unless noted otherwise, the most current edition, with applicable interims, shall be used;

- (1) CDOT 2005 Standard Specification for Road and Bridge Construction, including all applicable Standard Special Provisions
- (2) CDOT Project Special Provisions
- (3) American Association of State Highway and Transportation Official (AASHTO) LRFD Bridge Design Specifications 4<sup>th</sup> Edition
- (4) AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges
- (5) Guidelines for Design for Constructability, AASHTO/NSBA Steel Bridge Collaboration, G12.1
- (6) Colorado Department of Transportation M & S Standards
- (7) Colorado Department of Transportation Bridge Design Manual
- (8) Colorado Department of Transportation Bridge Rating Manual
- (9) CDOT Staff Bridge Design Worksheets
- (10) CDOT Bridge Detailing Manual

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- (11) CDOT Staff Bridge Technical Memorandums
- (12) ANSI/AASHTO/AWS Bridge Welding Code
- (13) AASHTO Guide Specification for Design and Construction of Segmental Concrete Bridges
- (14) Colorado Department of Transportation (CDOT) Field Materials Manual
- (15) CDOT Survey Manual
- (16) MUTCD, latest edition
- (17) CDOT Cost Estimates Item Book
- (18) CDOT Cost Estimates Cost Data
- (19) CDOT Procedural Directive 508.1 Professional Engineer's Stamp
- (20) Subsurface Exploration and Geotechnical Recommendations as listed in Revision of Section 102 Project Plans and Other Data.

**631.10 Qualifications, Requirements and Responsibilities of the Contractor's Professional Engineer.**

- (1) *Qualifications.* The alternative design shall be accomplished under the direct supervision and responsible charge of a Professional Engineer registered in the State of Colorado; and who is hereafter referred to as the Contractor's Professional Engineer.

The Contractor's Professional Engineer shall meet the minimum requirements of Section 631.03.

If there is any change in the Contractor's Professional Engineer, after award of the Contract, the Contractor shall submit to the Engineer for review and acceptance the replacement personnel qualifications at least 30 calendar days prior to beginning construction or changing personnel. Construction shall not begin, or continue, until the Engineer has reviewed and accepted the proposed change in qualified personnel.

Acceptance by CDOT or the Engineer of the Contractor's Professional Engineer proposed for the project shall in no way relieve the Contractor of full responsibility for the work of all design and construction personnel and full compliance with the Contract Documents.

- (2) *Services to be Provided.* The Contractor's Professional Engineer shall be responsible for carrying out all engineering services required to design the alternative bridge in accordance with this specification and the Contract Documents.

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The Contractor's Professional Engineer shall be responsible for observing and monitoring the Contractor's work, as necessary, during construction of the alternative bridge to ensure conformance with the alternative bridge design and design intent; and to ensure the requirements of the Contract Documents are being met for all aspects of the work for which the Contractor's Professional Engineer is responsible.

- (1) *Availability.* The Contractor's Professional Engineer, or a designated representative shall be available on-site and/or by telephone as deemed necessary by the Engineer.
- (2) *Authority.* The Contractor shall authorize the Contractor's Professional Engineer to stop or suspend construction operations and / or work for which the Contractor's Professional Engineer is responsible, if in the opinion of the Contractor's Professional Engineer, the alternative bridge is not being constructed in conformance with the alternative design or the Contract Documents. The Engineer shall be notified in writing by the Contractor of any work stoppage or suspension authorized by the Contractor's Professional Engineer. Such work shall not re-commence until the Contractor's Professional Engineer agrees and certifies in writing that the work deficiency has been remedied / corrected.

**QUALITY CONTROL / QUALITY ASSURANCE**

**631.11 Quality Control - Quality Assurance Responsibility** Quality control and quality assurance responsibilities shall be in accordance with the following table:

	<i>Quality Control</i>	<i>Quality Assurance</i>
Alternative Bridge	Contractor	CDOT

**631.12 Quality Control**

- (1) *Alternative Bridge.* Quality Control for all alternative bridge elements is the responsibility of the Contractor. The Contractor shall perform all quality control inspection during all phases of the work at a rate sufficient to assure that the work conforms to the contract requirements. In addition, the contractor shall follow the minimum testing frequency for sampling and testing as set forth in the 2010 Field Materials Manual for all elements incorporated into their design.
- (2) *Quality Control Documentation.* The Contractor shall maintain current records of quality control operation activities, and tests performed for the alternative bridge , including the work of vendors and subcontractors. These records shall be in the form shown in the Quality Control Plan. Documentation of aspects of the QC process for which the Contractor is responsible shall be kept by the Contractor and submitted to the Engineer and to the Contractor's Professional Engineer on a weekly basis.

**631.13 Quality Control Standards.** Except as amended herein, all sampling, testing, inspection and acceptance of materials shall conform to the following standards:

- (1) Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, 2005, including project Standard Special Provisions and Project Special Provisions, as applicable.
- (2) CDOT Field Material Manual (2010)



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- (1) AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, latest edition.
- (2) AASHTO/AWS Structural Welding Code D1.1, latest edition.
- (3) AASHTO/AWS Bridge Welding Code D1.5, latest edition.

**631.14 Quality Control Personnel.**

- (1) *Qualification.* The Contractor shall provide qualified personnel for sampling, testing and inspection of materials and construction activities. The Contractor shall ensure that qualifications are maintained during the course of sampling, testing and inspection. The Engineer's continued acceptance of Contractor personnel qualifications over the course of the project is subject to satisfactory results from periodic independent assurance evaluations.
- (2) *Conformance to Contract Documents.* Personnel and laboratories performing sampling and testing of materials shall conform to the requirements of the Contract Documents, and the applicable standards as listed above.
- (3) *Personnel.* The Contractor shall have at least one person qualified to perform quality control on the project during all times that work is being performed. Qualifications for QC personnel shall, as a minimum, consist of ACI Level I certification and AWS QC1 certification.

All Quality Control personnel shall be dedicated to the QC process and shall not be utilized in any other capacity. They shall have sufficient independence to be focused on quality alone, without regard to schedule and budget, and shall have the authority to stop unsatisfactory work until quality has been improved such that the requirements of the Contract Documents and the Contractor's Quality Control Plan have been met to the satisfaction of the QC personnel and the Engineer.

- (4) *Minimum Documentation by QC Personnel.* As a minimum, each Quality Control person shall fully document each day's QC activities by filling out a daily inspection report and submitting a copy to the Engineer or his representative. This report shall become part of the documentation described below.

**631.15 Quality Control Plan (QCP).**

- (1) *General.* For all materials and construction operations included in the Contract, the Contractor shall submit to the Engineer a QCP prepared in accordance with the requirements of this specification and the Contract Documents. No materials shall be incorporated into the project or construction operations commenced prior to the Engineer's written approval of the Quality Control Plan.
- (2) *QCP Submittal.* The Contractor shall submit the QCP to the Engineer for review and approval within 30 days following Award. The Engineer will review the QCP and respond to the Contractor within 30 calendar days following receipt of the QCP. The Contractor's QC personnel shall work diligently with the Engineer to correct any deficiencies in the QCP as noted by the Engineer.

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- (3) *Contractor Compliance with the QCP.* If, at any time, the Contractor is not in compliance with any portion the Contract Documents or the approved QCP, affected portions of the work may be disapproved. The Contractor shall cease work of the affected operation(s) and submit a revision to the Engineer for approval. The Engineer will review the revision and respond within seven (7) calendar days of receipt. Work may continue on operations that are still in compliance with the Contract Documents and the approved sections of the QCP.
- (4) *QCP Guidelines.* The QCP shall include all construction operations and materials, both on site and at off-site production facilities. The QCP shall be sufficient to ensure that the requirements of the Contract Documents are being met for all aspects of the work.

The following guidelines shall be used for development of the QCP:

1. Personnel.
  - A. *Qualifications.* Submit a list of technicians that will be performing sampling, testing and inspection, with resumes and their qualifications, for both field and laboratory testing. Include employed and subcontracted technicians. Submitted personnel shall be dedicated to quality control and shall not be used for any other construction operations.
  - B. *Level of Responsibility and Authority.* Identify the primary QC contact for the Engineer. Identify roles, responsibilities and authority of various personnel involved in the quality control process.
2. Documentation.
  - A. *Types of Documentation.* Submit what specific documentation, including quality control charts, qualification / accreditation records, inspection reports, mill certifications, test results and other pertinent / supporting documents, will be kept by the Contractor to verify that the QCP has been properly implemented and followed throughout the project. Include method of documentation of test results.
  - B. *Submittals to Engineer.* Copies of all documentation as identified in the QCP shall be submitted to the Engineer on a weekly basis. Documentation shall be in a clear, orderly, and in a neat manner acceptable to the Engineer.
3. Materials.
  - A. *Source.* Identify the sources of materials.
  - B. *Certification.* Describe methods for verifying compliance of certification with the specifications.
  - C. *Disposition of Failing Materials.* Describe the system for controlling non-conforming materials, including procedures for identification, isolation and disposition.

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4. Storage Facilities for Materials.
  - A. *Protection from Environment.* Describe means, measures, and methods for protecting all materials from environmental conditions (rain, snow, temperature, etc.) while in storage.
  - B. *Integrity of Materials.* Describe means, measures, and methods for preventing segregation, contamination and degradation.
  - C. *Material Identification.* Describe methods of identifying individual materials. Where applicable, submit a site plan showing the locations of various materials.
5. Construction and Testing Equipment.
  - A. *Calibration.* Describe calibration frequencies, maintenance schedule and procedures for all construction and testing equipment.
6. Construction Operations.
  - A. *Substructure Construction.* Describe means, measures and methods for control of substructure construction operations, including location, plumbness, dimensional requirements, field welding, and reinforcing placement requirements.
  - B. *Superstructure Construction.* Describe means, measures and methods for control of superstructure construction operations including, but not limited to: dimensional requirements, reinforcing placement, concrete cover, post-tensioning duct and hardware placement and stressing operations.
7. Plant Requirements.
  - A. *Plant Identification and Certification.* Provide the mailing address, physical address including county, telephone and fax numbers, E-mail address, primary contact at the plant, responsible person in charge, Owner information and other information as required. Plant certifications, if applicable, shall be provided.
  - B. *Process Control System.* Describe the methods and measures established to ensure Contract compliance for the produced materials. These methods and measures shall include, but are not limited to, inspection schedule, sampling and testing, maintenance schedule, etc.
  - C. *Loading and Shipping Control.* Describe the methods and measures for preventing segregation, contamination and degradation as applicable during loading and shipping operations. Describe the methods and measures for keeping elements within allowable stresses and preventing damage as applicable during loading and shipping. Describe the methods established for materials to be in compliance with the Project Specifications at the point of use.

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8. **Manufactured Product.**
  - A. *Manufacturing / Fabrication.* Describe the methods and identify the type of equipment used in the manufacture and / or fabrication of the products.
  - B. *Storage.* When storage of the produced materials is required at the plant or the construction site, describe the methods and duration of storage. Include measures and methods as applicable for preventing segregation, contamination and degradation during storage. Include measures and methods as applicable for protection from environmental conditions and the controlling of deformations and stresses.
  - C. *Transportation.* Describe the method of delivery from the point of production / storage to the point of placement. Include methods for keeping elements within allowable stresses and preventing damage as applicable during loading and shipping. Describe the methods established for materials to be in compliance with the Contract Documents at the point of use.
  - D. *Placement.* Describe the methods and identify the type of equipment used to incorporate the product into the project. Describe the methods to control geometry, stresses and prevent damage during placement and erection.
  - E. *Identification and Disposition of Failing Materials.* Describe the methods and measures for identifying and controlling the failing materials. Include preventive and corrective measures. Describe disposition of failing materials.
9. **Damaged Materials.**
  - A. *Criteria for Damaged Material.* Describe criteria for determining if damaged materials, components and products may be repaired, or shall be disposed.
  - B. *Repair, Restoration of Damage Material.* Describe methods for repairing damaged materials, components and products as applicable. Describe restoration/correction criteria for damaged or flawed materials, components and products that are to be repaired to such extent that they will conform to the requirements of the Contract Documents.
10. **Testing Laboratories**
  - A. *Identification of Testing Laboratories.* Identify all laboratories performing testing and include certification documentation. All testing shall be performed by qualified laboratories and/or equipment in accordance with the Contract Documents and the applicable standards listed above.

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**REVISION OF SECTION 631  
ALTERNATIVE BRIDGE DESIGN & CONSTRUCTION**

**631.16 Testing Equipment.**

- (1) *General.* The Contractor shall furnish and maintain, throughout the project, the equipment necessary to implement the QCP. All equipment shall be in good condition and calibrated in accordance with applicable ASTM specifications and the requirements specified herein. Backup testing equipment shall be kept on-site at all times and be kept in good condition and calibrated as above.
- (2) *Concrete Cylinder Curing and Testing.* The Contractor shall furnish and maintain, throughout the required work, facilities suitable for curing and testing concrete test cylinders.

**631.17 Non-Conformance.** If, at any time, any construction operation or material is found not to be in conformance with the Contract Documents, or the Contractor's QCP, all non-conforming work shall cease immediately. The Contractor's Quality Control personnel shall develop and submit a Non-Conformance Report to the Engineer. The report shall detail the specific nature and causes of the non-conformance, as well as the means and methods that will be undertaken to bring the non-conforming work, or materials back into conformance with the Contract Documents and the Contractor's Quality Control Plan. The Engineer will review the report and proposed corrective procedures within five (5) working days of receipt. Work that was found to be non-conforming may not continue until the Engineer has approved the Non-Conformance Report. An approval of the report by the Engineer in no way relieves the Contractor from conforming to the Contract Documents and the Contractor's Quality Control Plan for all future work, regardless of whether or not the approved corrective procedures are successful.

**MATERIALS**

**631.18 General.** All materials used in the construction of an alternative bridge structure must meet the requirements of subsection 631.08 and 631.09. Materials that do not meet these requirements are subject to rejection or price adjustment.

**CONSTRUCTION**

**631.19 General, Survey and Traffic Control.**

- (1) *General.* Construction of the alternative bridge shall strictly conform to the applicable sections of the Standard specifications.
- (2) *Survey.* Construction survey for the alternative bridge shall be in accordance with Section 625, as revised for this project.
- (3) *Traffic Control.* Traffic control for the alternative bridge shall conform to the intent of the Traffic Control Plans and Specifications included in the Contract. Any changes required to construct any alternative bridge shall be approved by the Engineer and included in the Lump Sum cost of the alternative bridge.

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**REVISION OF SECTION 631**  
**ALTERNATIVE BRIDGE DESIGN & CONSTRUCTION**

**631.20 Contractor's Responsibility.** The presence of the Contractor's Professional Engineer, or his designated staff, on the project shall in no way act to relieve the Contractor of the full responsibility for: conformance of the work to the requirements of the contract documents; the structural adequacy of the erection scheme he chooses; or the safety of workers or the general public.

**631.21 Record Documents.** The Contractor shall provide CDOT with copies of the as-constructed plans, shop drawings, and working drawings for the alternative bridge for informational purposes and for archiving. The as-constructed plans shall include complete original hardcopy plans in 11"x17" format, along with electronic files entirely in MicroStation format utilizing CDOT's latest CAD configuration; as well as in Adobe Acrobat (PDF) format. All linked and referenced files shall be included.

**METHOD OF MEASUREMENT**

**631.22** The alternative bridge design and construction will not be measured, but will be paid for on a lump sum basis, and will include all work and materials required to design and construct the alternative bridge.

The work will include, without limitation: design calculations and documentation, the independent design and detail check, bridge rating, preparation of plans, details, and drawings as required to fabricate and construct the alternative bridge, including, but not limited to, construction of the superstructure, foundations, abutments, railings and appurtenances, other project elements required to construct the alternative bridge; and the record documents (as-constructed plans, shop drawings, and working drawings).

All discrepancies in quantities for the alternative bridge design will be the Contractor's sole responsibility and will not be adjusted.

The completed structure shall include, as applicable but not limited to, the following items, which will not be measured separately, but will be included in the bid price for Item 631, Alternative Bridge Design and Construction:

Structure Excavation, Structure Backfill, Mechanical Reinforcement of Soil, Drilled Caissons, Concrete Slope and Ditch Paving (Reinforced), Provide Temporary support (when applicable), Structural Steel (Steel Alternative), Concrete Sealer, Bearing Devices, Bridge Drain(Special), Bridge Expansion Devices, Structural Concrete, Hot Mix Asphalt, Structural Concrete Coating, Anti-Graffiti Coating, Reinforcing Steel, Reinforcing Steel (Epoxy Coated), Electrical Conduit, Fence Chain Link (Special), Prestressing Steel Wire or Strand, Prestressed Concrete Slab, Precast Concrete, and all other work and materials necessary to complete the structure.

By submitting a bid for Alternative Bridge Design and Construction, the Contractor agrees to accept the amount of that bid, as a lump sum basis, for the complete and satisfactory performance of the work.

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**REVISION OF SECTION 631  
ALTERNATIVE BRIDGE DESIGN & CONSTRUCTION**

**BASIS OF PAYMENT**

**631.23** The accepted quantities for construction of the alternative bridge will be paid for at the contract lump sum bid as follows:

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Alternate Bridge Design & Construction (F-16-XR)	Lump Sum
Alternate Bridge Design & Construction (F-16-XS)	Lump Sum

**631.24 Lump Sum Basis.**

The lump sum bid price shall be full compensation for the cost of all the work, materials, tools, equipment, and incidentals required to complete the design and construction of the alternative bridge.

The work shall include design, independent design check, bridge rating, and plan preparation for the alternative bridge.

Supplemental survey and foundation investigation work required by the Contractor for the alternative bridge shall be included in the work.

The Contractor's construction oversight; the cost of preparing and implementing the Quality Control Plan; and all costs associated / required for Quality Control personnel, equipment, sampling, testing, inspections and documentation of the alternative bridge superstructure shall be included in the work.

Any design or construction costs resulting from changes or impacts to other project elements as a result of the alternative bridge design and construction, which were not required by the default bridge, such as, but not limited to: roadway, drainage, utilities, environmental clearances and permits, phasing, and traffic control, shall be the sole responsibility of the Contractor; and the cost of such changes or impacts shall be included in the alternative bridge lump sum cost.

The Engineer will determine partial payment for the construction of the alternative bridge and include the partial payment on the monthly pay estimate.

**Partial Payment and Price Reduction:** The Contractor shall furnish an itemized quantity and cost break down of the Lump Sum bid to the Engineer prior to commencement of construction. The Contractor's itemized quantity and cost break down shall reference the CDOT item numbers as provided in the CDOT Item Code Book.

The Engineer will review the Contractor's itemized quantity and cost break down to determine its trueness and reasonableness by using CDOT cost estimate data. The Contractor's approved itemized quantity and cost break down shall be used as a basis for calculating monthly partial payments and price adjustments for materials that do not meet specifications.

No adjustment will be made for differences in preliminary estimated quantities and final quantities.

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**REVISION OF SECTION 631**  
**ALTERNATIVE BRIDGE DESIGN & CONSTRUCTION**

Items replaced by 631-10000 Alternate Bridge Design and Construction include, but are not limited to, the following:

For Ramp 1 Flyover (F-16-XR) -

206-00000 Structure Excavation, CY	601-03040 Concrete Class D (Bridge), CY
206-00100 Structure Backfill (Class 1), CY	601-05050 Concrete Class S50, CY
206-00200 Structure Backfill (Class 2), CY	601-40302 Structural Concrete Coating (Anti-Graffiti), SF
206-00360 Mechanical Reinforcement of Soil, CY	601-40400 Structural Concrete Stain, SY
206-01786 Shoring (Area 6), LS	602-00000 Reinforcing Steel, LB
403-09221 Stone Matrix Asphalt (Fibers)(Asphalt), Ton	602-00020 Reinforcing Steel (Epoxy Coated), LB
503-00024 Drilled Caisson (24 Inch), LF	603-50015 15 Inch Plastic Pipe, LF
503-00036 Drilled Caisson (36 Inch), LF	606-10700 Bridge Rail Type 7, LF
503-00048 Drilled Caisson (48 Inch), LF	607-53137 Fence Chain Link (Special)(36 Inch), LF
503-00072 Drilled Caisson (72 Inch), LF	613-00100 1 Inch Electrical Conduit, LF
509-08100 Provide Temporary Support (F-16-XR), LS	613-00200 2 Inch Electrical Conduit, LF
512-00103 Bearing Device (Type III), Each	618-00002 Prestressing Steel Strand, MKFT
513-00600 Bridge Drain, Each	618-00005 Prestressing Steel Bar, LB
515-00120 Waterproofing (Membrane), SY	618-06032 Prestressed Concrete Slab (Depth less than 6 inches), SF
518-01004 Bridge Expansion Device (0-4 Inch), LF	618-10372 Precast U Girder (U72)(Curved), LF
518-01012 Bridge Expansion Device (0-12 Inch), LF	

For Mainline I-25 (F-16-XS) -

206-01785 Shoring (Area 5), LS	601-40400 Structural Concrete Stain, SY
403-09221 Stone Matrix Asphalt (Fibers)(Asphalt), Ton	602-00020 Reinforcing Steel (Epoxy Coated), LB
503-00042 Drilled Caisson (42 Inch), LF	606-10700 Bridge Rail Type 7, LF
503-00048 Drilled Caisson (48 Inch), LF	606-10705 Bridge Rail Type 7 (Special), LF
509-08100 Provide Temporary Support (F-16-XS), LS	607-53137 Fence Chain Link (Special)(36 Inch), LF
515-00120 Waterproofing (Membrane), SY	613-00100 1 Inch Electrical Conduit, LF
518-01004 Bridge Expansion Device (0-4 Inch), LF	613-00200 2 Inch Electrical Conduit, LF
601-03040 Concrete Class D (Bridge), CY	618-00002 Prestressing Steel Strand, MKFT
601-05050 Concrete Class S50, CY	618-10372 Precast Concrete U Girder (Precast and Post-Tensioned), LF
601-40302 Structural Concrete Coating (Anti-Graffiti), SF	

Items not replaced by 631-10000 Alternate Bridge Design and Construction, Mainline I-25 (F-16-XS) –

202-00400 Removal of Bridge, Each



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## REVISION OF SECTION 715 LIGHTING MATERIALS

**715.01 General.** Materials shall be of a standard line from a name brand manufacturer, or must be approved. Electrical material shall be approved by the Underwriters' Laboratories, Inc., and shall conform to the recommendations and requirements of the National Electrical Code.

Material shall be the same as, or compatible with, that used by the local utility, provided it meets the above requirements.

All lighting materials and all electrical materials shall be subject to inspection and approval and may be rejected as unsuitable at the project site. Samples may be taken or manufacturer's certification may be accepted in lieu of samples.

**715.02 Concrete Foundation Pads.** Concrete shall be Class "B" conforming to Section 601.

Anchor bolts shall be designed by the Contractors Engineer and shown on the working drawings. The threaded ends of the anchor bolts and the nuts and washers shall be galvanized in accordance with ASTM A 153/A 153M. Galvanizing for anchor bolts shall extend from 50 to 100 mm (2 to 4 inches) beyond the threads.

Reinforcing steel shall conform to the requirements of Section 602.

Grounding wire cast in the foundation shall be No. 6 AWG, soft drawn bare copper or better.

**715.03 Light Standards.**

- (a) *General.* All structural components of light standards, bases, couplers, anchor bolts, luminaires, and other attachments to be used for lighting shall be designed for a minimum of 145 km/h (90 MPH) wind velocity, in accordance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals," unless otherwise shown on the plans.

All breakaway bases and couplers shall meet the breakaway requirements as specified in AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Section 7.1.7.2. Conformance shall be verified by crash tests reviewed and accepted by FHWA. A certificate of compliance shall be provided.

- (b) *Metal Light Standards.* Metal light standards shall be fabricated of either steel or aluminum, or as specified.

All standards shall have cable-entrance holes located in conformity with the type of arm mounting used. Metal surfaces shall be free of any imperfections marring the appearance and of any burrs or sharp edges that might damage the cable.

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**REVISION OF SECTION 715  
LIGHTING MATERIALS**

All metal poles shall be tapered and shall be supplied with pole caps.

Aluminum alloys shall have a minimum yield strength of 172 MPa (25,000 psi). Aluminum poles, arms and fittings shall be made of aluminum alloy conforming to the following for the material form required:

<b>ASTM</b>	<b>Alloy No.</b>
B 209M (B 209)	6061-T6
B 211M (B 211)	6061-T6
B 221M (B 221)	6061-T6
	6063-T6
	6005-T5
B 241/B 241M	6061-T6
	6063-T6

Aluminum poles may also be made of aluminum alloy conforming to ASTM B 313/B 313M (excluding pressure and burst tests) alloy 5086-H34.

Aluminum mast arms shall be tapered and trussed as shown on the plans.

Steel mast arms and trusses shall be made of Schedule 40 standard steel pipe conforming to ASTM A 53.

All steel poles, mast arms and base flanges shall be hot-dip galvanized in accordance with ASTM A 123. Units on which the spelter coating has been damaged shall be repaired as provided in AASHTO M 36M/M 36, or other approved method.

Base flanges for both aluminum and steel poles shall have continuous welds both inside and outside, unless otherwise permitted. Base flanges inserted into the pole and bonded shall meet the requirements for materials and strength stated herein.

Base flanges for aluminum poles and transformer bases shall be aluminum castings of material conforming to ASTM B 26/B 26M alloy SG70A-T6 or an acceptable equivalent.

All transformer bases shall have vandal resistant, removable access doors.

- (c) Hardware used with steel standards shall be either cadmium plated, hot dip galvanized or stainless steel. All hardware used with aluminum standards shall be anodized aluminum or stainless steel. Bolts to be inserted in aluminum threads shall be stainless steel.

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**REVISION OF SECTION 715  
LIGHTING MATERIALS**

**715.04 Luminaires and Lamps.** A luminaire shall be a complete pre-wired lighting device specifically manufactured for the purpose of roadway lighting. A luminaire unit shall consist of housing, lens, reflector, ballast, lamp holder, photoelectric control, mounting slip-fitter, and all necessary internal wiring. Luminaires shall be adaptable to the type of power distribution system to be used. Luminaires shall have a noncorrosive housing, a portion of which, by means of a hinge with a safety catch and a latch, may be opened to provide access to all internal components. Lamp holder shall be glazed porcelain. Screw shell shall be nickel plated or equal. Luminaires shall also conform to the following requirements:

- (a) Roadway luminaires shall be of the high pressure sodium type. Units for the project shall all be of the same type and design.

The luminaire light distribution shall be IES Type II, unless otherwise specified on the plans.

When luminaires are furnished for continuous roadway lighting, the manufacturer's photometric charts showing utilization curves and isolux lines shall be furnished to the Engineer to verify:

1. The average initial illumination on the traveled way will be at least 8.6 lux (0.8 foot-candle).
2. The initial lux (foot-candle) value at the point of least illumination on the pavement area will be at least one fourth the average initial illumination.

- (b) Wall type luminaires for use under overpass structures shall be complete pre-wired lighting devices. Each luminaire shall be weatherproof, corrosion resistant and shall consist of a housing, reflector, shrouded porcelain socket, refractor, door, integral ballast and lamp.

Detail requirements are as follows:

1. The housing shall be cast aluminum.
2. The door shall be a cast aluminum frame with stainless steel hinges and latch containing a thermal shock resistant prismatic refractor.
3. Reflector shall be aluminum and shall be asymmetric.
4. Socket shall be for horizontal lamp position.
5. Integral ballast shall be rated to the circuit voltage and size of lamp specified.
6. Main beam angle setting shall be adjustable from 60° to 70°.

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**REVISION OF SECTION 715  
LIGHTING MATERIALS**

7. Manufacturer's photometric charts corresponding to the luminaire be installed shall be furnished to the Engineer upon request. The charts will be used to verify that the luminaire will meet the following illumination requirements:
- A. The average initial illumination on the traveled way will be at least 8.6 lux (0.8 foot-candle).
  - B. The initial lux (foot-candle) value at the point of least illumination on the traveled way will be at least 0.5 (0.05).

For the purpose of making the above calculations:

- (1) Traveled way is defined as the portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes; and limited to a 20 m (70 foot) length of roadway measured 10 m (35 feet) each way from the luminaire station.
- (2) The luminaire is considered to be located 4.6 m (15 feet) from the nearest edge of the traveled way and mounted 4.6 m (15 feet) above the roadway surface. The luminaire shall be designed to permit either wall or pendant mounting as required.

- (c) *Lamps.* Lamps for roadway lighting shall be high pressure sodium of the wattage shown on the plans. Minimum lumens for each specific wattage shall be as follows:

Watts	Min. Lumens
100	8 500
150	12 000
250	25 000
400	50 000
1000	130 000

**715.05 Ballasts.** Ballasts shall be of the magnetic regulator type specifically manufactured for use with high pressure sodium lamps, and shall operate at a minimum of 90% power factor. Operation shall be suitable with a line voltage variation of  $\pm 10\%$ . Satisfactory starting operation shall be obtained with an ambient temperature of  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ).

**715.06 Conduit.** Conduit for highway lighting shall be semi-rigid plastic. Conduit not under any pavement shall be a minimum of schedule 40. Conduit under pavement shall be schedule 80.

Direct buried cable will not be allowed for highway lighting. All highway lighting feeds shall be in conduit.

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**REVISION OF SECTION 715  
LIGHTING MATERIALS**

Conduit threads, when used in damp or wet locations, or when buried in the earth, or buried in concrete which is in contact with the earth, shall be completely covered with a coating of white lead. Coatings having insulating qualities will not be permitted.

Plastic conduit shall be a semi rigid type currently recommended and approved by Underwriters' Laboratories, Inc. for the proposed usage. Underground plastic conduit for traffic signals shall conform to the requirements of ASTM F 441/F 441M schedule 80. Fittings shall be of the type used outside the conduit and shall be secured to the conduit in such manner that the joints are watertight.

Concrete and plastic pull boxes shall be as shown on the plans.

Junction boxes used in structures shall be galvanized steel, 150 mm (6 inches) square by 100 mm (4 inches) deep with weatherproof covers.

Pull boxes shall be a minimum of 400 mm by 300 mm (16 inches by 12 inches) and 150 mm (6 inches) deep, or as shown on the plans, and shall have weatherproof covers.

**715.07 Direct Burial Cable.** Direct burial cables shall consist of 7-strand concentric Class B stranding. If not otherwise specified in the Contract, the conductors shall be a minimum of No. 6 AWG copper.

The cables shall have conductors insulated with 1.5 mm (60 mils) of cross linked polyethylene.

Compact stranding will not be permitted. A separator shall be applied on conductors to provide free stripping. The void areas between conductors may or may not be filled with a non-hygroscopic material. Cables shall be bound with binding tape. The bound conductors shall be covered with interlocked galvanized (inside and outside) steel tape armor and covered with 1.3 mm (50 mils) of polyvinyl chloride (PVC), or the armor may be a 250 micrometer (10 mil) thick corrugated bronze tape, helically applied with a minimum overlap of 12.5% or three corrugations, whichever is greater. The completed cable shall be marked "Type USE or RHH or RHW". The outside diameter of the completed cable shall not be more than 28 mm (1.10 inches).

Cable assembly in polyethylene pipe will be allowed as an alternative to direct burial cable. Conductor size as shown in the Contract shall be in appropriate size polyethylene pipe as shown in the following table.

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**REVISION OF SECTION 715  
LIGHTING MATERIALS**

<b>Conductor Size</b>	<b>Nominal Pipe Size (mm)</b>	<b>Pipe Size (Inch)</b>
#6	25	1
#4	32	1 1/4
#2	32	1 1/4
#1	40	1 1/2

Polyethylene pipe shall be medium or high density and shall meet all provisions of NEMA standard publication No. TC7.

The requirements for conductors shall be the same as those specified for buried cable.

When crossing under roadway, all conductors, regardless of type, shall be run in rigid metal conduit or schedule 80 plastic conduit.

**715.08 Lighting Circuitry and Wiring.** Lighting systems shall be photoelectrically controlled. Photo cells shall be of the hermetically sealed, cadmium sulfide type and shall be preaged. Photoelectric units shall have a turn-on setting of 22 lux (2.0 foot-candles), maximum. The ratio of the turn-off to turn-on setting shall be 3:1, maximum.

All electrical apparatus used in the lighting system shall be of ratings adequate to handle the necessary loads and shall conform to power source requirements.

Unless otherwise shown on the plans, copper wires and copper conductors shall be used and shall meet the minimum specifications and sizes as required by the National Electrical Code.

**FORCE ACCOUNT ITEMS**

**DESCRIPTION**

This special provision contains the Department's estimate for force account items included in the Contract. The estimated amounts marked with an asterisk will be added to the total bid to determine the amount of the performance and payment bonds. Force Account work shall be performed as directed by the Engineer.

**BASIS OF PAYMENT**

Payment will be made in accordance with subsection 109.04. Payment will constitute full compensation for all work necessary to complete the item.

Force account work valued at \$5,000 or less, that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

<u>Estimated Force Account Item</u>	<u>Quantity</u>	<u>Amount</u>
F/A Minor Contract Revisions	F A	\$ 5,000,000*
F/A Partnering	F A	\$ 50,000
F/A Concrete Pavement Incentive	F A	\$ 150,000
F/A Roadway Smoothness Incentive	F A	\$ 50,000
F/A Asphalt Cement Cost Adjustment	F A	\$ 200,000
F/A Fuel Cost Adjustment	F A	\$ 10,000
F/A On-The-Job Trainee	HR	\$ 4/hour
F/A OJT Colorado Training Program	F A	\$ 6,500
F/A Quality Incentive Payment	F A	\$ 50,000
F/A ESB Program	F A	\$ 25,000
F/A Interim Surface Repair	F A	\$ 50,000
<b>F/A Landscaping (Restoration)</b>	F A	\$ 25,000
F/A Uniformed Traffic Control (Officer Time)	F A	<b>\$ 10,000</b>
F/A Furnish and Install Electrical Services	F A	\$ 30,000
F/A Erosion Control	F A	\$ 50,000
F/A Provide Security Guard	F A	\$ 10,000
F/A Environmental, Health and Safety Management	F A	\$ 100,000
F/A Dewatering	FA	\$ 100,000
F/A Hazardous Waste Disposal	FA	\$ 50,000
F/A Early Completion of Work Incentive	FA	\$ 1,000,000
<b>F/A Obtain Street Permits from Denver</b>	FA	\$ 500,000

F/A Minor Contract Revisions payments are for contract adjustments authorized through contract modification orders.

F/A Partnering Program payment is for costs associated with the partnering process as detailed in Standard Special Provision – Partnering Program.

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## **FORCE ACCOUNT ITEMS**

F/A Concrete Pavement Incentive payment is for incentive payment in accordance with Standard Special Provision – Revision of Sections 105 and 106 – Conformity to the Contract of Portland Cement Concrete Pavement.

F/A Fuel Cost Adjustment payment is for Standard Special Provision – Revision of Section 109 – Fuel Cost Adjustment.

F/A Roadway Smoothness Incentive payment is for Standard Special Provision – Revision of Sections 105, 202, 402, 406, and 601 – Hot Mix Asphalt Pavement Roadway Smoothness (High Speed Profiler); and for Revision of Sections 105 and 601 – Portland Cement Concrete Pavement Roadway Smoothness (High Speed Profiler).

F/A Asphalt Cement Cost Adjustment payment is for Standard Special Provision – Revision of Section 109 – Asphalt Cement Cost Adjustment (Asphalt Included in the Work).

F/A On the Job Trainee payment is made for on the job trainees used on this project.

F/A OJT Colorado Training Program payment is made for cost of maintaining on the job training program in compliance with the provisions of the Standard Special Provision – On the Job Training.

F/A Quality Incentive Payment – Incentive payment is for Standard Special Provisions Revision of Sections 105 and 106 Conformity to the Contract for Hot Mix Asphalt (Less than 5000 Tons) and Revision of Sections 105 and 106 Conformity to the Contract for Hot Mix Asphalt (Voids Acceptance).

F/A ESB Program payment is made for implementation of the State's Emerging Small Business program as detailed in Standard Special Provision – Emerging Small Business Program.

F/A Interim Surface Repair payment is for work that includes placing and compacting a machine scratch course in locations as directed by the Engineer. The machine scratch course may be used once the Contractor meets all the specification requirements for the Revision of Section 202-Removal of Asphalt Mat and the Revision of Section 202-Removal of Asphalt Mat (Planing).

**F/A Landscaping (Restoration)** payments are for restoring landscaped areas damaged before the project, or by necessary project work. It does not include repairing areas unnecessarily damaged by the Contractor.

F/A Uniformed Traffic Control (officer Time) **payment is for police agency** administrative loading, other than from the Colorado State Patrol, **and** will be paid by the Department to the Contractor based on invoice cost, through the force account Uniformed Traffic Control (officer Time). The Contractor shall submit all billings from the police agency to the Engineer monthly. Colorado State Patrol (CSP) officer time, CSP vehicle, and CSP agency administrative loading will be paid for by the Department directly to the CSP based on invoice cost.

F/A Furnish and Install Electrical Service payment is for all cost charges from the power service provider, and all necessary materials, labor, and coordination required to maintain existing or establish new power sources required for permanent operation of equipment as shown in the plans.



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### **FORCE ACCOUNT ITEMS**

F/A Erosion Control payment is for any unforeseen stormwater issues that require erosion control but are not included in the 208 items listed in the Summary of Approximated Quantities. This work shall be approved by the Engineer prior to purchasing and placing any erosion control items. If justification is not proven before implementation, payment will not be made.

F/A Provide Security Guard payment is for providing an armed security guard at the field office facilities as requested by the Engineer. The Contractor shall provide a qualified armed Security Guard with radio/telephone. The Engineer will give the Contractor a minimum of a one week notice prior to the time in which the security guard is required.

F/A Environmental, Health and Safety Management payment is additional environmental health and safety work required and authorized by the Engineer, but not included in the Section 250 Environmental, Health and Safety Management bid items listed in the summary of approximate quantities. This force account includes, but is not limited to, the removal, sample collection, analytical testing, containerization, transportation, and disposal or treatment of all contaminated groundwater; miscellaneous hazardous materials handling; and any required asbestos handling.

F/A Dewatering is payment for construction related dewatering.

F/A Hazardous Waste Disposal is payment for analytical testing of suspected contaminated soils; containerization of suspected contaminated soils, and transporting contaminated soils to a hazardous waste disposal facility, and any fees required by the hazardous waste disposal facility.

F/A Early Completion of Work Incentive is payment for early completion of work as outlined in Revision of Sections 101, 102 and 108 Basic Cost Plus Time Bidding.

F/A **Obtain Street Permits from Denver** is payment for obtaining City and County of Denver (CCD) Street Occupancy Permits and Street Cut Permits. In order to be reimbursed for permit fees, the work within CCD ROW and covered by the permits must have been accepted in a MHT.

**UTILITIES**

The known utilities within the limits of this project are:

<b>UTILITY</b>	<b>CONTACT/EMAIL</b>	<b>PHONE/FAX</b>
Xcel Energy	Builders Call Line	1-800-628-2121 1-800-628-2521 fax
Xcel Energy- Electrical Distribution 1123 W. 3rd Ave. Denver, CO 80223	Bruce Burr <a href="mailto:Bruce.burr@xcelenergy.com">Bruce.burr@xcelenergy.com</a>	303-571-3124 303-571-3102
Xcel Energy- Gas Operations 1123 W. 3rd Avenue, #10 Denver, CO 80223	Michelle O’Nan <a href="mailto:Michelle.t.o'nan@xcelenergy.com">Michelle.t.o'nan@xcelenergy.com</a>	(303) 571-3358 (303) 571-3166
Xcel Energy-Electric Transmission 550 15th Street, Suite 600 Denver, CO 80202	Bill Braasch Mike Diehl (ROW) Paul Urban (Line man)	303-571-7082 (Bill) 303-571-7260 (Mike) 303-273-4669 (Paul)
Qwest Communications 9750 E. Costilla Ave., Room 201 Englewood, CO 80112	Andy Devine <a href="mailto:Andy.Devine@qwest.com">Andy.Devine@qwest.com</a>	303-792-6298 303-792-6262
Comcast Cable 1617 Acoma Street Denver, CO 80223	Leon Glawe <a href="mailto:Leon_Glawe@cable.comcast.com">Leon_Glawe@cable.comcast.com</a>	303-603-5235 303-603-5980
Denver Water Department 1600 W. 12th Avenue Denver, CO	Vince Gaiter <a href="mailto:Vincent.Gaiter@denverwater.org">Vincent.Gaiter@denverwater.org</a>	303- 628-6527 303-628-6851
Metro Wastewater Reclamation District 6450 York Street Denver, CO 80229	Troy Gottschalk <a href="mailto:tgottschalk@mwr.d.dst.co.us">tgottschalk@mwr.d.dst.co.us</a>	303-286-3331 720-201-3442
Denver Wastewater Management 201 W. Colfax Ave., Dept 506 Denver, CO 80202	Ted Christensen	303-446-3722 303-446-3589
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The work described in these plans and specifications requires full cooperation between the Contractor and the utility owners in accordance with Subsection 105.10 in conducting their respective operations, to complete the utility work with minimum delay to the project.

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**UTILITIES**

**PART 1 - CONTRACTOR SHALL PERFORM THE WORK LISTED BELOW:**

Coordinate project construction with the performance by the utility owner of each utility work element listed in Part 2 below. Perform preparatory work specified in Part 2 for each utility work element. Provide an accurate construction schedule that includes all utility work elements to the owner of each impacted utility. Provide each utility owner with periodic updates to the schedule. Conduct necessary utility coordination meetings, and provide other necessary accommodations as directed by the Engineer. Notify each utility owner in writing, with a copy to the Engineer, prior to the time each utility work element is to be performed by the utility owner. Provide the notice the number of days specified in Part 2 immediately prior to the time the utility work must be begun to meet the project schedule.

Provide traffic control, as directed by the Engineer, for any utility work by the utility owner expected to be coordinated with construction. However, traffic control for utility work outside of typical project work hours shall be the responsibility of the utility owner.

Perform each utility work element for every utility owner listed here in Part 1. Notify each utility owner in advance of any work being done by the Contractor to its facility, so that the utility owner can coordinate its inspections for final acceptance of the work with the Engineer.

**Project Limits – All Utility Owners**

Prior to excavating, the Contractor shall positively locate all potential conflicts with existing underground utilities and proposed construction, as determined by the Contractor according to proposed methods and schedule of construction. The Contractor shall modify construction plans to avoid existing underground facilities as needed, and as approved by the Engineer. Please note that UNCC marks only its members' facilities – Other facilities, such as ditches and drainage pipes may exist, and it is the Contractor's responsibility to investigate, locate and avoid such facilities.

**Xcel Energy- Electrical Transmission:**

When the CDOT Contractor is working near or under the high voltage transmission line, it shall be assumed the transmission line is energized and the CDOT Contractor shall not be closer than twenty feet (20') in any direction from the energized conductors. If work will be within twenty feet (20') of energized conductors, CDOT Contractor shall call Paul Urban at 303-273-4669 a minimum of twenty (20) working days in advance to arrange for a Xcel Energy representative (Patrolman) to be on site during the work. An outage will be arranged if it is determined to be necessary. The outage will be a day-by-day situation. The Patrolman shall be on the job site at all times during outages of the line at this location.

Under no circumstances shall work be started within twenty feet (20') in any direction of the transmission lines without clearance from Xcel Energy's Patrolman. The CDOT Contractor shall notify the Patrolman whenever it is going to be starting and ending work. If an outage has been arranged and the Patrolman has given approval, the CDOT Contractor shall not be closer than three feet (3') in any direction from the de-energized conductors.

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**UTILITIES**

**PART 2 - UTILITY OWNERS SHALL PERFORM THE WORK LISTED BELOW:**

Although the CDOT Contractor shall provide traffic control for utility work expected to be coordinated with construction, traffic control for utility work outside of typical project work hours shall be the responsibility of the utility owner. The utility owner shall prepare and submit to the CDOT Engineer a Method of Handling Traffic for utility work to be performed outside typical project work hours. The utility owner shall obtain acceptance of the Method of Handling Traffic from the CDOT Engineer prior to beginning the utility work to be performed outside typical project work hours.

**Xcel Energy- Electrical Distribution:**

The CDOT Contractor shall be responsible for the coordination of power source work to be performed by Xcel Energy. The CDOT Contractor shall contact the Xcel Energy Builder's Call Line at 1-800-628-2121 to request, and process to completion, the required coordination to establish the power sources for street lighting, traffic signal, and ITS equipment as shown on the plans. The CDOT Contractor shall perform all work necessary to maintain existing or establish a new power source for the roadway elements called for in the plans. All cost charges from the power service provider, and all necessary materials, labor and coordination required to maintain existing or establish new power sources required for permanent operation of equipment as shown in the plans shall be reimbursed from the Force Account Furnish and Install Electrical Service.

The CDOT Contractor shall submit the materials lists for the flat rated City & County of Denver (CCD) proposed roadway lighting for review and approval by Xcel Energy forces prior to ordering material. This review is expected to take 30 calendar days to complete.

Prior to work, all lighting locations including under deck lighting shall be staked or designated by the CDOT Contractor for field review and confirmation. Under deck lighting shall be located in the ultimate configuration of Santa Fe and I-25. Any adjustments to the lighting locations and electrical conduit routing based on the walk through shall be staked or designated. Final lighting locations shall be approved by Xcel Energy and the Project Engineer prior to ordering material associated with street lighting. Coordinate any electrical conduit routing changes with the bridge plans prior to bridge construction.

After the CDOT Contractor has completed the installation of the roadway lighting, including under deck lighting for each construction phase including conduit and wiring to the power sources as shown on the plans, Xcel forces shall connect the CCD flat rate power sources. This work is expected to be coordinated with construction and take 1 working day for each location to complete.

After the CDOT Contractor has completed the installation of the proposed Denver traffic signals, including conduit and wiring to the flat rate power sources as shown on the plans, Xcel forces shall connect the flat rate Denver power source. This work is expected to be coordinated with construction and take 1 working day at each location to complete.

After the CDOT Contractor has completed the installation of the CDOT ITS equipment including conduit and wiring to the power sources as shown on the plans, Xcel forces shall connect the CDOT metered power source. This work is expected to be coordinated with construction and take 1 working day for each construction phase to complete.

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**UTILITIES**

After CDOT Contractor has survey staked the proposed roadway elements(permanent and temporary) , and also completed grading to within 6” of final grade in areas of the proposed transformer, then Xcel Energy forces shall install a new transformer, as shown on the plans. This work is expected to be coordinated with construction and take 15 working days to complete.

The CDOT Contractor shall be responsible for the coordination of relocation and removal work to be performed by Xcel Energy. The CDOT Contractor shall contact the Xcel Energy Builder’s Call Line at 1-800-628-2121 to request, and process to completion, the required coordination to remove street light standards, and traffic signal poles with luminaires as shown on the plans

Xcel Energy forces shall remove the existing roadway lighting, including under deck lighting and any aerial facilities supplying the roadway lighting as required for each construction phase. This work is anticipated to take 3 working days for each construction phase to complete. Xcel Energy forces will assure that the remaining existing roadway lighting is operational. The CDOT Contractor shall assure that there is adequate roadway lighting throughout the duration of the project.

After the proposed traffic signals are operational and the CDOT Contractor has removed all of the existing traffic signal equipment including mast arm, Xcel forces shall remove the existing traffic signal poles with luminaires as shown on the plans. This work is expected to be coordinated with construction and take 1 working day at each location to complete.

CDOT Contractor shall provide the utility owner written notice 30 days immediately prior to each utility work element expected to be coordinated with construction.

***Xcel Energy- Electrical Transmission:***

Xcel Energy –Transmission forces shall de-energize the high voltage transmission lines when the CDOT Contractor performs the following work item elements: bridge demolition, sub structure elements, girder erection and deck placement. This work will need to be coordinated with the construction phases, it is anticipated that ten (10) outages will need to be scheduled to accommodate project construction temporary outages shall be provided at no cost to the project.

CDOT Contractor shall provide the utility owner written notice 45 days immediately prior to each utility work element expected to be coordinated with construction.

**GENERAL:**

The Contractor shall comply with Article 1.5 of Title 9, CRS ("Excavation Requirements") when excavating or grading is planned in the area of underground utility facilities. The Contractor shall notify all affected utilities at least two (2) business days, not including the actual day of notice, prior to commencing such operations. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) at phone no. **811 or 1-800-922-1987**, to have locations of UNCC registered lines marked by member companies. All other underground facilities shall be located by contacting the respective owner. Utility service laterals shall also be located prior to beginning excavation or grading.

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**UTILITIES**

The location of utility facilities as shown on the plan and profile sheets, and herein described, were obtained from the best available information.

All costs incidental to the foregoing requirements will not be paid for separately but shall be included in the work.

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## **TRAFFIC CONTROL PLAN - GENERAL**

The key elements of the Contractor's method of handling traffic (MHT) are outlined in subsection 630.09.

The components of the Traffic Control Plan (TCP) for this project are included in the following:

- (a) Subsection 104.04 and Section 630 of the Standard Specifications.
- (b) Schedule of Construction Traffic Control Devices.
- (c) Tabulation of Traffic Engineering Items included in the plans for this project.
- (d) Latest revised Standard Plan S-630-1(02/17/2010), Traffic Controls for Highway Construction and Standard Plans S-630-2, **630-3, and 630-4.**

Special Traffic Control Plan requirements for this project are as follows:

- (a) This project includes restrictions to work times and days that affect traffic during peak traffic times and days, holidays, holiday eves (all day), holiday weekends, special events, and other circumstances as described later in this special provision. Wherever other laws, ordinances, regulations or orders are more restrictive, they shall take precedence over these requirements.
- (b) All lane closures are subject to the approval of the Engineer. The Contractor shall submit a plan for each lane closure to the Engineer for review and approval at least 72 hours in advance of the time the lane closure is to be implemented. Lane closures will not be allowed to remain unless being used continuously for the purpose for which they were set up.
- (c) The Contractor shall coordinate and cooperate fully with the CDOT, the City and County of Denver, RTD, utility owners, and other contractors, to assure adequate and proper traffic control is provided.
- (d) The Contractor shall coordinate and cooperate fully with any others providing traffic control for other operations to assure that work or traffic control devices do not interfere with the free flow of traffic except as allowed by the Traffic Control Plan. During flagging and uniform traffic control operations at signalized intersections, the signal heads shall be masked.

### **RESTRICTED WORK TIMES FOR PEAK TRAFFIC**

Work performed and material placed that interferes with traffic during the times and in the locations that the roadway is specified to remain open will not be paid for unless the work is directed by the Engineer to be done during those times.

Following are allowed work times for night time closures:

- (a) I-25 Closures (Bridge Demolition, Pier Construction, Girder Erection)
  - Single Lane 9:00 p.m. to 5:30 a.m.
  - Double Lane 11:00 p.m. to 5:30 a.m.
  - Full Closures Times and days must be approved by the Engineer

Lane or full closures on I-25 shall be coordinated with Special Events in the City and County of Denver.

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## **TRAFFIC CONTROL PLAN – GENERAL**

Full closure of I-25 shall be posted a minimum of 72 hours in advance of the closure.

(b) **Santa Fe and Kalamath Closures**

Double Lane or Full Closures      9:00 p.m. to 5:30 a.m.

Double Lane or Full Closures on Santa Fe shall be coordinated with Special Events in the City and County of Denver.

Full closure of Santa Fe shall be posted a minimum of 72 hours in advance of the closure.

(c) **Northbound I-25 off ramp (Ramp 2) closure will be limited to a one time closure with a maximum duration of 14 consecutive days unless approved by the Engineer.**

Following are allowed work times for day time closures:

(a) **Santa Fe and Kalamath Closures**

Single Lane    9:00 a.m. to 3:00 p.m.

### **GENERAL TIME RESTRICTIONS**

No work shall be performed which interferes with the flow of traffic on mainline I-25, ramps or secondary streets during the peak traffic hours of 5:30 a.m. to 9:00 p.m. Work shall not be performed on Saturdays or Sundays except where noted elsewhere in the Traffic Control Plan and other special circumstances when approved in advance by the Engineer.

A minimum of two lanes in each direction on Santa Fe and three lanes in each direction on I-25 shall remain open for traffic, except for girder erection, pier construction and bridge demolition, or as approved by the Engineer.

All turn lanes, acceleration and deceleration lanes, and all ramps shall remain open to traffic unless approved by the Engineer or shown on the Construction Phasing Plans.

**No work that interferes with traffic will be allowed on holidays or any day of a three-day or four-day weekend that includes a holiday. Holidays on which this restriction applies consist of those holidays recognized by the State of Colorado as listed in Subsection 101.33.**

### **RESTRICTED WORK TIMES FOR SPECIAL EVENTS**

Per the Engineer's discretion, contract time may be extended in accordance with Subsection 108.07 on days during which special events interfere with the Contractor's normally scheduled activities, such that the resulting delay affects the ultimate completion of the project.

### **CONSTRUCTION PHASING AND DETOUR PLANS**

A proposed construction phasing plan for the construction of the project and the maintenance of traffic is shown in the plans. Stop and start dates for each phase will not be necessary by coincident, but overlap of phases may occur subject to the Contractor's production rates and scheduling



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### **TRAFFIC CONTROL PLAN – GENERAL**

If the Contractor proposes alternate phasing plans, traffic control plans or detours plans, he shall submit a written proposal to the Engineer for approval seven working days prior to commencement of work. The proposal shall be signed and sealed by a Professional Engineer registered in the State of Colorado, and shall include detailed plans for phasing, detours, and construction traffic control. The proposal shall also include a summary of quantities for all affected pay items.

#### **CONSTRUCTION ACCESS**

Construction access to and from all roadways is prohibited unless approved by the Engineer or otherwise specified in the Contract.

As part of the MHT the Contractor shall prepare, and submit to the Engineer for approval, a Construction Access Plan. This plan shall contain, but is not limited to, a diagram showing access to and from each affected roadway; location and duration of each signing and flagger position; and a narrative explanation of the plan. The Engineer shall approve the Construction Access Plan prior to the Contractor beginning any work.

The Construction Access Plan shall address maintenance of all accesses to the project, including access to the Engineer's field facilities. Access to all work areas will be limited to that which can be safely accomplished without hazard to traffic, and which does not interfere with traffic during the times specified. Access will not be allowed to any work areas where such access requires the implementation of traffic control measures that interfere with the flow of traffic, except where such implementation is in compliance with the working limitations in the Contract.

#### **ACCESS MAINTENANCE**

Unless otherwise included in the plans or directed by the Engineer, the Contractor shall maintain access to all roadways, side streets, walkways, alleyways, driveways, and other pathways at all times.

As part of the MHT the Contractor shall develop, and submit to the Engineer for approval, an Access Maintenance Plan. This plan shall be coordinated with, and approved by, all affected owners and tenants. The Engineer's approval of the Access Maintenance Plan is dependent on the Contractor acquiring signatures from each affected owner or tenant. If the Contractor is unable to obtain approval and signatures, documentation of "good faith efforts" to obtain said approval and signatures shall be submitted.

All accesses shall be maintained on surfaces equal to or better than those existing at the time the access is first disturbed. For short periods of time only, as allowed by the Engineer, access may be maintained on aggregate base course surfaces. All costs incidental to the maintenance of access will not be paid for separately, but shall be included in the work. Utilization of materials to be incorporated permanently into the work may be permitted, however, any degradation or other contamination, or destruction shall be corrected at the Contractor's expense prior to acceptance.

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## **TRAFFIC CONTROL PLAN – GENERAL**

### **CONSTRUCTION CLEAR ZONE**

**The construction clear zone for the project is defined in the traffic control plan.**

**Vertical cuts or fills greater than 1 inch resulting from construction operations adjacent to traffic lanes, or within the clear zone shall be temporarily sloped at a 6:1 or flatter slope, and delineated at 55 foot intervals immediately after removal operations to safeguard the traveling public.**

The construction clear zone shall contain no areas of unprotected ground slope steeper than 3:1. The construction clear zone shall contain no immediate vertical drop offs in excess of 1 inch. The construction clear zone shall contain no unprotected collision hazards. All parking shall be outside of the clear zone.

Traffic control devices shall not be stored within the construction clear zone, except behind guardrail, unless laid flat; nor shall traffic control devices be stored in landscaped areas unless otherwise designated or permitted.

### **PEDESTRIAN AND BICYCLE SAFETY**

The Contractor shall cover and fence all open trenches, manholes, inlets, etc. during non-construction work hours to protect the public.

### **MISCELLANEOUS**

The Contractor shall obtain street Occupancy Permit from the City and County of Denver Right-of-Way Construction Engineering Unit (Michael Holm 303-446-3639) for construction activities on Santa Fe.

The Contractor shall remove and reset all existing signs prior to performing any work that affects those signs. All signs damaged due to the Contractor operations shall be replaced in kind or repaired by the Contractor at no cost to the project. An inventory of all existing signs shall be made with the Engineer prior to beginning work.

Whenever the Contractor removes, obliterates, or covers in any way, pavement markings, they shall be replaced on a daily basis prior to opening affected areas to traffic. All pavement markings shall be in place in accordance with the Contract.

Traffic shall be carried on a paved surface at all times except as otherwise provided or approved by the Engineer.

During non-working hours, the roadways shall be restored to safe pre-construction travel conditions for the free flow of traffic. All maintenance required to restore the roadways to this condition, including pavement patching, grading, and sweeping shall be done prior to opening the areas to traffic or completing work for the day.

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### **TRAFFIC CONTROL PLAN – GENERAL**

Workers shall not access the work areas by crossing roadways unless proper traffic control or other necessary precautions are provided. Suitable transportation to the work site for personnel whose vehicles are parked off site shall be provided by the Contractor.

The Contractor shall not have construction equipment or material in the lanes open to traffic at any time, unless approved by the Engineer.

**Construction equipment used on this project shall meet the same minimum exhaust requirements as those specified by the manufacturer of the equipment.**

**The Contractor and subcontractors shall equip their construction vehicles with flashing amber lights. Equipment to be used at night shall also be equipped with flashing amber lights. Flashing amber lights on vehicles and equipment shall be visible from all directions.**

**The Contractor shall not place tack coat on any surface to be paved where traffic will be forced to travel upon fresh bituminous materials.**

**All flagging stations used at night shall be illuminated with floodlights. Street, highway lights, and “high mast lighting” may be used for flagging station illumination when approved by the Engineer. Floodlights shall be located and directed so as not to interfere with the sight of any motorists and the cost is to be included in the work.**

**Prior to removal and resetting of any sign the Contractor and Engineer shall prepare an inventory. Any signs damaged due to the Contractor’s operations shall be replaced in kind or repaired by the Contractor at no additional cost to the project.**

All costs incidental to the foregoing requirements shall be included in the original contract prices for the project, including any additional traffic control items required for haul routes into or away from the project.