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## 15.0 Structures

### 15.0.1 Structures

The Contractor shall design and construct all of the structures required to make the Project fully functional in accordance with the Contract Requirements.

To advance longer-lasting highways, CDOT encourages using innovative technologies and practices to accomplish the fast construction of efficient and safe highways and bridges. Consideration by the Contractor of state-of-the-art technologies and elevated performance standards that result in improved safety, faster construction, reduced congestion from construction, improved quality, and user satisfaction are encouraged.

- The following are the Replacement Bridges for the Project:
  - K-18-CK MP 97.889 NB I-25 over Ilex Street, Bennett Street and UPRR
  - K-18-CL MP 97.889 SB I-25 over Ilex Street, Bennett Street and UPRR
  - K-18-CI MP 98.225 NB I-25 over Gruma Street and BNSF RR
  - K-18-CJ MP 98.226 SB I-25 over Gruma Street and BNSF RR
  
- The following are the Rehabilitation Bridges for the Project:
  - L-18-M MP 95.901 I-25 NB over Indiana Avenue
  - L-18-W MP 95.902 I-25 SB over Indiana Avenue
  - L-18-AQ MP 96.809 Northern Avenue over I-25
  - L-18-AU MP 96.947 Mesa Avenue over I-25
  - K-18-AX MP 97.691 I-25 NB over US 50C Business
  - K-18-R MP 1.136 US 50C EB Business over Arkansas

The Contractor shall obtain new Structure numbers from CDOT during the final design process.

## 15.1 Administrative Requirements

### 15.1.1 Standards

The standards used for design and construction of the structures, including rehabilitation of bridges and walls, for this project shall be as specifically referenced in this section. The versions of the referenced software, standards, data, and reports which are current at the time of the Proposal Due Date, including all interim revisions and updates, shall be used unless specified otherwise in Section 15.

Standards referenced by this section include:

- AASHTO LRFD Bridge Design Specifications, 6<sup>th</sup> Edition, 2012
- The CDOT Bridge Design Manual
- The Manual for Bridge Evaluation, 2010 2<sup>nd</sup> Edition, with 2011 Interims
- Horizontally curved steel Bridges shall be designed in accordance with the AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges
- AASHTO Standard Specifications for Structural Supports and Highway Signs, Luminaires, and Traffic Signals, 5<sup>th</sup> Edition, 2009, with 2010 and 2011 Interims
- AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2011, 2<sup>nd</sup> Edition
- Seismic design may be done using either the AASHTO Guide Specification for LRFD Seismic Bridge Design Specifications or the AASHTO LRFD Bridge Design

Specifications, but shall be consistent and use one or the other for the design of all components of the bridge

- The 2011 Edition of the Standard Specifications for Road and Bridge Construction as published by the Colorado Department of Transportation and any documents referenced therein
- The 2012 Edition of the M&S Standard Plans as published by the Colorado Department of Transportation and any new and revised Standard Plans referenced therein

### 15.1.2 Software

The software(s) for Structural Capacity Rating for the Bridge Superstructures, the Concrete Box Culverts (CBC), and the Concrete Rigid Frame (CRF) shall be per the Bridge Rating Manual.

The VIRTIS, Bridge Load Rating (AASHTOWARE) software shall be used to load rate Structures for this Project

If a Bridge type is selected that cannot be rated using the above software packages, the Contractor shall submit to CDOT the proposed rating software for Approval with associated structural submittals.

### 15.1.3 Structural Capacity Rating Submittal and Review

The Structural Capacity Rating for the Bridge Superstructures, the Concrete Box Culverts, and the Concrete Rigid Frames for this project shall be in accordance with the Bridge Rating Manual. Preliminary ratings shall be submitted with the In-Process Design Packages for review. The final structural capacity rating packages shall be submitted with the Final Plans and Specification Packages for review and Approval by CDOT. If significant field changes are made, the rating package shall be revised to reflect those changes and resubmitted.

## 15.2 Design Requirements

### 15.2.1 Structure Concept Plan

The Contractor shall submit a Structure Concept Plan (SCP) for each bridge that is replaced as part of the Project. The Contractor shall also submit a Rehabilitation/Widening Structure Concept Plan (RWSCP) for each bridge that is rehabilitated and/or widened as part of the Project. The SCP's and RWSCP's shall be submitted for Approval by CDOT prior to the submittal of the Preliminary Design Package for each bridge. Proceeding with any structure design, prior to Approval will be at the Contractor's risk. CDOT reserves ten (10) Working Days review time for each of the SCP's and the RWSCP's.

The SCPs shall include the following:

1. Bridge, CBC, CRF - Two page description of bridge type, superstructure type, and foundation, with one of the two pages a layout sheet showing Plan, Typical Section and Section.
2. Wall- Two page description of wall (if any) type and foundation with one of the two pages a layout sheet showing Location, Plan and Typical Wall Section.

The RWSCPs shall include the following:

1. Bridge, CRF - Minimum two page description of rehabilitation/widening concepts including any ~~new~~ girders or superstructure widening required and description of these girders, any ~~new~~ substructure widening required and description of the substructure

- widening and ~~new~~ foundation elements required and a description of these. Description of how the new foundation elements will make the structure stable for the 500 yr scour event. Description of all the repairs to be done, repair materials and methods. Minimum two layout sheets showing Plan, Typical Section and Section and any details necessary to fully show the rehabilitation/widening concepts.
2. CBC – Two page descriptions of any new CBC lengthening or additional CBC cells needed. Description of how the new portions are compatible and behave structurally and hydraulically with the existing to-remain portions of the widened/rehabilitated structure. Description of all the repairs to be done, repair materials and methods. Minimum two layout sheets showing Plan, Typical Section and Section and any details necessary to fully show the rehabilitation/widening concepts.
  3. Wall - Two page description of wall (if any) type and foundation with one of the two layout sheets showing Location, Plan and Typical Wall Section.

Additionally if the structure is creative or innovative or typically not used by CDOT the SCPs and RWSCPs shall include a description of the design, construction, and/or choice of structural type or rehabilitation concept that will benefit and/or enhance project schedule, hydraulic performance, traffic impacts, and quality of the Project.

1. Bridge, CBC, CRF - One page description of type, materials, strategy for lateral loads, and design life considerations for each proposed new major structure, superstructure, substructure and/or foundation.
  - A. A list of the transportation authorities that have used the proposed bridge, superstructure, substructure and/or foundation type and/or rehabilitation/widening concept. Include actual projects and references as examples of successful construction.
2. Wall - Description of each wall type that is creative or innovative or not typically used by CDOT (one page)
  - A. A description of the methods of accommodating settlement and differential settlement.
  - B. A description of the type of foundation for each type of wall (if any).
  - C. The location of walls and identification of wall type (if any).
  - ~~C-D.~~ A list of the transportation authorities that have used the proposed wall type. Include actual projects and references as examples of successful construction.
3. Description of conceptual solutions for complex structural problems identified by the Contractor.

### 15.2.2 General Design Parameters (Including Rehabilitated Structures)

Design Parameters shall be in accordance with the following:

1. Requirements contained in this section and referenced Standards
2. Project aesthetic guidelines in Book 3 – Contract Drawings (Project aesthetic guidelines)

All design calculations and plans shall be performed in English (Standard) units. For bridges, stain (or paint for steel structures) shall be applied to surfaces for each particular structure in accordance with the Project aesthetic guidelines and the requirements in this Section 15. All other visible, exposed, and accessible concrete surfaces shall have a surface treatment of concrete stain. This shall include all retaining walls, noise walls, and slope paving. The paint/stain color shall be submitted for Acceptance with the associated structural submittals.

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### **15.2.3 Temporary Works**

Bridge superstructure types that would require temporary falsework or shoring for construction are allowed and shall meet all required vertical and horizontal clearances for both temporary conditions (construction) and final conditions. All falsework shall be designed in accordance with the AASHTO Guide Design Specifications for Bridge Temporary Works. All grade separated crossing of railroad facilities shall be designed and constructed in accordance with the current BNSF Railway – Union Pacific Railroad Guidelines for Railroad Grade Separation Projects and the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

### **15.2.4 Geotechnical Data**

See Section 10 – Geotechnical and Roadway Pavements for Geotechnical requirements.

Geotechnical testing has been completed by the CDOT Materials and Geotechnical Branch for the replacement bridges K-18-CK and K-18-CL (I-25 over Ilex Street, Bennett Street and UPRR) and K-18-CI and K-18-CJ (I-25 over Gruma Street and BNSF RR) and the rehabilitation bridges L-18-M, L-18-W (I-25 over Indiana Avenue) and K-18-AX (I-25 NB over US 50C Business). Final Foundation Reports for these structures are included in Book 5 - Reference Documents. The Contractor shall determine the additional geotechnical information required for the replacement bridges, rehabilitation bridges, AREs, retaining walls, bridges, noise walls, and other structures and conduct supplemental investigations as necessary per the standards to complete the final design. When planning and conducting additional investigations, the Contractor shall refer to the referenced geotechnical documents completed for this Project. Additional boring logs and laboratory test results shall be presented in similar format as those referenced geotechnical documents.

If groundwater observation wells are necessary to monitor water level or water quality, it shall be the Contractor's responsibility to properly abandon, permit, or renew the permits of these wells in accordance with State Engineer's Office requirements.

### **15.2.5 Structure Aesthetics**

The Contractor shall adhere to the Project aesthetic guidelines and all other Contract Documents related to aesthetics. Any revisions to the Project aesthetic guidelines shall be submitted to CDOT for Acceptance prior to any associated structural submittals. Treatment concepts and details for all structures (bridges, retaining walls, noise walls, etc.) shall meet the requirements of this Section 15, shall be consistent with and complement the existing corridor aesthetic treatments, and shall provide (as a minimum) the baseline aesthetic treatments, approach, and commitments included in the I-25 New Pueblo Freeway FEIS, ROD, and the Project aesthetic guidelines.

For bridges, stain (or paint for steel structures) shall be applied to surfaces for each particular structure in accordance with the Project aesthetic guidelines and the requirements in this Section 15. All other visible, exposed, and accessible concrete surfaces shall have a surface treatment of concrete stain. This shall include all retaining walls, noise walls, and slope paving. The paint/stain color shall be submitted for Acceptance with the associated structural submittals.

## **15.3 Materials**

**15.3.1 Concrete**

Concrete shall be in accordance with the referenced Standards.  
The use of lightweight concrete will not be allowed.

Minimum design concrete strengths shall meet the requirements of Section 601 of the Standard Specifications.

Maximum design concrete strengths used for design shall be:

Cast-in-place:  $f'c = 6.0$  ksi

Precast:  $f'c = 10.0$  ksi

Concrete Class D (Special), shrinkage compensating concrete, shall be used on one of the Structures over Indiana (see Section 20 - Project Special Provisions).

**15.3.2 Prestressing Steel**

Prestressing Steel shall be in accordance with the referenced Standards.

The minimum center-to-center strand spacing shall be 1 ¾ inches for 0.5 inch diameter strand and 2 inches for 0.6 inch diameter strand.

**15.3.3 Post-Tensioning Steel Systems**

Post Tensioning Steel Systems shall be in accordance with the referenced Standards.

The Contractor shall provide corrosion protection for the strands consisting of grout filled galvanized or non-metallic ducts. Grout shall meet the requirements of Section 618 of the Standard Specifications. Installers of pre-stressing, post-tensioning systems shall be Post-Tensioning Institute (PTI) certified.

The diameter for strands shall be 0.6 inches or 0.5 inches.

**15.3.4 Reinforcing Steel**

Reinforcing Steel shall be in accordance with the referenced Standards.

The use of epoxy coated reinforcing steel for all bridges, walls, tunnels, noise walls, and box culverts shall be as defined in Table 1, Subsection No. 8.1 of the CDOT Bridge Design Manual and as defined in CDOT Bridge Technical Memorandums. The design category for anticipated level of de-icing salt application shall be "High". Abutments and pier columns exposed to splash from the adjacent Roadway shall use epoxy coated reinforcing steel. Splash zone is defined as anything within 10 feet horizontally of the outside edge of roadway shoulder. All reinforcing shall consist of deformed bars only per ASTM A 615 and conform to the requirements of the Standard Specifications.

**15.3.5 Structural Steel**

Structural Steel shall be in accordance with the referenced Standards.

Structural steel shall conform to AASHTO M 270, Grades 36, 50, or 70. Structural steel supplied for main load-carrying members or components in tension, which are non-redundant, shall be designated as fracture-critical, meeting the Charpy V-notch tests for Zone 2 in AASHTO M

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222/M 222M and AASHTO M 223/M 223M. All structural steel shall be painted per Section 509 of the Standard Specifications and the Project aesthetic guidelines.

## 15.4 Bridges

### 15.4.1 Geometry

Bridge Geometry shall be in accordance with the referenced Standards (including the Project aesthetic guidelines) and the requirements contained in this section.

See Section 13 – Roadway and Section 12 – Drainage for additional structure requirements.

### 15.4.2 Type

Structure Type shall be in accordance with the referenced Standards and the requirements contained in this section.

#### Replacement Bridges and Retaining Walls

Bridge and retaining wall types will not be restricted to those historically used by CDOT. Other types will be allowed, but only if they have been accepted for general use by other state or federal transportation authorities. The Contractor must also demonstrate that the design of the Bridge and retaining wall types and components will meet the Project criteria and perform well under the Project's environmental conditions, including frequent freeze-thaw cycles, anti-icing and de-icing. Experimental Bridge and retaining wall types, timber Bridges, masonry Bridges and all types of truss bridges and structural-plate arches will not be allowed. Bridges shall incorporate as few joints and bearings as possible, be continuous over supports, not use intermediate hinges or expansion devices, and use integral or semi-integral abutments wherever possible. Bridge types selected shall allow for and facilitate future Bridge widening. The Contractor shall submit, for Approval, all proposed Bridge and retaining wall types historically not used by CDOT in the Structural Concept Plans. CDOT reserves the right to reject the use of non-historic bridge types proposed by the Contractor, if they cannot meet the Project design and performance criteria in this section.

The following structural requirements are to be met when new and innovative concepts or accelerated bridge construction (ABC) techniques are employed:

1. A corrosion engineering consulting firm as approved by CDOT with expertise in the prevention of corrosion for civil engineering structures shall be retained by the Contractor to review the integrity of the proposed connection details for a 75 year design life. The Contractor shall submit the results of this evaluation to the CDOT for CDOT's use in determining the acceptability of the proposed connection details.
2. Weld plates can only be used as temporary supports during erection and shall not be placed in a pre-stressed load path or prevent elements from seating properly.
3. Match casting shall be used to eliminate joint shifting in post-tensioned connections. Additionally, post-tensioning strands and bars shall be long enough to provide a meaningful amount of force after anchor set and long term losses have occurred.

Final typical sections of roadways under Replacement Bridges shall be as shown in Table 15-1 below:

**TABLE 15-1**

LOCATION	D Street	Alan Hamel/RR	Gruma Street
Number of Lanes	See Concept Plan	2	2
Width of Travel Lanes (Ft.)	See Concept Plan	12	12
Width of Turn Lanes (Ft.)	See Concept Plan	10	-
Bike Lanes Width (Ft.)	See Concept Plan	5	-
Parking Lanes Width (Ft.)	See Concept Plan	8	-
Median Width (Ft.)	See Concept Plan	-	-
Maintenance Shoulder Widths (Ft.)	-	-	10
River Channel Width (Ft.)	-	-	30
Sidewalk Widths (Ft.)	-	10	15
Railroad Width (Ft.)	-	As determined by Railroad	-

Typical section drawings for Alan Hamel/RR and Gruma Street are included in Book 5 – Reference Documents.

Rehabilitation Bridges

Existing Structures L-18-M, L-18-W, L-18-AQ, L-18-AU, K-18-AX and K-18-R shall be rehabilitated and/or widened per the requirements of this section. See Book 5 - Reference Documents for existing bridge plans, inspection reports, ultimate lane configurations and the Condition Assessment and Rehabilitation Recommendations.

Final typical sections of all Rehabilitation Bridges shall be as shown in Table 15-2 below:

**TABLE 15-2**

STRUCTURE NO.	L-18-M	L-18-W	L-18-AQ	L-18-AU	K-18-AX	K-18-R
LOCATION	I-25 NB over Indiana Ave	I-25 SB over Indiana Ave	Northern Ave over I-25	Mesa Ave over I-25	I-25 NB over US 50C	US 50C EB over Arkansas
Number of Lanes	2	2	4	2	2	2
Width of Lanes (Ft.)	12	12	11 inside 10 outside	10	12	12
Outside Shoulder Width (Ft.)	10	10	2	5	8	2
Inside Shoulder Width (Ft.)	8	8	-	-	8	2
Sidewalk Width (Ft.)	-	-	7 ft North side	9 ft both sides	-	7 ft West side

The structures, as rehabilitated and/or widened, shall be rated per CDOT Bridge Rating Manual requirements, as if the rehabilitated and widened bridge were a new bridge. The Contractor is responsible for all analysis and all work necessary to meet the bridge rating requirements (including but not limited to work to existing foundation elements, piers, abutments, etc.).

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Structures L-18-M and L-18-W: I-25 NB and SB over Indiana Avenue

The Contractor shall perform the following rehabilitation work similar to the referenced Condition Assessment and Rehabilitation Recommendations Report, Level C:

1. Superstructure
  - A. Close the median and connect to the adjacent bridge (L-18-W) to clear deck geometry issues and provide adequate space during the rehabilitation of the bridge
  - B. Remove and replace the concrete decks
    - i. The 1<sup>st</sup> deck replaced shall be Concrete Class D (Special) with expansive Class K cement (see Section 20 - Project Special Provisions)
    - ii. The 2<sup>nd</sup> deck replaced shall be Concrete Class H
    - iii. The structure will be bare deck – no waterproofing membrane or asphalt
  - C. Add shear connectors to provide composite action between the girders and the concrete deck **for all girders**
  - D. Install new bridge curb, bridge railing and guardrail
  - E. Make both abutments integral
  - F. Construct new approach slabs with an expansion joint at the north
  - G. Sandblast, wash, and topcoat paint on all girders and diaphragms
2. Substructure
  - A. Piers 2 & 3:
    - i. Remove all loose and delaminated concrete from the cap and columns
    - ii. Treat the pier caps and columns with corrosion inhibitor and concrete sealer
    - iii. Replace broken or damaged reinforcement
    - iv. Patch – for areas with less than 2-ft of exposed corner rebars
    - v. Refer to patch & wrap details in the Substructure Repair Details sheet for areas with more than 2-ft of exposed corner rebars
    - vi. Refer to encapsulate detail in the Substructure Repair Details sheet for areas with more than 2-ft of exposed corner rebars and severe delaminated concrete
  - B. Abutments 1 and 4:
    - i. Remove all the delaminated concrete
    - ii. Treat the abutment cap with corrosion inhibitor
    - iii. Patch
      1. Refer to the patch details in the Substructure Repair Details sheet
    - iv. Treat all exposed concrete with concrete sealer

The Contractor shall also perform the following additional rehabilitation work:

1. Stain/paint all concrete (including slope and ditch paving) and girders with colors consistent with the Project aesthetic guidelines
2. Transition and stripe to tie back to the existing I-25 alignment
3. Replace all damaged concrete on sidewalks, curbs, and/or slope and ditch paving under the structure
4. Electric, Fiber, and Phone Utilities shall not be attached to the new bridge deck but shall be incorporated via curb conduits unless Approved by CDOT
5. Permanent water quality as per the Contract Documents

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Structure L-18-AQ: Northern Avenue over I-25

The Contractor shall perform the following rehabilitation work similar to the referenced Condition Assessment and Rehabilitation Recommendations Report, Level C:

1. Superstructure
  - A. Remove and replace the concrete deck
  - B. Add shear connectors to provide composite action between the girders and the concrete deck for all girders, waterproof membrane and HMA
  - C. 8-in drain pipes with box uphill from Abutments 1 and 6 and Piers 2 and 4
  - D. Install new bridge curb, bridge railing and guardrail. The railing on the north side shall be installed on the outer edge of the raised sidewalk.
    - i. The overhang on the exterior girders is greater than what is currently allowed by CDOT Staff Bridge for new bridges.
    - ii. Innovative design and construction methods may be required to meet the desired typical section (ie. deck pour phasing, bolted angles, etc.)
  - E. Construct new approach slabs at Abutment 6 to move leakage away from abutment
  - F. Wash and topcoat paint on all girders and diaphragms
  - G. Pier 2 made integral in order to eliminate the fatigue prone connection angles between the girder ends
2. Substructure
  - A. Piers 2, 3, 4 & 5:
    - i. Remove all loose and delaminated concrete from the cap and columns
    - ii. Treat the pier caps and columns with corrosion inhibitor
    - iii. Replace broken or damaged reinforcement
    - iv. Piers 3 and 5 shall be patched and/or wrapped depending on the level of damage
    - v. Refer to patch and patch & wrap details in the Substructure Repair Details sheet
    - vi. Piers 2 and 4 shall be encapsulated. Refer to encapsulate detail in the Substructure Repair Details sheet
    - vii. Treat all exposed concrete with concrete sealer
  - B. Abutments 1 and 6:
    - i. Remove all the delaminated concrete.
    - ii. Treat the abutment cap and columns with corrosion inhibitor and wrap the repaired portion with FRP at Abutment 6
    - iii. Treat all exposed concrete with concrete sealer

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The Contractor shall also perform the following additional rehabilitation work:

1. Rehab the structure to accommodate the typical section in Table 15-1
  - A. Sidewalk shall be reconstructed and width shall continue from Elm to Taylor
    - i. Access to Rio Grande shall be closed with curb, gutter, and sidewalk.
  - B. The retaining walls on the east side of bridge shall be tested and analyzed to determine stability. If the analysis determines that the walls have deficiencies that will not meet a 30 year life, the walls shall be modified to eliminate the deficiencies and provide for 30 year life. The Contractor's Engineer shall submit a signed and stamped report describing the testing and analysis and proposed modifications to CDOT for Acceptance prior to Released for Construction Documents.
2. Stain/paint all concrete and girders with colors consistent with the Project aesthetic guidelines
3. Transition, pave and stripe to tie back to the existing Northern Avenue and sidewalk alignments
4. Pedestrian railing as per the Project aesthetic guidelines and referenced standards
5. Railroad fencing as per the Project aesthetic guidelines
6. Patch, patch and wrap, or encapsulate retaining wall concrete depending on severity of exposure to obtain a consistent surface then stain abutment retaining walls with colors consistent with the Project aesthetic guidelines
7. Lighting shall be installed per City of Pueblo lighting standards
8. Electric, Fiber, and Phone Utilities shall not be attached to the new bridge deck but shall be incorporated via curb conduits unless Approved by CDOT
9. Permanent water quality as per the Contract Documents

Structure L-18-AU: Mesa Avenue over I-25

The Contractor shall perform the following rehabilitation work similar to the referenced Condition Assessment and Rehabilitation Recommendations Report, Level C:

1. Superstructure
  - A. Remove and replace the concrete deck
  - B. Add shear connectors to provide composite action between the girders and the concrete deck for all girders, waterproof membrane and HMA
  - C. 8-in drain pipes with box uphill from joints at Abutments 1 and 6 and Pier 2
  - D. Install new bridge curb, bridge railing and guardrail on the outer edge of the raised sidewalks.
  - E. Construct new approach slabs at Abutment 6 to move leakage away from abutment
  - F. Eliminate joint at Pier 2, add bearing pad at Abutment 1. Pier 2 should have continuity considerations along with the joint removal.
  - G. Wash and topcoat paint on all girders and diaphragms
2. Substructure
  - A. Pier 2:
    - i. Remove all loose and delaminated concrete from the cap and columns
    - ii. Replace reinforcing with significant section loss
    - iii. Treat the pier caps and columns with corrosion inhibitor and concrete sealer
    - iv. Add a reinforcing cage with stainless steel welded wire fabric and encapsulate with 4- in of DT concrete
    - v. Refer to encapsulate detail in the Substructure Repair Details sheet
  - B. Piers 3, 4 & 5:
    - i. Treat the pier columns with corrosion inhibitor and concrete sealer
  - C. Abutments 1 and 6:
    - i. Remove all the delaminated concrete
    - ii. Treat the abutment cap and columns with corrosion inhibitor and wrap the repaired portion with FRP at Abutment 6
    - iii. Treat all exposed concrete with concrete sealer

The Contractor shall also perform the following additional rehabilitation work:

1. Accommodate the typical section in Table 15-1
  - A. Sidewalk shall be reconstructed and constant width shall continue from Elm to Taylor eliminating the stairs and providing ADA compliance
  - B. The Contractor shall protect the mural on the SE retaining wall from damage during all construction activity. If the mural is damaged the Contractor shall be responsible to repaint to match the existing mural.
2. Stain/paint all concrete and girders with colors consistent with the Project aesthetic guidelines
3. Transition, pave and stripe to tie back to the existing Mesa Avenue alignment
4. Pedestrian railing as per the Project aesthetic guidelines and referenced standards
5. Railroad fencing as per the Project aesthetic guidelines
6. Lighting shall be installed per City of Pueblo lighting standards
7. Electric, Fiber, and Phone Utilities shall not be attached to the new bridge deck but shall be incorporated via curb conduits unless Approved by CDOT.
8. Permanent water quality as per the Contract Documents



Structure K-18-AX: I-25 NB over US 50C Business

The Contractor shall perform the following rehabilitation work similar to the referenced Condition Assessment and Rehabilitation Recommendations Report, Level C:

1. Superstructure
  - A. Close the median and connect to the adjacent bridge (K-18-AY) to clear deck geometry issues and provide adequate space during the rehabilitation of the bridge
  - B. Remove and replace the concrete deck
  - C. Add shear connectors to provide composite action between the girders and the concrete deck for all girders, waterproof membrane and HMA
  - D. Install new bridge curb, bridge railing and guardrail
  - E. Construct new approach slabs with expansion joints at the ends
  - F. Sandblast, wash, and topcoat paint on all girders and diaphragms
  - G. Add bottom flange intermediate struts due to large unbraced length
2. Substructure
  - A. Piers 2, 3, & 4:
    - i. Remove all loose and delaminated concrete from the cap and columns.
    - ii. Treat the pier caps and columns with corrosion inhibitor
    - iii. Replace broken or damaged reinforcement
    - iv. Patch – for areas with less than 2-ft of exposed corner rebars
    - v. Refer to patch & wrap details in the Substructure Repair Details sheet for areas with more than 2-ft of exposed corner rebars
    - vi. Refer to encapsulate detail in the Substructure Repair Details sheet for areas with more than 2-ft of exposed corner rebars and severe delaminated concrete
    - vii. Treat all exposed concrete with concrete sealer
  - B. Abutments 1 and 5:
    - i. Remove all delaminated concrete, treat the abutments with corrosion inhibitor, and patch the damaged areas
    - ii. Treat all exposed concrete with concrete sealer
    - iii. Refer to the patch details in the Substructure Repair Details sheet

The Contractor shall also perform the following additional rehabilitation work:

1. Stain/paint all concrete and girders (K-18-AX and K-18-AY) with colors consistent with the Project aesthetic guidelines
2. Transition, pave and stripe to tie back to the I-25 alignment
3. Permanent water quality as per the Contract Documents
4. Interstate lighting shall be consistent with lighting on the Replacement Bridges
5. Electric, Fiber, and Phone Utilities shall not be attached to the new bridge deck but shall be incorporated via curb conduits unless Approved by CDOT
6. Permanent water quality as per the Contract Documents

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Structure K-18-R: US 50C EB Business over Arkansas

The Contractor shall perform the following rehabilitation work similar to the referenced Condition Assessment and Rehabilitation Recommendations Report, Level A:

1. Superstructure
  - A. Deck
    - i. Maintain current traffic configuration and provide new bridge rails and curbs
    - ii. Replace deck with increased crown
    - iii. Provide waterproof membrane and add 3-in of asphalt
    - iv. Construct approach slab to tie to the deck and move expansion joints to end of approach slabs
    - v. Provide expansion joints at the end of the approach slabs
    - vi. Add 8-in drain pipe extending beyond the lower bracing members
  - B. Railing
    - i. Replace traffic rail with a Modified 54" Type 10 bridge rail to protect the truss members
      1. The modified rail will require an additional horizontal element to achieve the desired height
      2. The modified rail shall be designed for impact (per AASHTO LRFD 6<sup>th</sup> Edition, Section 13)
      3. The modified rail does not require crash testing provided that the rail meets the post and tube configuration of a Type 10M Bridge Rail
      4. Splash protection shall be installed between the curb and horizontal elements and between horizontal elements
    - ii. Wash and treat the existing pedestrian rail with chloride remover
    - iii. Replace the missing top pipe joint straps
    - iv. Use encapsulating paint system to coat the existing pedestrian rail
    - v. Replace damaged or broken pipe railing at the approaches
    - vi. Add a concrete glare screen to the top of the existing bridge rail to serve as a splash guard on the east side of the adjacent bridge
  - C. Sidewalk
    - i. Remove and replace sidewalk across structure with curbs to meet ADA requirements
  - D. Stringers
    - i. Discard stringers classified as condition 4 or 5 which will involve resetting some of the stringers that are in better condition
    - ii. Stringer lines B, D, E, and G should remain present but do not support new deck
    - iii. Wash and treat remaining stringers with chloride remover
  - E. Floor beams
    - i. Add shear connectors
    - ii. Wash and treat corroded members with chloride remover
    - iii. Install doublers or replace on plates classified as condition state 5 in the inspection report
    - iv. Replace any broken or heavily corroded rivets with high-strength bolts
    - v. Spot paint using an encapsulating paint system in areas classified as condition state 4 or 5 in the inspection report
  - F. Lower chord and truss members below the deck
    - i. Wash and treat corroded members with chloride remover

- ii. Install or replace doublers on plates classified as condition state 5 in the inspection report
- iii. Replace any broken or heavily corroded rivets with high-strength bolts
- iv. Spot paint areas with condition states 3, 4, and 5 using an encapsulating paint system
- G. Bottom lateral brace system
  - i. Wash and treat corroded members with chloride remover
  - ii. Install doubler over holes in lateral brace system gussets at L2, L4, L6, L10, and L14
  - iii. Replace any broken or heavily corroded rivets with high-strength bolts
  - iv. Spot paint the braces and gusset plates in areas with R2 or greater corrosion level using an encapsulating paint system
- H. Upper chords, truss and bracing members above the deck
  - i. Wash the members up to 5-ft above the deck level
  - ii. Bolt angles to L0M1, M1U2, U2U4, U12U14, M15U14 and M15L16 on the right truss to strengthen the members for the HL93 load
  - iii. Bolt angles to L0M1 and M15L16 on the left truss to strengthen the members for the HL93 load
  - iv. Treat with chloride remover
  - v. Replace any broken or heavily corroded rivets with high-strength bolts
  - vi. Straighten diagonal U4L6 and add doubler plate. Replace affected rivets with high-strength bolts
  - vii. Spot paint as needed using an encapsulating paint system in areas classified as condition state 4
- I. Bearings
  - i. Clear all the debris and treat with chloride remover
  - ii. Replace the broken/loose roller bolts. Temporary jacking of the bridge may be needed
  - iii. Use an encapsulating paint system to coat the bearings
  - iv. Install zerks and lubricate pins at both the expansion and fixed bearings
- 2. Substructure
  - A. Clean and treat with corrosion inhibitor and concrete sealer to the abutment surfaces

The Contractor shall also perform the following additional rehabilitation work:

1. Modification to the knee brace at the portals - either move the knee brace upwards or make it "breakaway"
2. Transition, pave and stripe to tie back to the existing Santa Fe Avenue alignment
3. Paint entire structure
4. Install additional sidewalk, curb and gutter along Santa Fe to tie to existing sidewalk at the intersection of Santa Fe Ave and Santa Fe Drive and the existing sidewalk under the I-25 bridge over US 50C – per CDOT Access regulations and ADA (if the Proposal included the Overlay ARE, the Contractor may include pricing in Overlay ARE. If the Overlay ARE is not included in the Proposal, the pricing shall be included in the BE GMP for this structure.)
5. Remove and replace transitions, guardrail and end anchorages to current CDOT standards
6. Electric, Fiber, and Phone Utilities shall not be attached to the new bridge deck but shall be incorporated via curb conduits unless Approved by CDOT
7. Permanent water quality as per the Contract Documents

8. Identify all fracture critical members on a plan and elevation sheet

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### **15.4.3 Inspection Access**

Inspection Access shall be in accordance with the referenced Standards.

All new Bridge superstructures, joints, and steel reinforced elastomeric bearing pads with sliding surfaces and high load multi-rotational (HLMR) bearings shall be made accessible for long-term inspections and maintenance and shall be designed and detailed for ease of replacement. Jack locations and required jack sizes shall be shown on the Released for Construction Documents. The Bridge shall be designed to withstand anticipated applied loads and forces with the superstructure jacked at the locations shown on the Released for Construction Documents.

Superstructures consisting of I-girders with exposed cross frames shall be made accessible for inspection either with walkways (see CDOT Bridge Design Manual) or by use of an A-40 inspection truck. All concrete or steel box girders with an inside depth of 5 feet or more shall be made accessible for interior inspection. All box or tub girders shall be provided with low-point drainage through the bottom slab.

Access doors/holes shall be placed at locations that do not impact traffic under the bridge, and shall be located to be readily accessible from bridge inspection trucks. All access doors/holes shall be accessible with ladders from the ground and shall not require access by use of a CDOT A-40 inspection truck. Where access doors/holes are provided above slope paving, cleats to support a ladder shall be provided in the slope paving. Location of access doors/holes shall be submitted, no later than 30 Days prior to fabrication, for Approval by CDOT. CDOT Standard Structural Worksheet B-618-2 shows typical bottom-slab access-door details. The doors shall swing into the box girder. Box girders shall be protected from access by vermin and unauthorized persons. The minimum opening for access doors shall be 2 feet by 3 feet and door shall be secured by a single padlock. Access holes through diaphragms shall be 2 feet, 6 inches in diameter, minimum.

### **15.4.4 Structure Components**

Structure Components shall be in accordance with the referenced Standards and the requirements contained in this section.

#### Bridge Rails, Decorative/Pedestrian Railing and Chain Link Fencing

The Contractor shall design and construct bridge rails, decorative/pedestrian railing, and chain link fencing that match the face, color and overall shape of barriers as defined in the Project aesthetic guidelines.

Bridge rails subject to vehicular impact, even if railing is place behind sidewalk, shall be designed to meet TL-4 loading in accordance with AASHTO LRFD Bridge Design Specifications. Current Standard CDOT Bridge rails that meet the above criteria are acceptable and do not have to be designed and crash tested. The Contractor shall use bridge rails on approach slabs. Alternate railing proposed shall be required to meet these requirements and be crash tested.

The Contractor shall design and construct decorative/pedestrian railing in accordance with AASHTO LRFD Bridge Design Specifications. All chain link fencing mounted on bridge structures and retaining walls shall be black vinyl-coated. Decorative/pedestrian railing and chain link fencing attached to Bridge rails shall be installed behind the bridge rail face, or back side of the bridge rail. All Decorative/pedestrian railing and chain link fencing mounted on bridge structures shall meet fencing and screening requirements in the AASHTO LRFD Bridge Design

Specifications. Cover plates shall be used over the face of joints on the interior and exterior concrete bridge rails, and on curbs and sidewalks to provide structural and safety shape continuity across the joint.

#### Approach Slabs

The Contractor shall provide an approach slab at each end of each Bridge. The approach slabs for Replacement Bridges shall be a minimum of 20 feet in length measured along the centerline of the Bridge, except when other physical features of the Project preclude this minimum length. Approach slabs shall be separate from, and fit between, cantilevered wingwalls or retaining wall wingwalls so that the approach slab can freely rotate about the abutment. Bridge rails shall be connected to approach slabs. The Bridge rails shall be designed to function as a barrier to keep water out of the joint between wingwall/retaining wall and the edge of approach slab. The approach slab for Highway Bridges shall be at least the same width as the Bridge deck plus additional width to allow for placement of the bridge rail on the approach slab, and provide for expansion and contraction at the approach pavement interface where required. Approach slabs shall be anchored to the abutment. The Contractor shall design and construct an underdrain system beneath all approach slabs to remove water at Bridge abutments. Backfill behind the abutments shall be as shown in the CDOT Bridge Structural Worksheets Backfill Drawings B-206-F1 or B-206-M1. Bridge approach slab drains shall be located so as to minimize the amount of water flowing across all joints.

Differential settlement across approach slabs shall be ~~designed such that they will not produce a grade break that is more than~~ less than 1/2-inch within one (1) year of Final Acceptance. The Contractor shall implement ground improvement techniques to the approach embankment subgrade if necessary to meet this requirement.

#### **15.4.5 Decks**

The Contractor shall provide a minimum concrete deck thickness of 8 inches.

Open or filled grating decks and orthotropic decks will not be permitted. Concrete decks designed to the simplified "Ontario", or any empirical methods, will not be permitted.

Full depth precast deck slabs shall require cast-in-place joint closures, post tensioning across joints and an overlay. Pre-tensioned, pre-cast concrete deck forms shall be a minimum of 3 inches thick and have a full grout or concrete bearing. Full grout is defined as a 1 inch minimum thickness by 2 inch wide grout pad.

Stay-in-place metal deck forms are permitted. If stay-in-place metal forms are used, the superstructure, substructure, and foundation shall be designed for an extra 5 pounds per square foot (psf) minimum dead load applied to the superstructure.

Permanent deck forms will not be allowed for cast-in-place post-tensioned box girders, T-girder deck slabs, or cantilevered portions of decks

Styrofoam blocks used to support precast deck panels shall be limited to five inches in height.

Parallel Bridges shall either have a minimum 2-inch (4-inch preferred) longitudinal gap between decks or parapets or shall be tied together to make one Bridge.

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Cast-in-place concrete placed on top of a pre-cast double tee or pre-cast box girders shall be considered composite with the pre-cast top flange if the minimum total laminated deck thickness is 8 inches, the minimum cast-in-place thickness is 5 inches and the top surface of the pre-cast top flange is roughened. Pre-cast double tees or pre-cast box girders without a cast-in-place deck placed on top will not be allowed.

If any part of a deck resists tension, the stress in the deck in this area shall not exceed 0.0948 times the square root of  $f'c$ , ( $0.0948 \times (f'c)^{1/2}$ ) where  $f'c$  is in ksi. Minimum longitudinal steel in the top mat of cast-in-place decks shall be #4's at 6-inch spacing spliced to the negative-moment steel reinforcing over piers.

#### **15.4.6 Deck Joints**

The Contactor shall avoid or minimize joints wherever possible.

Bridges in length up to 640 feet (steel) or 790 feet (precast or cast-in-place concrete) shall be jointless, wherever possible, according to guidelines given in CDOT Bridge Design Manual.

A minimum 0 to 4-inch joint shall be placed at the end of approach slabs unless Approved otherwise by CDOT.

Use of only strip seals for joints as reflected in CDOT Bridge Structural Worksheet - Bridge Expansion Device (0-4 inch) B-518-1 with expected maximum 4-inch movement or modular joints for expected movements of 4-inches or greater shall be used.

Design and location of joints shall provide for maintenance accessibility and future replacement. Aluminum joints will not be permitted. Modular joints shall be designed by LRFD and shall include LRFD fatigue requirements. Modular joints shall be tested for fatigue loading according to National Cooperative Highway Research Program (NCHRP) Report 402, Fatigue Design of Modular Bridge Expansion Joints (1997) Appendix A & Appendix B. Expansion devices shall be set to provide a smooth surface between the final grade into the device and the final grade out from the device. A smooth surface is defined as a maximum grade break, at 30 feet either side of the device, of ~~0-30.10~~ percent.

To facilitate the proper placement of expansion devices, the tabular Bridge geometry shall include a bent line for the expansion devices on a Bridge or approach slab.

Asphaltic expansion devices and asphaltic plug joints shall not be used for any new construction.

#### **15.4.7 Overlays**

Structures L-28-M and L-28-W over Indiana Avenue shall be concrete bare deck. The Contractor shall provide an initial overlay system for all other Bridge decks. Bridge overlays shall be 3-inch HMA over a waterproofing membrane. The asphalt overlay with a waterproofing membrane shall be used on both the Bridge deck and associated approach slab. Thin-bonded overlays, such as epoxy or polyester, shall not be used, except for the repair of cracked concrete bare decks. Latex-modified overlays shall not be used.

See Section 10 – Geotechnical and Roadway Pavements for type of HMA and for mill and fill transition area requirements.

#### 15.4.8 Superstructures

The Contractor shall ensure that all superstructures meet the requirements for redundancy, fatigue, crack control, and deflection in AASHTO LRFD Bridge Design Specifications.

New girders needed for widening existing bridges shall be of the same type as the existing girders for that structure.

Bridge deck drainage or anti-icing pipes shall not be allowed inside of box girders or embedded within concrete structural members.

For concrete box girder structures, the Contractor shall consider the effects of a temperature gradient.

#### Cast In-Place Girders

The maximum shear reinforcement spacing for cast-in-place mildly reinforced or post-tensioned concrete Bridges shall be 1.5 feet. All reinforcing steel shall have a minimum 2 inch clearance between parallel bars including spirals.

The minimum concrete strength  $f'_c$  shall be 4.5 ksi for any cast-in-place concrete member which forms part of a deck.

All formwork inside cast-in-place concrete box girders shall be completely removed before completion of the bridge.

#### Precast and Post Tensioned Girders

When utilizing continuity for design of precast prestressed girders, the effects of differential shrinkage, differential temperature, and any redistribution of moments due to creep shall be investigated. The transverse steel area in precast box girder flanges shall, at a minimum, be equal to the minimum required shear reinforcing steel for one web.

Precast girders used in segmental construction shall be bonded with epoxy or concrete closure pours. The top surface of precast deck panels shall be roughened perpendicular to the longitudinal axis of the Bridge to ensure composite action between the precast and cast-in-place slab. The minimum amount of non-prestressed longitudinal steel required in the cast-in-place portion of the slab shall be 0.2 square inch per foot width of slab.

The minimum shear strength of steel for prestressed or post-tensioned concrete girders shall be at least  $A_v = 135 \times b'/f_y$ , with  $b'$  the web width in inches, and  $f_y$  the yield strength of the reinforcing in psi. Webs shall have at least double this minimum reinforcement for a distance  $d$  in front of anchorages. Minimum side-face steel shall be 1.5 times the minimum shear steel for areas more than the depth of girder from the supports and shall be spaced at 1 foot maximum. All reinforcing steel shall have a minimum 2 inch clearance between parallel bars including spirals.

Under full dead load, without live load and after all losses, no part of the top or bottom girder fiber which resists moments using pre-stressing shall be in tension. Under full loads, after losses, tension due to live load will not be permitted if well distributed fully bonded reinforcing is not provided in these areas. Negative camber is prohibited in precast concrete members.

#### Steel Girders

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All steel girders shall be designed to be fully composite with the deck along the entire length of the structure. All shear studs on steel girders shall be field welded. The minimum flange thickness (excluding the bottom flange of box girders) shall be 5/8-inch, and the minimum thickness of steel to which shear studs are to be connected shall be at least 0.33 times the stud diameter. The minimum flange width shall be 12 inches. The minimum thickness of the bottom flange of a box girder shall be 3/8-inch. The minimum thickness of any stiffener or web plate of a girder shall be 3/8-inch. The thickness of any web or flange plate shall not change by more than a factor of two at any splice (see CDOT Bridge Detail Manual, Chapter 13.2, for welded plate girder detail guidelines).

Cover plates shall not be used. Longitudinal flange stiffeners shall not be used except for spans exceeding 165 feet between points of zero dead-load moment. Transverse stiffeners shall be normal to the top flange and placed on the non-visible side (inside) of exterior girders. Shop splices of stiffeners, if any, shall be made with full penetration groove welds. These welds shall be completed before the stiffeners are welded to the girder. Stiffeners with diaphragms connected to them shall be welded with fillet welds to the top and bottom flange. The skew angle between bearing stiffeners and web shall not be less than 60 degrees.

All splices shall be normal to the top flange and normal to the longitudinal axis of the girder. Field splices shall preferably be located at or near points of dead load contraflexure. The full penetration welds at girder shop splices shall be made without backing.

Field connections shall not be welded, but shall be made with high strength bolts. All full penetration welds shall be ground flush for testing. Slip critical connections shall be made with 3/4 inch, 7/8 inch, or 1 inch diameter ASTM A325 bolts.

Shear connectors shall penetrate at least three inches above the bottom of the slab. The minimum cover from top of deck to top of stud for bare decks shall be 3 inches and for decks with an overlay and membrane shall be 2 inches.

The use of pins and hangers will not be allowed. The Contractor shall avoid Category D or poorer weld details in tension zones subject to fatigue stress ranges. The design life of the structure for fatigue calculations shall be 75 years.

For structural steel, redundant-member structures are preferred. The location of all Fracture Critical Members (FCMs) shall be clearly delineated on the drawings. The Bridge design notes shall contain the supporting calculations and evaluations as to which members are designated FCMs and why they are so designated. CDOT shall be notified of any new Bridge containing FCMs. The Bridge designer shall provide the half-size copies of the Bridge drawings showing the FCMs and their details. These members and their details shall be highlighted. In addition, the fracture critical form that will be posted in the structure folder shall be obtained from CDOT and filled out with the correct information. This form and the highlighted drawings shall be submitted to CDOT with the rating package for the Bridge.

The Contractor shall follow the Shop Detail Drawing Review/Approval Guidelines developed by the AASHTO/NSBA Steel Bridge Collaboration G1.1-2000 for preparation of steel shop drawings.

#### Utilities

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Refer to Section 15.4.15 for Utilities.

#### 15.4.9 Bearings

The Contractor shall design and locate bearings to allow maintenance accessibility and future replacement. Only one bearing type shall be used across the width of the Bridge at any given substructure location. Elastomeric pads and steel reinforced elastomeric bearing devices shall not be mixed with HLMR bearings at any one particular Bridge. Substructure drawings shall show locations for lifting when removing bearings. Elastomeric pads and steel reinforced elastomeric bearings, with or without sliding surfaces, are the preferred bearing types.

Sliding surfaces shall be polytetrafluoroethylene (PTFE) with a stainless steel mating surface.

Bearings shall be either elastomeric pads (CDOT Type I), steel reinforced elastomeric bearings with or without PTFE and stainless steel sliding surfaces (CDOT Type I or Type II), or HLMR bearings (CDOT Type III). The maximum bearing height for Type I bearings shall be 7 inches. The thickness of Type II bearings shall be designed so that the acceptable shear deflection limits of the pad are not exceeded if slip does not occur.

The design of elastomeric pads and steel reinforced elastomeric bearings shall be such that pad walk-out will not occur by including pad-walkout restraints. Sole plates shall have a 3/4 inch minimum thickness. At expansion bearings, the edge of the sole plate shall not slide past the edge of the elastomeric pad by the use of a positive stop.

The Contractor shall provide at least 3 inches of cover between anchor bolt centerlines and the edge of the concrete pedestal. The Contractor shall provide reinforcement for pedestals greater than 3 inches high. Suppliers of bearings devices shall only be those on CDOT's pre-approved product list.

#### 15.4.10 Piers and Pier Caps

The Contractor shall design a type of pier cap that will be consistent with the Project aesthetic guidelines. Drop caps or integral caps are acceptable. Integral caps are preferred with cast-in-place concrete box section systems. The Contractor shall not use integral steel pier caps unless prior Approval from CDOT. Inspection access for integral steel pier caps shall be provided. Aesthetic treatments on piers for the bridge over Gruma shall extend below existing grade and be considered for ultimate template as necessary to accommodate future construction of the HARP extension under the Interstate. Concrete guardrail shall not be cast monolithically with the pier.

#### 15.4.11 Abutments

Structure backfill at abutments shall be per B-206-F1 or B-206-M1. The Contractor shall provide integral, or semi-integral, end diaphragm-type abutments for Bridges whenever possible. GRS abutments are only allowed for simple span bridges. Retaining wall wingwalls may be used in lieu of cantilevered wingwalls at abutments for all categories of Bridges according to the Project aesthetic guidelines. Cantilevered wingwalls and/or retaining walls shall extend 4 feet beyond the point of intersection of the embankment slope with the roadway finished grade. Bridge monuments shall be supported on separate foundations.

#### 15.4.12 Slope Protection

The Contractor shall provide concrete slope protection for all slopes under Rehab Bridges, on any slopes from shoulder to top of retaining wall, and on slopes between tiered walls. Slope

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protection shall conform to details contained in CDOT Standard Structural Worksheets Slope Paving Details, Drawings No. B-507-1 and B-507-2 and the Project aesthetic guidelines. Slope protection on slopes between tiered walls and any slopes from shoulder to the top of retaining wall shall use similar detail.

#### **15.4.13 Foundations**

The Contractor shall ensure that differential settlement shall not exceed 1/2 inch within a pier or abutment of span (foot)/400 between adjacent piers or abutments. The Contractor shall design for down-drag where required. Spread footings are acceptable if the top of the footing is located below 500 year scour or if the bottom of the footing is located below frost heave, whichever is greater, and if they are an accepted foundation type in the Foundation Design Report. Foundations of integral abutments with skews between the axis of the abutment and the direction of allowed movement shall be designed to resist the unbalanced earth pressures behind the abutments.

The Contractor's Quality Management Plan (QMP) shall include inspection of all drilled caisson operations using non-destructive testing for non-redundant (single shaft) drilled caissons. Cross Sonic Log (CSL) or impact echo are acceptable methods of non-destructive testing for drilled caissons. Additional methods for non-destructive testing that are in accordance with the AASHTO/ASTM/FHWA guidelines may be considered for use on this Project subject to incorporation into the Approved QMP.

Dynamic monitoring of driven-pile foundations using the Pile Driving Analyzer (PDA) tests shall be performed by the Contractor at a minimum of two piles per Structure, each at a separate foundation element (abutment or pier foundation), and at a minimum of 2 percent of driven piles for the Project to verify pile capacity with appropriate resistance factor meets or exceeds the design factored load per pile. The PDA tests shall cover pile size, hammer type, and geology condition changes for Structures. The PDA tests shall include the measurements for initial driving and restrike. The Contractor may replace or supplement PDA tests with static load tests for piles. Static load tests shall be in accordance with ASTM D-1143 or ASTM D-3996. The exact number, type, layout and location of static and PDA tests will be per the Contractor's QMP, subject to incorporation into the Approved QMP. Static axial load tests or PDA on driven piles shall be performed in locations where driven piles will be used and the vertical loads will control the depth of the driven piles. Driven piles are allowed on this Project if noise constraints of the local entity are met.

#### **15.4.14 Drainage**

Bridge deck drainage and approach slab drainage systems shall be designed in accordance with the CDOT Bridge Design Manual. Scour analyses shall be based on the procedures in the FHWA HEC-18, Scour at Bridges, and HEC-20, Stream Stability at Highways. Scour countermeasures shall be designed in accordance with the FHWA HEC-23, Design of Countermeasures. Stormwater flowing toward the Bridges shall be intercepted prior to flowing onto the approach slab. Stormwater which falls on bridges shall be intercepted before it reaches expansion joints. All stormwater shall be directed to an outfall conforming to the Contract requirements. Permanent erosion protection shall be designed and installed at all outfall locations to prevent the occurrence of erosion. Outfalls shall have a well-defined and protected channel or pipe flow path. Sheet flow will not be allowed. Energy dissipation in the channel shall be required.

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All Bridge deck drain inlets shall be grated. The Bridge deck drainage system shall be compatible with the structural reinforcement, components, and aesthetics of the Bridge. Outfalls shall be positioned to avoid corrosion of structural members, and drainage or splash on vehicular traffic and pedestrian or bike areas below the Bridge. Downspouts for Bridge drains shall be minimum 10-inch diameter galvanized steel pipe, and shall meet the requirements of ASTM A53, Grade B, and standard weight schedule 40. Downspout pipe shall be hot dipped galvanized after fabrication. Galvanizing shall meet the requirements of AASHTO M111. Metal used in the manufacture of castings shall meet the requirements of ASTM A48, Class 35B. Cleanouts shall be provided for downspout systems.

Bridge deck drains shall be located so that downspouts can be taken immediately down pier columns. ~~Clean outs shall be accessible via an all-weather surface below.~~ Bridge drain systems with “horizontal” runs shall not be used. ~~The minimum slope for bridge drain systems shall be 3/16 inch per foot.~~

The Bridge deck drain system shall be designed and constructed to be easily modified to accommodate future changes to the Bridge. Downspout and outfall locations shall be located such that no changes are required in the future to accommodate the ultimate construction of I-25 and adjacent ramp improvements.

The Bridge deck system shall also comply with requirements in Section 12 - Drainage.

#### **15.4.15 Utilities**

Utilities to be placed on Structures shall be submitted to CDOT for Approval no later than 30 Days prior to construction. Utility supports and other details shall be designed by a Professional Engineer licensed in the State of Colorado. Utilities shall be hidden from view in superstructure elevation.

The Contractor shall identify, maintain, and coordinate all Utility locations on rehab Structures. Hanging of electrical conduits, telephone conduits, or other Utilities shall not be permitted under deck overhangs or on Bridge Rail. Protection of conduits from the settlement of the abutment backfill shall be provided.

The Contractor shall provide four (4) 2-inch conduit(s) in all Bridge curb(s) (replacement and rehab bridges) for the required and future utility line(s) on each bridge structure.

#### **15.4.16 Median**

The concrete median barrier on the Bridge deck and approach slabs shall be constructed to allow removal and modification in the future without causing damage to the Bridge deck or approach slab concrete or reinforcement.

#### **15.4.17 Maintenance Plan**

The Contractor shall submit to CDOT, for Acceptance with the Final Plans and Specifications Packages, maintenance plans for each Bridge describing routine maintenance and items specific to each component of the Bridge. It shall also include a detailed list of all maintenance and rehabilitation work and the number of times each procedure is anticipated to be performed over the 75-year replacement Bridge life and 30-year rehabilitation bridge life itemized by the year performed.

#### 15.4.18 Removal of Bridges or Structures and Removal of Portions of Present Structure

Removal of Bridges or Structures and Removal of Portions of Present Structure shall be in accordance with the referenced Standards and the requirements contained in this section.

The Contractor shall follow the requirements of the Section 7 – Utilities for the removal of the existing utilities on the existing structures.

Concrete deck and, any removed steel girders, any removed steel diaphragms, steel bridge railing, and bearings shall become the property of the Contractor and shall be removed from the site and shall not be reused in the new construction. The Contractor shall refer to the pre-demolition/renovation asbestos and lead-based paint inspection reports for all Bridges that are part of this Project.

A removal report/plan for each Bridge or Structure to be removed shall be submitted to CDOT for review, a minimum of fourteen (14) Days before removal operations begin. The report/plan shall describe methods of removal, equipment to be used, and sequence of removal. The report/plan shall document any structural analysis that was done for different stages of removal and explain whether or not any portion of the Bridge or Structure will remain open to traffic or over traffic during the different stages of removal. The report/plan shall describe any areas of concern for worker safety and the traveling public. The report/plan shall also describe the length of time for the removal, anticipated roadway closures and proposed detours, the estimated total number of worker shifts, effects of removal on pedestrians, bicycle, and traffic, locations where removed Bridge material will be temporarily stockpiled, and requirements for disposing of removed material including any material painted with lead-based paint.

A removal report/plan shall also be submitted to CDOT for review, a minimum of fourteen (14) Days before removal operations begin for removal of retaining walls supporting or adjacent to traffic or pedestrian activities, sound walls, overhead sign structures and traffic signals on the Project.

Removal of the substructure shall be taken down to at least 2 feet below the existing natural ground surface at the lowest point of interface, including consideration of any current or future improvements identified by the City of Pueblo as well as other current or future recreational uses in all other areas of the Project including future construction of the HARP extension. Holes resulting from substructure removal shall be backfilled with Structure Backfill (Class 2) to the adjacent existing grades. The Contractor shall schedule a pre-removal meeting at least ten (10) Days prior to removal operations. The meeting shall be coordinated with CDOT.

#### 15.4.19 Structure Aesthetics

Aesthetics for Structures shall be per the Project aesthetic guidelines and this Section 15. The Contractor shall produce and submit to CDOT, for Approval with the Preliminary Design Packages, a visual graphic of each Structure to demonstrate aesthetic conformance to the Plan. This graphic shall be submitted in both hard and electronic format. Proposed Structure aesthetics graphics shall include all visible surfaces and slope protection and shall be submitted with the Contractor's proposed general layouts of each Structure. This submittal shall include drawings illustrating form, texture, and color. As part of the submittal, the Contractor shall provide full-size mockups for all surface treatments for texture, color, and quality. For Project

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consistency, Structures within a common viewshed shall incorporate similar visual aesthetics. Parallel Bridges shall have similar Structure types and aesthetic treatments.

All Structures with concrete surfaces, including those accessible by graffiti vandals, shall have a surface treatment of concrete stain. This includes all retaining walls, noise barriers, concrete roadway/bridge barriers, and slope protection.

## **15.5 Box Culverts**

### **15.5.1 Existing Box Culverts**

The existing concrete box culvert at Thomas Phelps Creek, STR # 025A098100BL, shall be removed and spanned by the new I-25 structure(s).

The limits of Work shall be within existing CDOT Right-of-Way with connections made to those existing facilities to remain in their current configuration outside of CDOT Right-of-Way.

The scope for removal of the Phelps Creek Structure, and associated drainage facilities, is further defined in the Section 12 - Drainage. The channel that replaces the concrete box culvert shall be riprap lined. The grade of the channel shall follow the grade of the removed concrete box culvert. The channel thalweg shall be 17 feet wide and side slopes shall be 2:1. Riprap shall extend across the thalweg and up the side slopes for a distance of 16 feet horizontally 7 and 8 feet vertically. The riprap shall be covered with dirt and vegetation to mimic the existing channel appearance. No bridge piers or abutments shall be placed in this channel.

## **15.6 Retaining Walls**

Retaining Walls shall be in accordance with the referenced Standards.

### **15.6.1 General**

The following criteria shall apply to permanent wall Structures. Retaining walls shall be designed to accommodate the Preferred Alignment in the FEIS. The portion of the retaining walls built with this Project shall follow the Contractor's Approved Project profile. Walls that support traffic for interim phases of traffic which are left in place and become part of the final Structure shall be designed and constructed as permanent walls. Walls that may be part of the future alignment shall be designed and constructed as permanent walls. The Contractor shall have sole responsibility for the type, material, performance, and safety of temporary retaining wall Structures.

### **15.6.2 Geometry**

The retaining wall layout shall address slope maintenance above and below the wall and provide returns into the retained fill or cut at retaining wall ends. Final tolerances shall be 1 to 200 for level and plumb. Any residual wall batter shall be into the fill. For maintenance access, the wall shall be located a minimum of 12 feet, on generally level terrain, inside the ROW line.

Design and construction shall consider surface and subsurface drainage. Walls which support soil and loads from outside ROW, and are built with MSE soil reinforcements, shall require an appropriate setback from ROW line for the construction of the wall or a temporary construction easement shall be required in accordance with requirements in Section 8 - Right-of-Way. A system shall be provided to intercept or prevent surface water from entering behind walls. Relief joints shall be provided to control the differential settlement.

### 15.6.3 Type

Metal walls, including bin and sheet pile walls, recycled material walls, Mechanically Stabilized Earth (MSE) (Block) walls, and timber walls shall not be permitted for permanent retaining walls. Wall types, selected by the Contractor, shall have been used successfully in similar geotechnical locations and environmental conditions.

### 15.6.4 Design Requirements

All permanent retaining walls and their associated structural support elements, constructed for the Project, shall be designed to resist corrosion or deterioration for a minimum service life of 75 years. Mechanically Stabilized Earth (MSE) walls shall be designed in accordance with the requirements of AASHTO LRFD Bridge Design Specifications, Sixth Edition 2012. Global stability, overturning, and sliding calculations shall be performed on all retaining wall systems. All retaining wall installations shall provide for a positive drainage system of the backfill. The design of MSE walls near or in bodies of water shall account for soft saturated soils and scour and shall prevent fine washout between facing elements. MSE walls can be used in scour areas, but the foundation of the wall needs to be below the scour level. The wall itself would either have to be designed for hydrostatic pressure or use a free draining material to account for water fluctuations. ~~6'-42"~~ chain link fence is required on all retaining walls. Fencing on walls shall satisfy OSHA, CDOT maintenance requirements, and the Project aesthetic guidelines.

All walls near irrigation lines for landscaping shall account for any additional hydrostatic load due to a waterline break. The Contractor may consider the use of free draining backfill material and/or leak detection devices to reduce hydrostatic loads on retaining walls. Retaining walls shall be designed according to the seismic criteria from AASHTO LRFD bridge design specifications.

Temporary retaining walls (constructed of materials not allowed for permanent walls) may be abandoned and left in place. Temporary retaining walls left in place must be completely covered by soil or construction material a minimum of ~~2-5~~ feet below finished grade so they are not visible. Structural components of temporary retaining walls may be reused as part of permanent retaining wall (two-phase walls) systems, provided all of the structural support elements and materials of the permanent retaining walls meet the requirements of this Section 15.

#### Mechanically Stabilized Earth (MSE) (Panel) Walls

Wall panels shall be constructed of reinforced concrete and provide corrosion protection for prestressing or post-tensioning steel. The cover to reinforcing steel shall be a minimum of 2 inches. Wall panels exposed to splash from traffic shall use epoxy coated reinforcing steel. Panel joints shall accommodate differential settlement.

A representative from the wall manufacturer shall be at the job site during all phases of wall construction to assist the Contractor and CDOT with Quality Control/Quality Assurance. The Contractor shall use the latest FHWA geotechnical references and guidelines in conformance with the Contract, as provided at the following website:  
<http://www.fhwa.dot.gov/engineering/geotech/index.cfm>, including the FHWA Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes - Volumes I and II.

A barrier shall be provided to prevent fine washout between horizontal and vertical facing panel joints, panel wall construction joints, or relief joints.

Mechanically Stabilized Earth (MSE) (Block) Walls

Block walls will not be allowed for use on this Project.

Cast-in-Place Walls

Cast-in-place walls shall be designed and constructed in accordance with AASHTO LRFD Bridge Design Specifications, Sixth Edition 2012. Construction-joint spacing shall accommodate or limit differential settlement.

Anchored Walls

Design and construction shall use FHWA DP-90-068, FHWA RD-82-046, FHWA RD-82-047, "Design Manual for Permanent Ground Anchor Walls" FHWA RD-97-130, "Geotechnical Engineering Circular No. 4 - Ground Anchors and Anchored Systems" FHWA IF-99-015 as guidelines. Anchors shall be encapsulated with plastic sheathing. Proof load tests for anchors shall be provided in accordance with the above FHWA guidelines.

Soil Nail Walls

Soil nail walls may only be used when top-down construction is warranted. Soil nail walls shall not be used if ground water seepage will occur. Design and construction shall use FHWA-RD-89-93, "Soil Nailing Field Inspectors Manual" FHWA SA-93-068, "Manual for the Design & Construction Monitoring of Soil Nail Walls" FHWA SA-96-069R, "Geotechnical Engineering Circular No. 7 - Soil Nail Walls" FHWA IF-03-017 as guidelines. Load testing for nails shall be provided in accordance with the above FHWA guidelines. Shotcrete exposed surface shall meet the aesthetic requirements of the Project aesthetic guidelines and this Section 15.

Soil Reinforcement

Soil reinforcement for MSE and modular walls shall be galvanized (or epoxy) coated steel, geogrids, or fabrics meeting creep requirements of AASHTO LRFD Specifications for Highway Bridges. Design shall account for any item projecting through the soil reinforcement. The Contractor shall avoid placing culverts and Utilities perpendicular to soil reinforcement within the reinforced soil mass. Soil reinforcement shall be protected from corrosion of metal due to stray electrical currents.

**15.6.5 Retaining Wall Aesthetics**

All retaining walls throughout this Project shall comply with the Project aesthetic guidelines and requirements in this Section 15.

All wall facing shall be of a consistent type (i.e. cast-in-place, pre-cast facing, etc.) within any section of road, interchange and single viewshed. This includes surface treatment, pattern, texture, color, and jointing layout. An overall negative batter (wall face leaning outward away from fill) between the bottom and the top of the wall is not allowed. Wall facing shall be installed vertically (plus or minus 1/2 inch in 10 feet or as defined in the CDOT Bridge Structure Worksheets for MSE walls) and shall be capped with a cast-in-place or precast concrete cap. Wall facing and cap shall be colored with structural concrete stain.

The Contractor shall produce and submit to CDOT a visual graphic of each retaining wall to demonstrate aesthetic conformance to the Plan. This graphic shall be submitted in both hard and electronic format. Proposed retaining wall aesthetics graphics shall include all visible surfaces and slope protection and shall be submitted to CDOT for Approval with the Contractor's proposed general layouts of each Structure. This submittal shall include drawings

illustrating form, texture, and color. As part of the submittal, the Contractor shall provide full-size mockups (10 ft. x 10 ft. minimum) for all surface treatments for texture, color, and quality for Approval by CDOT. For Project consistency, retaining walls within a common viewshed shall incorporate similar visual aesthetics. Retaining walls for parallel Bridges shall have similar Structure types and aesthetic treatments.

All Structures with concrete surfaces, including those accessible by graffiti vandals, shall have a surface treatment of concrete stain. This includes all retaining walls, noise barriers, concrete roadway/bridge barriers, and slope protection.

## 15.7 Noise Walls

### 15.7.1 General

The retaining wall under the noise wall at Kelly Street Residences may be raised with future projects to meet the requirements of the FEIS. The noise wall on top of this retaining wall shall be designed and built to be removed and reset to accommodate the retaining wall expansion. The portion of the noise walls built with this Project shall follow the noise requirements in the FEIS and Section 5 – Environmental Requirements.

Noise walls shall be designed for a 100-mph wind with specified gust factor (30 percent). Final tolerances shall be 1/8 inch in 1 foot for level and plumb. The design of noise walls shall provide for adequate surface drainage. When the installation of a noise wall interferes with the access to existing, or proposed fire hydrants, the noise wall installation shall include fire hose access openings and associated identification signs per CDOT and City of Pueblo standards. Location and demand for these openings shall be established in cooperation with the local fire department.

### 15.7.2 Geometry

When placed behind guardrail, noise walls shall be offset according to applicable standards for that particular guardrail. The Contractor shall place noise walls on top of concrete guardrail when offset space is limited to 10 ft. or less. The minimum spacing between all guardrails and the noise wall shall be 10 ft. for maintenance purposes and shall provide for access from the roadway to the wall.

### 15.7.3 Design Requirements

#### Panels

Panels shall be constructed of concrete. Panels may be cast-in-place or pre-cast. Panels on Bridges shall be cast-in-place concrete and jointed from longitudinal structural elements of the Bridge. Panel design and construction shall consider ease of replacement and/or repair, and shall limit the risk from falling debris resulting from traffic impacting with the noise wall.

#### Posts

Posts shall be reinforced concrete, prestressed concrete, or galvanized and painted steel.

#### Foundations

Foundations shall be posts set in concrete, flowfill, caissons, cast-in-place, or pre-cast reinforced concrete footings. The bottom of all spread footing foundations shall be placed a minimum of 3 feet below finished grade. Reinforcing steel projecting into the above ground portion of walls, subject to splash from the Roadway (areas within 10 feet horizontally of the edge of travel lane), shall be epoxy-coated.

#### 15.7.4 Noise Wall Aesthetics

All noise walls throughout this Project shall comply with the Project aesthetic guidelines and requirements in this Section 15.

Panels shall be colored on both sides with concrete stain. Panels shall span between and be supported by galvanized and painted steel, wide flange columns, or pre-cast I-section columns. The barrier heights are as described in the FEIS and Record of Decision for the Project. If sound barriers are located within the clear zone (as defined by AASHTO) they shall have a Type 7 concrete barrier or crash worthy railing along the base of the traffic side of the wall.

The Contractor shall produce and submit to CDOT a visual graphic of each noise wall to demonstrate aesthetic conformance to the Plan. This graphic shall be submitted in both hard and electronic format. Proposed noise wall aesthetics graphics shall include all visible surfaces and slope protection and shall be submitted to CDOT for Approval with the Contractor's proposed general layouts of each Structure. This submittal shall include drawings illustrating form, texture, and color. As part of the submittal, the Contractor shall provide full-size mockups (10 ft. x 10 ft. minimum) for all surface treatments for texture, color, and quality for Acceptance by CDOT. For Project consistency, noise walls within a common viewshed shall incorporate similar visual aesthetics. Walls for parallel noise walls shall have similar Structure types and aesthetic treatments.

All Structures with concrete surfaces, including those accessible by graffiti vandals, shall have a surface treatment of concrete stain. This includes all retaining walls, noise walls, concrete roadway/bridge barriers, and slope protection.

### 15.8 Road Sign and VMS Structures

#### 15.8.1 General

Major sign ~~s~~Structures (ie. class 3) and VMS sign structures and minor sign structures (ie class 1 and 2) shall be constructed in accordance with CDOT M&S Standard Plans.

~~and supports for Intelligent Transportation System (ITS) equipment shall be designed and constructed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5<sup>th</sup> Edition with 2010 Interim Revisions and CDOT M&S Standards. The Contractor shall provide minimum vertical clearances in accordance with the above specified AASHTO requirements and loadings shall consider natural period of vibration from vortex shedding and upward wind pressures from passing trucks.~~ Sign Structures shall be galvanized structural steel (single) tubing, painted or powder coated in accordance with the Project aesthetic guidelines requirements of the Contract. ~~Draft structural worksheets for single-tube sign supports are available from CDOT Staff Bridge Branch.~~ The Contractor shall not mount major sign supports (cantilevered signs, sign bridges, etc.) on MSE retaining walls or noise walls.

~~Variable Message Signs (VMSs) shall be mounted on a sign bridge or cantilever. The Contractor shall prepare a structural design for each VMS structure and provide to CDOT for Approval prior to issuance of Released for Construction documents.~~

~~Minor sign Structures and supports shall be constructed in accordance with CDOT M&S Standard Plans.~~

## 15.8.2 Design Requirements

### Foundations

Drilled caissons shall be used to support overhead and cantilever sign Structures. The Contractor shall prepare one general project foundation report for all sign Structures and shall have one foundation boring within 10 ft. of each single caisson supporting large sign supports.

### Connections

Connections shall be made with high strength A325 bolts. Shop splices shall be made with full penetration butt welds. Base connections shall be made with full penetration shop butt welds. All sign connection hardware shall be galvanized with strengthened structural tubing at electrical connection openings.

### Bridge Mounted Signs

The Contractor shall not mount signs, VMS, or brackets on Bridges unless Approved by CDOT.

## 15.9 Submittals/Report Elements

### 15.9.1 Design Reviews

Reviews will be conducted in accordance with the Contractor's Approved Quality Management Plan (QMP). Shop drawings shall be submitted for review by the Contractor's Engineer. The Contractor is solely responsible for shop drawing accuracy. Structure drawings shall conform to the CDOT CADD Standards. Structure drawing standards shall be addressed in the Contractor's Approved QMP. The requirements for this section also apply to noise walls and retaining walls required for the Project.

### 15.9.2 Progress Submittals

The Contractor shall submit three separate design packages for each structure within each segment of the Project

The Structural design packages are defined as:

#### Preliminary Design Package

For each structure in each segment of the Project, a Preliminary Design Package shall be submitted to CDOT for review as defined in Section 2 – Project Management - Contract Schedules.

The submittal shall include:

1. Completed general layout drawings (including aesthetics)
2. Final geometry and proposed structure type detailed drawings
3. Structure Concept Plans or Rehabilitation/Widening Structure Concept Plans
4. Aesthetic visual graphics and full-size mockups
5. Identification of additional soil borings (if required)
6. Foundation system drawings

The preliminary design packages are equivalent to a traditional CDOT Field Inspection Review (FIR) set.

#### In-Process Design Package

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For each structure in each segment of the Project, an In-Process Design Package shall be submitted to CDOT for review as defined in Section 2 – Project Management - Contract Schedules.

The submittal shall include:

1. Final structural drawings
2. Completed soil boring and final foundation report
3. Quantities

For this submittal, the final Structural design shall have been completed, ~~but not necessarily the independent design check~~. All drawings shall have been completed and the first independent plan check of those drawings shall have been completed. Tabulated (Bridge) geometry drawings and minor miscellaneous details need not be completed and submitted with this package.

#### Final Plans and Specification Package

For each structure in each segment of the Project, a Final Plans and Specification Package shall be submitted to CDOT for review after final design has been completed. The Contractor is allowed to submit RFCs for structure components (ie. foundations, substructure, superstructure, etc.) prior submittal of the Final Plans and Specs Package for each structure.

The submittal shall include:

1. Final design calculations
2. Final design drawings including aesthetics
3. Final project special provisions
4. Completed maintenance plan

All changes or revisions resulting from the in-process design review shall be incorporated into the final design documents. If required by earlier review comments, the final foundation report shall be updated and resubmitted with this package.

The Contractor shall be required to submit only Final Plans and Specification Packages for minor structural elements, such as sign structures.

#### **15.9.3 Released for Construction, Revisions to Released for Construction and As-Built Documents**

Drawings and specifications for each Structure shall be signed and sealed by the Contractor's designer in accordance with laws for registration of Professional Engineers in the State of Colorado. Copies in PDF and MicroStation electronic format shall be made of all plans for all Structures on the Project and submitted to CDOT on computer disk (CD or DVD) format.

#### **15.9.4 Documentation**

Design and design-check calculations shall have pages numbered and include a table of contents. All calculations shall identify which code is utilized, and reference the appropriate section in the right-hand column. References shall be included in the calculations to computer programs used to do the calculations. Computer documentation shall include the name of program, vendor, version, and release date; record of software output and verification of output with manual calculations or other recognized program; clear identification of input and output values and meaning; and check of input. All calculations shall be signed and sealed by the Contractor's Engineer in accordance with the laws for registration of professional engineers in Colorado. Copies in PDF format shall be made of all design and design-check calculations for the Project and then submitted to CDOT on computer disk (CD or DVD) format. Bridge rating

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packages for all new Bridges and affected existing structures shall be submitted in accordance with the CDOT Bridge Rating Manual.

**15.9.5 As-Built, Falsework, Shoring, and Shop Drawing Plans**

Falsework and shoring plans shall be signed and sealed by a Professional Engineer licensed in the State of Colorado. Shop Drawings and working Drawings shall be reviewed and approved by the Contractor's structural design engineer. The Contractor shall submit As-Built Drawings with Shop Drawings and working Drawings for each Structure in accordance with the Contract Documents. The Contractor shall seal Shop Drawings in accordance with Table 105-1 of the CDOT Standard Specifications. Copies in PDF format shall be made of all As-Built and Shop Drawings, and working Drawings for all Structures on the Project and submitted to CDOT on computer disk (CD or DVD) format.

The Contractor shall follow the Shop Detail Drawing Review/Approval Guidelines developed by the AASHTO/NSBA Steel Bridge Collaboration G1.1-1999 for preparation of steel shop drawings.

Shop Drawings shall be submitted to CDOT for information only. The Contractor is solely responsible for Shop Drawing accuracy.

**15.9.6 Construction Requirements**

The CDOT Permit Office shall be notified 2 Working Days in advance of reductions in vertical clearances or when lane closures, lane reductions, or lane width restrictions are put into effect.

~~Bridge deck and approach slab surface smoothness shall not deviate more than 3/8 inch in 25 feet as described in the Standard Specifications.~~

A representative from the wall manufacturer shall be at the job site during all phases of MSE wall construction to assist the Contractor and CDOT in Quality Control/Quality Assurance. The representative shall maintain a construction diary and sign-off on all hold points as defined in the Contractor's Approved Quality Management Plan. The diary shall be submitted with the final Design Documents.

**15.10 Deliverables**

At a minimum, the Contractor shall submit the following to CDOT for review, Approval and/or Acceptance:

<b>Deliverable</b>	<b>review, Acceptance or Approval</b>	<b>Schedule</b>
Proposed bridge rating software	Approval	With associated structural submittals
Preliminary structural capacity ratings	review	With the In-Process Design Packages
Final structural capacity rating packages	Approval	With the Final Plans and Specification Packages
Structure Concept Plans (SCP)	Approval	With the Preliminary Design Packages
Rehabilitation/Widening Structure Concept Plans (RWSCP)	Approval	With the Preliminary Design Packages
Paint/stain color	Acceptance	With associated structural submittals
Revisions to Project aesthetic guidelines	Acceptance	Prior to any associated structural submittals
Retaining wall analysis	Acceptance	Prior to Released for Construction Documents
Location of access holes/doors	Approval	30 Days prior to fabrication
Utilities to be placed on structures	Approval	30 Days prior to construction
Maintenance plans	Acceptance	With the Final Plans and Specifications Packages
Bridge, Structure, retaining wall removal reports/plans	review	14 Days before removal operations begin
Structure, retaining wall, and noise wall aesthetic visual graphics and full-size mockups	Approval	With the Preliminary Design Packages
VMS structural design	Approval	Prior to Released for Construction Documents
Preliminary Design Packages	review	As defined in Contract Schedules
In-Process Design Packages	review	As defined in Contract Schedules
Final Plans and Specification Packages	review	After final design has been completed

All deliverables shall also conform to the requirements of Section 3 - Quality Management.