10.0 GEOTECHNICAL AND ROADWAY PAVEMENTS

This Section 10 includes the requirements for the geotechnical and Roadway pavements Work for the US 550/160 Connection South Design Build Project (Project). This Work shall be completed in accordance with the Contract Documents.

10.1 Administrative Requirements

10.1.1. Standards

The Contractor shall design and construct the Project in accordance with the requirements of the standards in the documents listed in Table 10-1 and those referenced in Book 3. The Contractor shall use the latest adopted edition at the time of the Proposal Due Date

Table 10-1. Standards

Author or Agency	Title
American Association of State Highway and Transportation Officials (AASHTO)	*AASHTOWare Pavement Mechanistic-Empirical Design Software, Version 2.3.1*
AASHTO	*Load Resistance Factor Design (LRFD) Bridge Design Specifications*
AASHTO	*Policy on Geometric Design of Highways and Streets, 2011*
Colorado Department of Transportation (CDOT)	*Standard Specifications for Road and Bridge Construction (Standard Specifications)*
CDOT	*Mechanistic-Empirical (M-E) Pavement Design Manual*
CDOT	*Field Materials Manual*
CDOT	*Bridge Design Manual*
CDOT	*Geotechnical Design Manual*
CDOT	*M&S Standard Plans*

10.2 Geotechnical Investigations

The results of geotechnical investigations performed by CDOT are provided in Book 4, *Geotechnical Data Report* (GDR) dated March 11, 2019 by Yeh and Associates, Inc. The data from an additional investigation for US 550 south of La Plata County Road 220 is provided in the GDR as an appendix.

Geotechnical investigations conducted in the area of the Structures and pavements are included in the GDR in Book 4. The soil and rock samples referenced in the GDR and collected as part of this geotechnical engineering exploration are available at the CDOT Durango facility:

CDOT Region 5
3803 North Main Avenue
Durango, CO 81301

The Contractor shall have 90 Days from NTP1 to take possession of these geotechnical samples. If the Contractor has not taken possession within this timeframe, CDOT will dispose of these materials. If the Contractor does take possession of these samples, the Contractor shall assume full responsibility for both storage and disposal.

The Contractor shall be responsible for supplemental subsurface investigation necessary to complete the Work, to support the proposers' design and to meet required sampling frequency. When planning and conducting additional investigations, the Contractor shall refer to the referenced Book 4 geotechnical documents completed for this Project. Geotechnical investigations and analysis shall comply with the requirements of the CDOT *Geotechnical Design Manual*, the CDOT *Field Materials Manual*, the CDOT *M-E Pavement Design Manual,* the AASHTO *LRFD Bridge Design Specifications*, where applicable, Table 10-2, and any other applicable standards necessary to perform the Work.

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 Colorado State Engineer's Office (CSEO) requirements.

Geotechnical investigation by the Contractor is required to supplement the data in the *Summary Geotechnical Data Report, US 550, MM 12.3 to MM 15.0* that is included in Appendix I of the GDR. Specifically, supplemental investigation is required at Structure locations and at locations of proposed cuts and fills within the new alignment south of MP 15.0 (station 980+00), where borings were confined to existing ROW.

The Contractor shall perform geotechnical investigations as required for sign Structure foundations. Additional geotechnical investigations beyond these requirements are at the discretion of the Contractor.

Supplemental investigations made by the Contractor shall be documented in supplemental geotechnical investigation reports of format similar to those in the referenced geotechnical documents. These supplemental investigations shall be submitted to CDOT within 30 Days following completion of the field Work for review and comment prior to Acceptance. Supplemental investigations made by the Contractor for County or other municipal roads shall be documented in separate Supplemental Geotechnical Investigation Reports according to the maintaining agency's requirements, and shall be submitted to CDOT within 30 Days following completion of the field Work for Acceptance.

The minimum depth and frequency of geotechnical borings for subsurface explorations is provided in Table 10-2. Roadway subgrade sampling is required for all pavement areas and shall conform to the *Region Soil Survey Sampling Checklist* for *Soil Survey of Constructed Roadbeds* presented in Chapter 200 of the CDOT *Field Materials Manual*. The soil survey shall be completed prior to beginning construction of the pavement Subbase course, in accordance with Book 2, Section 11.

Table 10-2 Geotechnical Boring Depth and Minimum Frequency Table

Exploration Type		Recommended Minimum Number of Borings	Recommended Minimum Boring Depth
Foundations	Drilled Shaft	One per substructure unit < 100 feet width Two per substructure unit > 100 feet width	10 feet into bedrock (N ≥ 50) or 3D below tip elevation.
	Driven Piles		10 feet into bedrock (N ≥ 50) or 20 feet below tip elevation.
	Spread Footing		2B where L < 2B, 4B where L > 2B and interpolate for L between 2B and 4B or 10 feet into bedrock.
	Concrete Box Culvert	One at each end and every 100 feet along axis	3H or 10 feet into bedrock (N ≥ 50).
Wall	Mechanically Stabilized Earth (MSE)/Cast in Place	One at each end and every 200 feet along wall	2H or 10 feet into bedrock (N ≥ 50).

Exploration Type		Recommended Minimum Number of Borings	Recommended Minimum Boring Depth
	Tieback Anchor	One in anchorage zone spaced every 200 feet along wall	
	Soil Nail/Ground Nail	One in nail zone 1H from wall every 200 feet along wall	
Landslide		Three along center of slide. Place at least one boring above and below sliding area.	10 feet below slide failure into competent stratum. Slide failure plane is rarely greater than slide width.
Pavement Settling		Determined by size and extent of distressed area.	Determined by size and extent of distressed area.
Pavement Heaving			20 feet.
Material Soil Survey	Pavement realignment or widening	One every 1,000 feet along centerline or determined by CDOT.	Minimum of 5 feet below top of proposed pavement elevation or determined by CDOT.
	Cut sections – road widening	One at each end of cut section and every 500 feet or determined by CDOT.	
	Cut sections – new alignment	One at each end of cut section on opposite shoulders. If cut > 20 feet vertical, 1 boring through deepest section of cut on centerline.	
	Embankment Fill > 5 feet New alignment	One every 500 feet with at least one through the greatest thickness of fill.	Borings shall extend at least 2 times the total height of the proposed fill below the base elevation or 5 feet into hard substratum (N>30).

Modified from *Checklists and Guidelines for Review of Geotechnical Reports and Preliminary Plans and Specifications.* Publication No. Federal Highway Administration (FHWA) ED-88-05, Table 2; CDOT *M-E Pavement Design Manual,* Chapter 4; CDOT *Field Materials Manual,* Chapter 200*; AASHTO LRFD Bridge Design Specifications,* Table 10.4.2-1; and *Landslides: Investigation and Mitigation,* Transportation Research Board (TRB) Special Report 247, Chapter 2*.*
D = Diameter B = Footing Width H = Wall Height L = Footing Length N = Blow count values in 12 inches

10.3 Design Requirements

10.3.1. Submittals

All submittals shall be prepared, Reviewed, and submitted in accordance with the requirements set forth in Book 2, Section 3.

10.3.2. Sulfate Resistant Concrete

Concrete for foundation elements and pavements shall be designed for Class 2 Severity of Sulfate Exposure unless field sampling and laboratory testing indicates a greater sulfate resistance is required.

10.3.3. Landslide Mitigation Analysis and Design

The geotechnical investigation documented in the GDR identified landslide areas within the Project limits. Observed evidence of landslides included vertical offsets (scarps) at the tops of slides, irregular terrain on the faces of slopes that indicates ground movement, distressed vegetation on slopes, seepage near the toes of slopes, and subsurface conditions logged from exploratory borings. Identified landslide areas are shown on the geologic map that is included in the GDR. Other active landslide areas may be encountered or may become active during construction. Placement of foundations or fill in landslide areas shall be avoided or suitable landslide stabilization shall be provided. Landslide stabilization shall be designed

using Limit-Equilibrium Analysis methods. Additional geotechnical investigations may be required for design of landslide mitigation and shall be the responsibility of the Contractor. The minimum number and locations of exploratory borings for landslide stabilization design are shown in Table 10-2. Design of landslide mitigation shall be in accordance with the CDOT *Geotechnical Design Manual*, CDOT *Bridge Design Manual*, and AASHTO *LRFD Bridge Design Specifications*. In landslide areas that support critical structures or slopes, the stabilization design shall have a minimum Factor of Safety of 1.5. Stabilization designs shall be submitted to CDOT for Acceptance a minimum of 45 Days prior to the start of stabilization construction.

10.3.4. Structure Foundation Analysis and Design

Structure foundation analysis and design shall follow the requirements provided in Book 2, Section 15. Modifications to existing Structures, including the ground nail wall south of the roundabout, may require additional geotechnical investigation and/or foundation design. Subsurface conditions at major Structures proposed north of station 980+00 (approximate milepost 15.26) have been evaluated by CDOT and are documented in the GDR. These include wildlife underpass Structures P-05-AU and P-05-AV and P-05-AT and P-05-AS, Bridge Structures P-05-AZ and P-05-BA; and new retaining walls as defined in Book 2, Section 15 and Book 2, Section 1,. Foundation designs for Structures south of station 980+00, sign Structures, and other minor Structures may require supplemental geotechnical investigations. Performance and reporting of supplemental geotechnical investigations shall be in accordance with Section 10.2. Foundation analysis and design for Structures shall conform to the AASHTO *LRFD Bridge Design Specifications* and the CDOT *Bridge Design Manual*.

A Preliminary Foundation Design Report shall be submitted for Review for each major Structure and minor Structure as required in Book 2, Section 15, for the design of foundations for Bridges, retaining walls, noise walls, and other Structures. The report shall be in draft form and contain design recommendations and substantiating analysis for foundation elements, lateral earth load parameters, soil corrosivity analysis, seismic design parameters, and any other geotechnical design or analysis parameters necessary to complete the design. The Preliminary Foundation Report shall be submitted to CDOT for Review with the Preliminary Design Plans package.

The Foundation Design Report shall be revised from the Preliminary Foundation Design Report and be the basis for the load analysis from seismic and earth loads and the basis for the design of foundation elements. Supplemental soil borings required for Structures design shall have been completed. Foundation Design Reports shall be submitted to CDOT for Acceptance 30 Days following completion of supplemental field Work or with the Release for Construction (RFC) Documents per Book 2, Section 3.

Designs of foundations in landslide areas shall consider the potential loss of support or structure distress due to potential landslide movement. Documentation that clearly tracks collaboration between the Contractor's Geotechnical Engineer and Structural Engineer through the structure foundation design process shall accompany the Foundation Design Report. The documentation shall be sufficient to verify the foundation design has followed the design recommendations of the Geotechnical Engineer and the geotechnical recommendations are appropriate for the designed structure foundation load conditions.

10.3.5. Baseline Roadway Pavement Analysis and Design

10.3.5.1 Pavement Structure

The Pavement Structure is defined as the combination of Subbase, Base Course, and Surface Course placed on a prepared Subgrade to support the traffic load and distribute it to the Roadbed:

1. **Subgrade.** The top surface of a Roadbed upon which the Pavement Structure and Shoulders are constructed.

2. **Subbase.** The layer or layers of specified or selected Material of designed thickness placed on a Subgrade to support a Base Course, Surface Course, or both.
3. **Base Course.** The layer or layers of specified or selected Material of designed thickness placed on a Subbase or a Subgrade to support a Surface Course.
4. **Surface Course.** The upper most component of a Pavement Structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate.

10.3.5.2 Subgrade Treatment

Expansive and high plasticity surficial soil and bedrock Subgrade Materials have been identified within the alignment as documented in the *GDR*. These Subgrade conditions shall be treated by the subexcavation method with granular material as defined in Chapter 4 of the CDOT *M-E Pavement Design Manual*. This is the only subgrade treatment allowed. This treatment is not ATC eligible. In order to achieve the Project goal of maximizing the use of available on Site Materials and for the long-term resiliency and benefit of the Project, the subexcavation shall be backfilled with a minimum thickness of 12 inches of moisture conditioned, recompacted subgrade and a minimum of 24 inches of Subbase course Materials consisting of suitable Material meeting the minimum requirements of Class 3 Aggregate Base Course (ABC), AASHTO classification of A-1 and with an R-value of at least 70, in accordance with Book 2, Section 11. Subbase course Materials may be produced from the terrace alluvial gravel deposits identified in the GDR. Subbase course constructed on expansive and high plasticity subgrade Materials (surficial soils and processed bedrock) shall be placed on a geosynthetic filter-separator layer and constructed with edge drains or other measures to collect and divert water from the Subbase Materials and prevent saturation of the Subgrade and Pavement Structure. The CDOT baseline pavement design has accounted for the reworked Subgrade and Subbase course layers. ATCs, including those prepared using the AASHTOWare Pavement M-E Design software, shall not propose reductions in the minimum requirements of this section. These minimum requirements are not ATC eligible.

10.3.5.3 Baseline Pavement Design

CDOT has prepared the baseline pavement design, as described in the Pavement Justification Report, and performed the Life-Cycle Cost Analysis (LCCA) to determine the types and thicknesses of pavement surface courses, thicknesses of Base Courses and Subbase courses, and Subgrade treatments that meet the requirements this Project. The Pavement Justification Report and LCCA are included in the Reference Documents. This baseline Pavement Structure is provided below and Contractor proposed ATC pavement designs shall include the same components as the baseline design. Proposed ATCs for pavement designs shall utilize the baseline pavement design parameters defined in this Section and the baseline pavement design calibration factors presented in Section 10. Output reports for the baseline M-E pavement design are provided in the Reference Documents.

10.3.5.4 Baseline Pavement Types and Thickness Requirements

The LCCA performed by CDOT indicates Portland Cement Concrete Pavement (PCCP) and Hot Mix Asphalt (HMA) pavement types have life-cycle costs that are similar such that neither has a distinct cost advantage. The two life-cycle costs are within the range where CDOT policy requires designs for both types of pavement be presented as baseline pavement designs. The Contractor shall select either the PCCP or HMA CDOT design for the entire extent of the US 550 mainline within the Project limits.

Permanent patching of HMA pavement shall conform to Section 403 of the Standard Specifications. Patching on US 160 shall consist of a minimum of 8-inches of HMA. Minor approach Roads shall have a minimum Surface Course thickness of 3 inches of HMA.

10.3.5.4.1 Portland Cement Concrete Pavement

PCCP shall meet flexural strength requirements as identified in the most current CDOT *Standard Specifications for Road and Bridge Construction* and any currently approved *Standard Special Provisions* as detailed in Book 2, Section 20.

1. PCCP shall be required for the roundabout.
2. PCCP matching the roundabout pavement shall be required from the roundabout to the existing bridge over US 160, Structure No. P-05-AG.

The baseline PCCP design shall have the minimum thicknesses shown in Table 10-3 for the design parameters provided as determined in accordance with CDOT *M-E Pavement Design Manual* for locations where new construction of the pavement section is required.

Table 10-3 Minimum Pavement Design Parameters for PCCP (New Construction)

Segments	Pavement Type	Design Life (Years)	2020 Daily Truck Volume (AADTT)	Thickness of PCCP Surface Course (in.)	Thickness of ABC Class 6 (in.)	Thickness of ABC Class 3 Subbase (in.)
US 550 In situ Surficial Soils Subgrade	Rigid	30	589	8.5	4	24
US 550 In situ Alluvial Gravel Subgrade	Rigid	30	589	8.5	4	0*
US 550 In situ Bedrock Subgrade	Rigid	30	589	8.5	4	24
Roundabout	Rigid	30	1,500	9.5	4	24
Bypass Lane (NB 550 to WB 160)	Rigid	30	589	9.5	4	24

Baseline PCCP designs based on use of 1.25-inch diameter dowel bars and 15-foot joint spacing.
ABC = Aggregate Base Course.
**Subbase course shall not be required in the Alluvial Gravel Subgrade section provided a minimum thickness of 5-feet of Alluvial Gravel has been verified.*

10.3.5.4.2 Hot Mix Asphalt Pavement

The baseline HMA pavement design shall have the minimum thicknesses shown in Table 10-4 for the parameters provided based on the M-E Design software for HMA where new construction of the Pavement Section is required.

Table 10-4 Minimum Pavement Design Parameters for HMA (New Construction)

Segments	Pavement Type	Design Life (Years)	2020 Daily Truck Volume (AADTT)	Thickness of HMA Surface Course (in.)	Thickness of ABC Class 6 (in.)	Thickness of ABC Class 3 Subbase (in.)
US 550 In situ Surficial Soils Subgrade	Flexible	20	589	6	4	24
US 550 In situ Alluvial Gravel Subgrade	Flexible	20	589	6	4	0*
US 550 In situ Bedrock Subgrade	Flexible	20	589	6	4	24

CR 219, CR 220, Frontage Rd.	Flexible	20	200	5	4	24
Ramp B (Roundabout to EB US 160)	Flexible	20	200	6	6	8
Bypass Lane (NB 550 to WB 160)	Flexible	20	589	7	4	24

ABC = Aggregate Base Course.
**Subbase course shall not be required in the Alluvial Gravel Subgrade section provided a minimum thickness of 5-feet of Alluvial Gravel has been verified.*

10.3.6. Alternate Pavement Designs

CDOT has performed an LCCA for the baseline pavement design that shows HMA and PCCP as equally suitable pavement type alternatives. ATCs for pavement designs proposed by the Contractor shall include analysis of life-cycle costs to show maintenance costs and demonstrate required design life.

The Contractor shall prepare the final ATC pavement designs using Version 2.3.1 of the AASHTOWare Pavement Mechanistic-Empirical Design software (M-E Design software) for all pavement constructed as part of this Project. In addition to M-E Design output, pavement design ATCs will be evaluated based on the requirements of the CDOT *M-E Pavement Design Manual,* in particular section 4.9 Expansive Subgrade soils. Contractor designs shall utilize the Colorado-specific calibration model and the inputs, calibration factors, Material properties, etc., set forth in the Pavement Justification Report and as provided in Exhibit 10-A. The Material properties of the Surface Course, Base Course, Subbase course, and Subgrade used during construction shall follow those used in the CDOT *M-E Pavement Design Manual* and CDOT baseline pavement design. Level 2 design parameters shall be used. The Contractor may use Level 1 design parameters when better information is available. Level 3 design parameters will not be applicable and shall not be used without specific written Acceptance of their applicability from CDOT. Items in conflict between the CDOT *M-E Pavement Design Manual* and the CDOT baseline design shall follow inputs provided in the CDOT baseline design. HMA and PCCP mixes from the CDOT material databases shall be used in all M-E Design analyses. Generic, nationwide, or similar, samples of HMA and PCCP shall not be used in the analysis.

Properties of Materials proposed for the Pavement Structure must be able to be represented within the M-E Design software. Materials incompatible with the M-E Design software will not be Accepted. Performance properties of alternative Materials shall be verified through documentation of the Materials' structural value within the Roadway prism and with formal guidance on how they should be modeled within the M-E Design software. The Contractor shall be required to provide the documentation and formal guidance for incorporation of Materials into the M-E Design software. CDOT will not Accept proposed pavement Materials modifications with insufficient documentation and/or lack of adequate modeling of a Material's structural value.

The Contractor's Alternate Pavement Design Report shall explicitly state any differences between the CDOT baseline pavement design and the ATC pavement design model proposed by the Contractor. All pages of the M-E Design software output reports for designs proposed by the Contractor shall be provided to CDOT. The exact model (electronic file) that generated the associated design shall also be provided to CDOT for Review. A narrative detailing the changes from the CDOT baseline model and associated detailed description and justification of changes and/or assumptions shall be provided with every ATC pavement design for Review. Review and any associated Review and comment time periods will not begin until all Requests for Information (RFI), narratives, and assumptions/descriptions are received from the Contractor. The Preliminary Alternate Pavement Design Report package shall be submitted to CDOT for Review as part of the Preliminary Design Plans submittal. The Alternate Pavement

Design Report packages shall be submitted to CDOT as part of the Pre-RFC Documents and Final RFC Documents submittals. It is the Contractor's responsibility to furnish this information in a timely manner. CDOT is not responsible for any delays associated with the Contractor furnishing incomplete information to CDOT for ATC pavement designs.

The minimum required pavement section thicknesses for ATC pavement designs within the Project are provided in Table 10-5. These minimum requirements are not ATC eligible.

Table 10-5 Minimum Pavement Section Thicknesses

Parameters	Segment			
	US 550 Mainline	CR 219, CR 220, Frontage Rd (Ramp B)	Roundabout	Bypass Lane (NB 550 to WB 160)
HMA Surface Course	5.5 inches	4.5 (6) inches	N/A	7 inches
PCCP Surface Course	8 inches	8 (8) inches	9.5 inches	9.5 inches
Base Course	4 inches	4 (6) inches	4 inches	4 inches
Subbase Course	24 inches	24 (8) inches	24 inches	24 inches

Chemical stabilization of Base Courses, Subbases, and Subgrades is not allowed on this Project.

Required modifications to Contractor pavement design ATCs as a result of conditions identified by post-design subsurface investigations or Subgrade soil survey performed by the Contractor after CDOT Approval of the ATC shall be the sole responsibility of the Contractor.

Pavement design ATCs shall have consistent pavement types for the full length of each segment identified in Table 10-5. ATCs that vary pavement types within segments will not be allowed.

Pavement designs shall address the differences in Subgrade Materials as described in the GDR. The design parameters shown in Table 10-3 and Table 10-4 are based on the three distinct native Materials that are expected to be encountered at Subgrade elevations along the alignment. These three Materials consist of surficial soils, terrace alluvial gravels and claystone/sandstone/shale bedrock of the Animas Formation. Refer to the GDR for additional descriptions and properties of these Materials. The pavement designs shall be uniform throughout each of the segments identified as having distinct Subgrade conditions. Pavement Material thickness and Subgrade treatment shall be consistent throughout the transverse and longitudinal limits of each section.

Calibration factors used in alternative pavement designs (ATCs) shall be the same as those for the baseline pavement design presented in Exhibit 10-A. Modifications of calibration factors will not be allowed.

Typical CDOT HMA and PCCP mixtures from the *Pavement Design Manual* materials databases shall be used in all M-E Design analysis. Generic, nationwide, or similar samples of HMA and PCCP shall not be utilized in the analysis without prior Approval by CDOT, as applicable for use and design within CDOT Roadways.

The appropriate Performance Grade (PG) binder shall be determined using the web-based tool, LTPPBind Online, that is available from http://www.fhwa.dot.gov/pavement/ltpp/ltppbind.cfm. The binder selection output from LTPPBind shall be included in the ATC pavement design submittal.

All material being modeled within the M-E Design software for ATC pavement designs shall be representative of actual Materials that will be installed. Deviation of modeling procedures in ATC pavement designs from to-be-installed Materials will only be allowed with CDOT's Approval. Recycled PCCP will not be allowed as a component in the new pavement surface Materials.

The maximum allowable Resilient Modulus (M_r) for design purposes shall be:

- 25,000 psi for Base Course
- 15,000 psi for Subbase Course and Subgrade

This design requirement is not ATC eligible.

Rigid pavement Surface Course designs consisting of PCCP shall contain load transfer devices tied to inside and outside Shoulders with doweled outside Shoulders. PCCP shall have a 30-year design life for new pavement. Continuously reinforced PCCP will not be permitted. Precast concrete panels will not be allowed for the permanent pavement surface.

HMA pavement shall be used for tie-ins to existing flexible pavement. Flexible pavement shall have a 20-year design life for new pavement.

Consistent subsurface drainage shall be provided as necessary to prevent saturation of the Subgrade Materials under pavement areas where Subgrade consists of reworked bedrock or surficial soil. Where subsurface drains are used, they shall extend laterally to a location at least 2 feet beyond the edge of pavement to an enclosed water conveyance system or daylighted to an open gravity flow ditch. The Contractor is responsible for managing and mitigating subsurface water per the CDOT *Pavement Design Manual* and Book 2, Section 12.

Where vertical sag areas in alignments can collect and concentrate subsurface water or surface water infiltration, they shall have longitudinal and/or transverse subsurface drains installed under the Pavement Structure to provide gravity drainage of the Subbase and Base Courses. Drains shall be located at the lowest point of the sag and shall be sufficient in size to drain the area. Drain outlets shall be located at culvert inlets or other appropriate locations.

The Contractor shall use the design parameters listed in Table 10-6 to prepare ATC pavement designs. This requirement is not ATC eligible.

Table 10-6 Minimum M-E Design Parameters

Parameters	Input			
	US 550 Mainline	**CR 219, CR 220, Frontage Rd (Ramp B)**	**Roundabout**	**Bypass Lane (NB 550 to WB 160)**
Reliability	90%	90%	90%	90%
Two-way Annual Average Daily Truck Traffic (AADTT) (2020 pulled in 2018)	589	200 (300)	1,500	589
Number of Lanes in Design Direction	2	1	1	1
Percent of Trucks in Design Direction	50	60	60	60
Percent of Trucks in Design Lane	90	100	100	100

Operational speed (in miles per hour [mph])	45 mph	25 mph	20 mph	35 mph
Vehicle Class Distribution (CDOT)	Cluster 3	Cluster 3	Cluster 3	Cluster 3
Growth Rate %	1.25	1.0	1.25	1.25
Growth Function	Compound	Compound	Compound	Compound
Climate Station	Durango, CO	Durango, CO	Durango, CO	Durango, CO
Depth of Water Table	10	10	10	10
Design life (Rigid) (New Construction)	30-year minimum	30-year minimum	30-year minimum	30-year minimum
Design Life (Flexible) (New Construction)	20-year minimum	20-year minimum	NA	20-year minimum
Performance Criteria Thresholds	Per CDOT *M-E Pavement Design Manual*			

All M-E designs for PCCP pavement shall use 13-foot design lane width. Modification of the design lane width shall require appropriate modification of the traffic wander deviation and supporting justification for the modification.

10.3.7. Detours

The Contractor shall be responsible for designing, providing, and maintaining detour pavements in a safe and serviceable condition, subject to CDOT Approval. The Contractor shall determine the type and thickness of detour pavement through the use of M-E Design software and shall submit a detour pavement design to CDOT for Approval a minimum of 14 Days prior to detour paving. Detour pavements shall be designed in accordance with the CDOT *M-E Pavement Design Manual* and CDOT baseline design parameters. The minimum detour thickness design shall be based on the actual Subgrade strength and traffic loading for the length of time the detour is anticipated to be in service or a minimum 2-year design life in M-E Design, whichever is greater. If the Contractor's detour pavement design requires thicknesses greater than the minimum to serve for the life of the detour pavement, these shall be provided at no additional cost. Where detours will include existing paved Shoulders, the Contractor shall verify that there is sufficient Pavement Structure within the Shoulders to accommodate detour traffic.

10.3.8. Ramp, Frontage Road, County Road, and Roundabout Pavements

The Contractor shall verify the required Pavement Structure thicknesses for pavements associated with the roundabout, Ramp B tie-in, CR 219, CR 220, and Frontage Roads utilizing M-E Design software and the CDOT *M-E Pavement Design Manual* for pavement design. Designs shall be in conformance with the minimum requirements in Table 10-3 through Table 10-6. Additional geotechnical investigation may be required to verify Subgrade conditions. Supplemental Geotechnical and Pavement Design Reports shall be submitted CDOT Acceptance as required in subsections 10.2 and 10.3.6 of this Section 10.

10.3.9. Existing Pavement Sections

Existing pavement structures within the Project limits shall be removed and/or replaced as or as necessary to construct the Project and per Book 2 Section as well as discussed in Book 2, Section 11.

10.4 Construction Requirements

Excavation to the profile grades shown on the Reference Drawings, and possible alternative profile grades proposed by the Contractor, will expose transitions in Subgrade Materials. The Contractor shall perform subsurface exploration at Subgrade transition areas to confirm and document thickness of suitable native Subgrade and adequate depth of subexcavation for placement of Subbase Materials.

The Contractor shall construct the PCCP, HMA, and all other pavements in accordance with the requirements of the Contract Documents. Project Special Provisions for pavement construction are included in this Section 10. Construction of permanent pavement ATCs shall not commence until the pavement design has been Accepted by CDOT.

A minimum of 30 Days prior to the proposed construction of any pavement on the Project, a pre-paving conference shall be conducted. Prior to the pre-paving conference, the Contractor shall present mix designs for Acceptance and construction Paving Quality Control Plans (QCP) for HMA and PCCP to CDOT for Approval.

Where it is required to cut existing pavement, the cutting shall be done to a neat work line, full-depth, with a pavement-cutting saw or other method as Approved by CDOT.

The Contractor shall modify existing valve boxes, manholes and inlets located in paving areas so that the pavement can be placed without covering or impacting their function. The Contractor shall submit an inlet/manhole modification plan for CDOT Acceptance with the applicable Traffic Control Plan for each paving operation.

10.4.1. PCCP Construction

Concrete pavement Acceptance shall be by flexural strength criteria.

The Contractor shall texture US 550 Shoulders and ramps in a manner consistent with the CDOT *M&S Standard Plans*. Station stamping is not required.

All jointing plans shall be submitted on 1:50 scale plans with fully scalable and legible letters, numbers, and details. Preliminary PCCP Jointing Plans shall be submitted to CDOT for Review as part of the Preliminary Design Plans Submittal. PCCP Jointing Plans for new construction and for connecting new to existing pavement shall be submitted to CDOT for Acceptance as part of the Pre-RFC Documents and Final RFC Documents submittals.

10.4.2. HMA Pavement Construction

Asphalt pavement Acceptance shall be by gradation criteria.

Hot Mix Asphalt shall be constructed in lifts with maximum thickness of 3-inches.

Tack coats for asphalt products shall be utilized in accordance with the following:

1. Tack coat (diluted) for asphalt products on this Project shall be one part emulsified asphalt (slow setting) and one part water. The rate of application shall be 0.1 gallons per square yard.
2. A tack coat of emulsified asphalt (slow setting) is to be applied to improve bond at the following locations:
    A. Before placing new pavement over existing pavement.
    B. Along the face of all curbs, gutters, manholes, adjacent existing pavement, and other surfaces against which asphalt will be placed.
    C. Between new pavement courses.

The Contactor shall prepare a Quality Control Plan (QCP) outlining the steps taken to minimize segregation of HMA. This plan shall be submitted to CDOT at the pre-paving conference.

10.4.2.1 Pavement Smoothness

The Contractor shall construct the PCCP or flexible pavement for the Project to the smoothness requirements as set forth in Table 10-7.

Table 10-7 Smoothness Requirements

Location	Pavement Smoothness Category
Flexible Pavement	MRI Category II (inches/mile)
Rigid Pavement	MRI Category II (inches/mile)
Proposed Structure	MRI Category II (inches/mile)

Pavement smoothness requirements shall apply to new Shoulders (greater than 12 feet in width), rehabilitated Shoulders (greater than 12 feet in width), and ramps in addition to the mainline pavement. Shoulders less than 12 feet in width and medians constructed as part of this project shall be measured in accordance with subsection 105.07(a). An incentive for pavement smoothness will not be paid. Full payment of the Upset Amount (UA) constitutes acknowledgment of meeting smoothness objectives. Disincentives for poor pavement smoothness shall apply per the Standard Specifications.

10.4.3. Shouldering

Shouldering Material is required along the inside pavement edge for the inside Shoulder of US 550 for 4 feet in width. Shouldering Material is not required along the outside pavement edge for the outside Shoulder of US 550. The shouldering Materials and placement shall conform to the requirements of Project Special Provision – Revision of Sections 304 and 703 Aggregate Base Course (Special).

10.5 Deliverables

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

Table 10-8 Deliverables

Deliverables	Review, Acceptance or Approval	Schedule
Supplemental Geotechnical Investigation Reports (CDOT)	Acceptance	For Review and Comment prior to Acceptance: within 30 Days following completion of the field Work
Supplemental Geotechnical Investigation Reports (County)	Acceptance	To CDOT within 30 Days following completion of the field Work
Landslide Stabilization Designs	Acceptance	45 Days prior to beginning stabilization construction
Supplemental Pavement Design Reports	Acceptance	Prior to the pre-paving conference and at least 30 days prior to placement of HMA on the project.
Preliminary Foundation Design Reports	Review	As part of the Preliminary Design Plans submittal
Foundation Design Reports	Acceptance	30 Days following completion of supplemental field Work or as part of the Pre-RFC Documents submittals
Preliminary Alternate Pavement Design Report	Review	As part of the Preliminary Design Plans submittal
Alternate Pavement Design Report	Acceptance	As part of the Pre-RFC Documents and Final RFC Documents submittals
Preliminary PCCP Jointing Plan	Review	As part of the Preliminary Design Plans Submittal.
PCCP Jointing Plan	Acceptance	As part of the Pre-RFC Documents and Final RFC Documents submittals.
PCCP Jointing Plan for Connecting New to Existing Pavement	Acceptance	As part of the Pre-RFC Documents and Final RFC Documents submittals
PCCP Mix Designs	Approval	Prior to the pre-paving conference and at least 30 Days prior to the use of any PCCP on the Project
HMA Mix Designs	Approval	Prior to the pre-paving conference and at least 30 Days prior to the planned placement of any HMA on the Project
Detour Paving Design	Approval	14 Days prior to beginning detour construction
Paving Quality Control Plan (QCP)	Acceptance	At the pre-paving conference and at a minimum of 30 Days prior to the planned placement of any HMA/PCCP on the Project.
QCP Outlining the Steps Taken to Minimize Segregation of HMA	Approval	At the pre-paving conference and at a minimum of 30 Days prior to the planned placement of any HMA on the Project
Inlet/Manhole Modifications Plans	Acceptance	Concurrently with each applicable Traffic Control Plan (TCP)

10.6 Project Special Provisions

The following Project Special Provisions supplement or modify the CDOT *Standard Specifications for Road and Bridge Construction* and take precedence over the CDOT *Standard Specifications* and plans. The Contractor is responsible to have a copy of the CDOT *Standard Specifications* at all times on the Project Site.

Index of Project Special Provisions

Revision of Section 106	Control of Material (Sampling)
Revision of Section 304	Aggregate Base Course
Revision of Sections 304, 403 and 601	Aggregate Base Course, Hot Mix Asphalt and Concrete Ticket Collection
Revision of Sections 304 and 703	Aggregate Base Course (Special)
Revision of Section 401	Hot Mix Asphalt Compaction
Revision of Section 403	Hot Mix Asphalt
Revision of Section 412	Portland Cement Concrete Pavement
Revision of Section 412	Tie Bar Inspection
Revision of Section 502	Drilling Hole to Facilitate Pile Driving
Revision of Section 621	Detour Pavement

REVISION OF SECTION 106
CONTROL OF MATERIAL (SAMPLING)

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

In subsection 106.03 delete the fifth paragraph and replace with the following:

Samples will be taken by the Department except that the Contractor shall sample the following:

(1) Asphalt cement, asphalt rejuvenating agent and emulsified asphalt in accordance with AASHTO T 40.
(2) Hot mix asphalt items 403 in accordance with Colorado Procedure 41 (CP-41), Method B
(3) A composite of aggregates for hot mix asphalt in accordance with Colorado Procedure 30 (CP-30).
(4) Plastic Portland cement concrete in accordance with AASHTO T 141 and Colorado Procedure 61 (CP-. The contractor shall transport the concrete sample to the place of testing.

CDOT will designate the sampling time, location, and sample size. The sampling will be conducted in the presence of CDOT.

REVISION OF SECTION 304
AGGREGATE BASE COURSE

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

Subsection 304.02 shall include the following:

Materials for the subbase shall be Aggregate Base Course (Class 2) or (Class 3) as shown in subsection 703.03.

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

The aggregate base course (Class 2), (Class 3) and (Class 6) must meet the gradation requirements and have a resistance value of at least 70, 70 and 78 respectively when tested per AASHTO T-190.

REVISION OF SECTIONS 304, 403 AND 601
AGGREGATE BASE COURSE, HOT MIX ASPHALT, AND CONCRETE TICKET COLLECTION

Sections 304, 403 and 601 of the Standard Specifications are hereby revised for this project as follows:

Subsections 304.08, 403.05 and 601.20 shall include the following:

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

load represented (i.e. waste, water added, etc.) shall be noted on the submitted ticket. The Contractor shall fill out CDOT Asphalt Paving Inspector's Daily Report (Form 282) as the material is placed.

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

Each day the Contractor shall provide to CDOT envelopes which contain the previous day's signed tickets, CDOT Form 282, and the following:

1. On each envelope: Project number, date of placement/paving, type of material, daily total and cumulative total.

2. One of the following:

    A. Two adding machine tape tabulations of the weight/volume tickets with corresponding totals run and signed by different persons,
    B. One signed adding machine tape tabulation of the weight/volume tickets that has been checked and signed by a second person,
    C. Signed check tape of computer scale tickets that have a cumulative total. These scale tickets must be consecutive and without voids adjustments.

3. A listing of any overweight loads on the envelope, including ticket numbers and amount over legal limit.

4. A comparison of the actual yield for each day's placement to the theoretical yield. Theoretical yield shall be based on the actual area placed/paved, the planned thickness, and the actual density of the mixture being placed. Any variance greater than +/- 2.5% shall be indicated on the envelope and a written explanation included.

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

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

If the Contractor fails to provide CDOT with the required information on a daily basis, placement or paving will not be allowed to resume unless approved by CDOT.

REVISION OF SECTIONS 304 AND 703
AGGREGATE BASE COURSE (SPECIAL)

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

Subsection 304.01 shall include the following:

The work includes the preparation of the shoulder subgrade by blading to remove vegetation and to slope shoulders away from the edge of the pavement. Shoulder grading shall take place prior to placement of the topmost layer of pavement.

The Contractor shall place Aggregate Base Course (Special) within 3 calendar days of placing pavement materials unless otherwise approved by CDOT. Pavement edge drop-offs 2" or greater immediately adjacent to traffic (within 10 feet of the traveled way) shall not be left unprotected overnight without placement of warning signs, drum channelizing devices, and a wedge of adequate material installed as directed by CDOT.

Subsection 304.02 shall include the following:

Acceptable shoulder gravel alternatives are:

(1) 100 percent asphalt millings that are well graded and a product from an asphalt milling machine.
(2) 100 percent Aggregate Base Course (Class 6).
(3) Any combination of #1 and #2 above.

Milled asphalt material used shall be 100 percent passing the 37.5 mm (1-1/2 inch) sieve.

The material shall not contain clay balls, organic matter, or other deleterious material.

Subsection 304.04 shall include the following:

Aggregate Base Course (Special) shall be placed using a device capable of placing this shoulder material in its final position at the required application rate. The device is subject to CDOT's approval prior to beginning the work. Shoulder gravel shall not be placed on the asphalt roadway surface.

Subsection 304.06 shall include the following:

Aggregate Base Course (Special) shall be compacted with rollers or wheel-rolled with equipment in a manner and to the extent deemed acceptable by CDOT.

REVISION OF SECTION 401
HOT MIX ASPHALT COMPACTION

Section 401 of the Standard Specifications is hereby revised for this project as follows:

Subsection 401.17, first paragraph, shall include the following:

Both steel wheel and pneumatic tire rollers shall be required on this project. If the Contractor has demonstrated to CDOT that all of the manufacturer’s recommendations were followed and the pneumatic tire roller is detrimental to the finished surface of the HMA, CDOT, in cooperation with the Contractor and the CDOT region materials engineer, may waive the pneumatic tire roller requirement. Steel wheel rollers shall not be operated in vibratory mode on bridge decks.

REVISION OF SECTION 403
HOT MIX ASPHALT

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

Subsection 403.02 shall include the following:

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

Table 403-1

Property	Test Method	Value For Grading			
				SX(75)	SX(75) (Patching)
Air Voids, percent at: N (design)	CPL 5115			3.0 – 4.0	3.0 – 4.0
Lab Compaction (Revolutions): N (design)	CPL 5115			75	75
Stability, minimum	CPL 5106			28	28
Aggregate Retained on the 4.75 mm (No. 4) Sieve with at least 2 Mechanically Induced fractured faces, % minimum*	CP 45			60	60
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109 Method B			80	80
Minimum Dry Split Tensile Strength, kPa (psi)	CPL 5109 Method B			205 (30)	205 (30)
Grade of Asphalt Cement, Top Layer				PG 58-28	PG 58-28
Grade of Asphalt Cement, Layers below Top				PG 58-28	PG 58-28
Voids in the Mineral Aggregate (VMA) % minimum	CP 48			See Table 403-2	See Table 403-2
Voids Filled with Asphalt (VFA), %	AI MS-2			65-80	65-80
Dust to Asphalt Ratio Fine Gradation Coarse Gradation	CP 50			0.60 – 1.20 0.80 – 1.60	0.60 – 1.20 0.80 – 1.60

Note:AI MS-2 = Asphalt Institute Manual Series 2

Note:Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems.

Note:Gradations for mixes with a nominal maximum aggregate size of one-inch or larger are considered a coarse gradation if they pass below the maximum density line at the #4 screen.
Gradations for mixes with a nominal maximum aggregate size of 3/4" to 3/8" are considered a coarse gradation if they pass below the maximum density line at the #8 screen.
Gradations for mixes with a nominal maximum aggregate size of #4 or smaller are considered a coarse gradation if they pass below the maximum density line at the #16 screen.

*Fractured face requirements for SF may be waived by RME depending on project conditions.

All mix designs shall be run with a gyratory compaction angle of 1.25 degrees and properties must satisfy Table 403-1. Form 43 will establish construction targets for Asphalt Cement and all mix properties at Air Voids up to 1.0 percent below the mix design optimum. CDOT will establish the production asphalt cement and volumetric targets based on the Contractor's mix design and the relationships shown between the hot mix asphalt mixture volumetric properties and asphalt cement contents on the Form 429. CDOT may select a different AC content other than the one shown at optimum on the Contractor's mix design in order to establish the production targets as contained on the Form 43. Historically, Air Voids adjustments typically result in asphalt cement increases from 0.1 to 0.5 percent. Contractors bidding the project should anticipate this change and factor it into their unit price bid.

Table 403-2

Minimum Voids in the Mineral Aggregate (VMA)			
Nominal Maximum Size*, mm (inches)	*****Design Air Voids ****		
	3.5%	**4.0%**	**4.5%**
37.5 (1½)	11.6	11.7	11.8
25.0 (1)	12.6	12.7	12.8
19.0 (¾)	13.6	13.7	13.8
12.5 (½)	14.6	14.7	14.8
9.5 (⅜)	15.6	15.7	15.8

***** The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%.
****** Interpolate specified VMA values for design air voids between those listed.
*** Extrapolate specified VMA values for production air voids beyond those listed.

The Contractor shall prepare a quality control plan outlining the steps taken to minimize segregation of HMA. This plan shall be submitted to CDOT for Acceptance at the pre-paving conference and at a minimum of 30 Days prior to beginning the paving operations. When CDOT determines that segregation is unacceptable, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

The hot mix asphalt may contain reclaimed asphalt pavement.

CDOT approved Warm Mix Asphalt (WMA) may be allowed on this project in accordance with CP 59. Unique requirements for WMA design, production and acceptance testing as documented during CDOT WMA approval shall be submitted and approved prior to creation of the Form 43 and before any WMA production on the project. Delays to the project due to WMA submittal and review will be considered within the Contractor's control and will be non-excusable.

Hot mix asphalt for patching shall conform to the gradation requirements for Hot Mix Asphalt (Grading SX).

A minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the

aggregate for all hot mix asphalt.

Acceptance samples shall be taken at the location specified in Method B of CP 41.

Hot Mix Asphalt (HMA) sampling according to CP-41 Method B Procedure 8.1 (windrow) will satisfy the split requirements of CP-17 Section 3.2 Blind Split Sample.

Subsection 403.03 shall include the following:

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

REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

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

Subsection 412.13 shall include the following:

(d) *Pressure Relief Joints*. Pressure relief joints in PCCP as shown in the Book 4 drawing titled Concrete Expansion Joint Details shall be installed 1) at a minimum of one per mile increments and 2) immediately adjacent to bridge structures and installed to the requirements and included Pressure Relief Joint Standard Drawings included herein.

Preformed elastomeric joint seals shall conform to the requirements provided in Table 412-2.

General: This material is a flexible, low density, multicellular homogeneous neoprene foam. It must be designed to create constant compression with the concrete joint faces once it is installed. If there is a possibility that the pavement will contract and the seal will be required to act in tension an epoxy adhesive must be used to secure the seal to the concrete joint. The joint seal is to be four inches wide and be inserted into a 3 ¾ inch joint gap. The depth and length shall be determined by the manufacturer. The product must conform to AASHTO M 220 and ASTM D 2628 when pertaining to pavement joints, or AASHTO M 297 and ASTM D 3542 if the product is intended for bridge use. Reinforcing steel shall be grade 60.

Table 412-2 Physical Requirements for Preformed Elastomeric Joint Seals

Property	Requirements	ASTM Method
Tensile Strength, min	2000 psi	D 412
Elongation at break, min	250%	D 412
Hardness Type A durometer, points	55 ± 5	D 2240 (modified)[A]
Oven aging, 70h at 212°F		D 573
Tensile Strength loss, max	20% max	
Elongation loss, max	20% max	
Hardness, Type A durometer, points change	0 to + 10	
Oil Swell ASTM Oil 3 70h at 212°F		D 471
Weight change max	45% max	
Ozone resistance		D 1149 (modified)[B]
20% strain 300 pphm in air 70h at 104°F	no cracks	
Low-temperature stiffening 7 Days at 14°F		D 2240
Hardness, Type A durometer, points change	0 to + 15	
Low-temperature recovery,[C] 72h at 14°F, 50% deflection, min	88%	D 2628
Low-temperature recovery,[C] 22h at -20°F, 50% deflection, min	83%	D 2628
High-temperature recovery,[C] 70h at 212°F, 50% deflection, min	85%	D 2628
Compression-deflection at 80% of nominal width, min	3.5 lbf/in	D 2628

[A] The term "modified" in the table relates to the specimen preparation. The use of joint seal as the specimen source requires that more plies than specified in either of the modified test procedures be used. Such specimen modification shall be agreed upon by the purchaser and seller prior to testing. The hardness test shall be made with the durometer in a durometer stand as recommended in Method D 2240
[B] Test in accordance with Procedure A of D 518
[C] Cracking, splitting, or sticking of a specimen during a recovery test shall mean that the specimen has failed the test

All epoxies, adhesives, lubricants, cementing agents, etc., that are required for installation of the seals are to be specified and provided by the manufacturer. All installation is to be in strict accordance with the specified procedures and practices of the seal manufacturer.

Properly package all of these components and provide instructions for safe handling, storage, transport, proper disposal of component and container, emergency procedures, etc. Durably label all containers with name and address of the manufacturer, date of manufacture, shelf life or expiration date if applicable, a unique identifier such as a batch or lot number, and any other relevant information.

Openings for the joint material shall be formed or sawed. Prior to installation of the joint material the faces of the joint shall be sandblasted followed by an air blast to clean all dust and debris from the joint face. Sandblasting and air blasting shall be limited to the amount that may be sealed in the same workday. A foam spacer block may be used beneath the seal to provide additional stability, but the foam must be easily compressible, so not to interfere with the joint or the joint seal's compression. Application and installation equipment shall be provided by the manufacturer and shall be inspected to ensure that installation meets the design and manufacturer's requirements.

REVISION OF SECTION 412
TIE BAR INSPECTION

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

Subsection 412.13(b) 1 shall include the following:

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

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

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

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

REVISION OF SECTION 502
DRILLING HOLE TO FACILITATE PILE DRIVING

Section 502 of the Standard Specifications is hereby revised for this project as follows:

Subsection 502.06 shall include the following:

When the plans call for drilled holes filled with slurry or mud made from clay or bentonite, the diameter of the drilled holes shall be at least two inches greater than either the pile diameter or the diagonal corner to corner measurement of the pile cross section, unless otherwise designated on the plans. Oversized holes due to sloughing, drifting, over-drilling, or other causes shall be filled with the accepted slurry or mud at the contractor's expense.

The following mixture will yield approximately 1.2 cubic yards of an acceptable slurry or mud:

(a) 50 lbs. dry bentonite powder

(b) Approximately 125 gallons of water (or sufficient amount to make a pourable mix)

(c) 1 cubic yard of sand; (approximately 2800 lbs.) reasonably free of material larger than 1/2 inch.

The sand need not be clean. Local soil reasonably free of material larger than 1/2 inch may be substituted for the sand. Cement, lime, flyash, or other pozzolanic or highly alkaline materials shall not be added.

This mixture may be mixed by auger in the drilled hole, by paddle type mortar mixers, by portable or semiportable concrete mixers, or by drum type concrete mixer trucks.

If the mixture is placed or mixed in the hole prior to pile driving, the top two to three feet of the hole may be filled with loose local soil to prevent splashing of the slurry or mud.

REVISION OF SECTION 621
DETOUR PAVEMENT

Section 621 is hereby added to the Standard Specifications for this project and shall include the following:

DESCRIPTION

This work shall consist of designing, submitting a phasing plan for Review and Acceptance; constructing, maintaining and removal of detour as well as all required traffic shifts as required to maintain two-lane traffic on US 550 during construction. This item shall include all work and materials necessary to provide a detour roadway meeting or exceeding the requirements of Book 2, Section 16. The detour roadway shall be constructed so as to meet or exceed minimum design standards of *A Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials, 2011.

MATERIALS

The Contractor shall be responsible for quality control required to assure adequate detour construction. This includes, but is not limited to embankments, subgrade, subbase and Hot Mix Asphalt used in the construction of the detour.

CONSTRUCTION REQUIREMENTS

The contractor shall complete and submit a detailed detour phasing plan consistent with the Transportation Management Plan per Book 2, Section 16 for CDOT Review and Acceptance. The Contractor's plan shall be submitted to CDOT a minimum of 14 days prior to any detour construction activities. Any deviations from the Contractor's Accepted phasing plans and these specifications must be submitted to CDOT for Review and Acceptance. The plan shall include both plan view and typical sections illustrating phasing, signing, striping, temporary pavement, lane widths, shoulder widths and lane taper lengths.

The minimum lane width shall be per Book 2, Section 16.

The minimum thickness of Hot Mix Asphalt shall be 4 inches. If the materials used require that the Contractor provide thickness greater than the minimums to serve the life of the detour, these shall be provided at no additional cost. The Contractor shall utilize the existing pavement surface to the maximum extent practical. All pavement markings and other traffic control devices shall be provided in accordance with the traffic control plan. When it is no longer needed to maintain traffic, the Contractor shall remove and dispose of the detour pavement and return the ground to its original state or reconstruct the area in the manner as shown in the final construction plans and specifications.

MAINTENANCE OF DETOUR

The Contractor shall maintain detours per Book 2, Section 16.

10.7 Exhibits

Exhibit 10-A Colorado Specific M-E Pavement Design Calibration Factors, 2019

Table 10-A1 New PCCP Calibration Factors

Distress Criteria	Calibration Factor
PCC Cracking	
PCC Cracking C1	2
PCC Cracking C2	1.22
PCC Cracking C4	0.6
PCC Cracking C5	-2.05
PCC Reliability Cracking Standard Deviation	Pow(57.08*CRACK,0.33) + 1.5
PCC Faulting	
PCC Faulting C1	0.51040000000000008
PCC Faulting C2	0.00838
PCC Faulting C3	0.00147
PCC Faulting C4	0.008345
PCC Faulting C5	5999
PCC Faulting C6	0.8404
PCC Faulting C7	5.9293000000000005
PCC Faulting C8	400
PCC Reliability Faulting Standard Deviation	0.0831*Pow(FAULT,0.3426) + 0.00521
PCC IRI-CRCP	
PCC IRI C1	3.15
PCC IRI C2	28.35
PCC IRI Initial CRCP Std. Dev.	5.4
PCC IRI-JPCP	
PCC IRI J1	0.8203
PCC IRI J2	0.44170000000000004
PCC IRI J3	1.4929000000000001
PCC IRI J4	25.240000000000002
PCC IRI Initial JPCP Std. Dev.	5.4
PCC Punchout	
PCC CRCP C1	2
PCC CRCP C2	1.22
PCC CRCP C3	107.73
PCC CRCP C4	2.475
PCC CRCP C5	-0.785
PCC CRCP Crack	1
PCC Reliability PO Standard Deviation	2.208 * Pow(PO,0.5316)

Table 10-A2 New AC Calibration Factors

Distress Criteria	Calibration Factor
AC Cracking	
AC Cracking Bottom Standard Deviation	1 + 15/(1+exp(-3.1472-4.1349*LOG10(BOTTOM+0.0001)))
AC Cracking C1 Bottom	0.021
AC Cracking C1 Top	7
AC Cracking C2 Bottom	2.35
AC Cracking C2 Top	3.5
AC Cracking C3 Bottom	6000
AC Cracking C3 Top	0
AC Cracking C4 Top	1000
AC Cracking Top Standard Deviation	200 + 2300/(1+exp(1.072-2.1654*LOG10(TOP+0.0001)))
AC Fatigue	
AC Fatigue BF1	130.3674
AC Fatigue BF2	1
AC Fatigue BF3	1.2177989999999999
AC Fatigue K1	0.007566
AC Fatigue K2	3.9492000000000003
AC Fatigue K3	1.2810000000000001
AC Rutting	
AC Rutting BR1 (1)	6.7
AC Rutting BR2 (1)	1
AC Rutting BR3 (1)	1
AC Rutting K1 (1)	-3.35412
AC Rutting K2 (1)	1.5606
AC Rutting K3 (1)	0.3791
AC Rutting Standard Deviation	0.1414 * Pow(RUT,0.25) + 0.001
IRI	
IRI Flexible C1	50
IRI Flexible C2	0.55
IRI Flexible C3	0.0111
IRI Flexible C4	0.02
IRI Flexible Over PCCC1	40.800000000000004
IRI Flexible Over PCCC2	0.57500000000000007
IRI Flexible Over PCCC3	0.0014
IRI Flexible Over PCCC4	0.00825
Subgrade Rutting	
Fine Subgrade Rutting BS1	0.37
Fine Subgrade Rutting K1	1.35

Distress Criteria	Calibration Factor
Fine Subgrade Rutting Standard Deviation	0.0663 * Pow(SUBRUT,0.5) + 0.001
Granular Subgrade Rutting BS1	0.22
Granular Subgrade Rutting K1	2.0300000000000002
Granular Subgrade Rutting Standard Deviation	0.0104 * Pow(BASERUT,0.67) + 0.001
Thermal Fracture	
AC Thermal Cracking Level 1K	6.3
AC Thermal Cracking Level 1 Std. Dev.	0.1468 * THERMAL + 65.027
AC Thermal Cracking Level 2K	0.5
AC Thermal Cracking level 2 Std. Dev.	0.2841 * THERMAL + 55.462
AC Thermal Cracking Level 3K	6.3
AC Thermal Cracking Level 3 Std. Dev.	0.3972 * THERMAL + 20.422

Table 10-A3 AC over AC Rehabilitation Calibration Factors

Distress Criteria	Calibration Factor
AC Cracking	
AC Cracking Bottom Standard Deviation	1+15 /(1+exp(-3.1472-4.1349*LOG10(BOTTOM+0.0001)))
AC Cracking C1 Bottom	0.021
AC Cracking C1 Top	7
AC Cracking C2 Bottom	2.35
AC Cracking C2 Top	3.5
AC Cracking C3 Bottom	6000
AC Cracking C3 Top	0
AC Cracking C4 Top	1000
AC Cracking Top Standard Deviation	200 + 2300/(1+exp(1.072-2.1654*LOG10(TOP+0.0001)))
AC Fatigue	
AC Fatigue BF1	130.3674
AC Fatigue BF2	1
AC Fatigue BF3	1.2177989999999999
AC Fatigue K1	0.007566
AC Fatigue K2	3.9492000000000003
AC Fatigue K3	1.2810000000000001
AC Rutting	
AC Rutting BR1 (1)	6.7
AC Rutting BR2 (1)	1
AC Rutting BR3 (1)	1
AC Rutting K1 (1)	-3.35412
AC Rutting K2 (1)	1.5606
AC Rutting k3 (1)	0.3791
AC Rutting Standard Deviation	0.1414 * Pow(RUT,0.25) + 0.001
IRI	
IRI Flexible C1	50
IRI Flexible C2	0.55
IRI Flexible C3	0.0111
IRI Flexible C4	0.02
IRI Flexible Over PCCC1	40.800000000000004
IRI Flexible Over PCCC2	0.57500000000000007
IRI Flexible Over PCCC3	0.0014
IRI Flexible Over PCCC4	0.00825
Reflective Fatigue Cracking AC	
Reflective Fatigue Cracking AC C1	0.38
Reflective Fatigue Cracking AC C2	1.6600000000000001

Distress Criteria	Calibration Factor
Reflective Fatigue Cracking AC C3	2.72
Reflective Fatigue Cracking AC C4	105.4
Reflective Fatigue Cracking AC C5	-7.0200000000000005
Reflective Fatigue Cracking AC K1	0.012
Reflective Fatigue Cracking AC K2	0.005
Reflective Fatigue Cracking AC K3	1
Reflective Fatigue Cracking AC Std. Dev.	1.1097 * Pow(FATIGUE,0.6804) + 1.23
Reflective Transverse Cracking AC	
Reflective Transverse Cracking AC C1	3.22
Reflective Transverse Cracking AC C2	25.7
Reflective Transverse Cracking AC C3	0.1
Reflective Transverse Cracking AC C4	133.4
Reflective Transverse Cracking AC C5	-72.4
Reflective Transverse Cracking AC K1	0.012
Reflective Transverse Cracking AC K2	0.005
Reflective Transverse Cracking AC K3	1
Reflective Transverse Cracking AC Std. Dev.	70.98 * Pow(TRANSVERSE,0.2994) + 30.12
Subgrade Rutting	
Fine Subgrade Rutting BS1	0.37
Fine Subgrade Rutting K1	1.35
Fine Subgrade Rutting Standard Deviation	0.0663 * Pow(SUBRUT,0.5) + 0.001
Granular Subgrade Rutting BS1	0.22
Granular Subgrade Rutting K1	2.0300000000000002
Granular Subgrade Rutting Standard Deviation	0.0104 * Pow(BASERUT,0.67) + 0.001
Thermal Fracture	
AC Thermal Cracking Level 1K	1.5
AC Thermal Cracking Level 2K	0.5
AC Thermal Cracking Level 3K	1.5