Texas Department of Transportation

DESIGN-BUILD SPECIAL SPECIFICATIONS

Items 10,000, 10,002, 10,003

February 22, 2019

Design-Build Special Specification Item 10,000 Skillman/Audelia Interchange

10000.1 **General Requirements**

The City of Dallas has planned for local enhancements associated with the proposed improvements to Skillman Street and Audelia Road (CSJ: 2374-01-171), herein referred to as the Skillman/Audelia Interchange. These local enhancements include roadway improvements, construction of a single-span tied-arch Skillman/Audelia bridge over I-635, and aesthetic improvements that are unique to the Skillman/Audelia interchange.

DB Contractor shall design and construct the interchange in conformance with the Contract Documents, current TxDOT policies and procedures, design manuals, TxDOT Standard Specifications and Special Specifications, applicable City of Dallas Codes and Ordinances, TxDOT Schematic Design, the approved I-635 LBJ East Aesthetic Technical Guidelines, Skillman-Audelia Hardscape and Landscape Aesthetic Concept Plan, which are included in the RIDs, the requirements set forth in this Item 10,000, and the requirements set forth in Item 19, “Roadways,” Item 21, “Structures,” Item 23, “Aesthetics and Landscaping,” and Item 28, “Bicycle and Pedestrian Facilities.”

10000.2 **Roadways**

DB Contractor shall design and construct the Skillman/Audelia interchange roadway improvements in accordance with the TxDOT Schematic Design and the requirements set forth in Item 19, “Roadways,” and as amended below by the clauses included with this Item 10,000.

10000.2.1 **Roadway Design Requirements**

DB Contractor shall design the elements of the Project related to the Skillman/Audelia interchange (as defined in Section 10000.1) to meet or exceed the geometric design criteria shown in Table 10000-1.

Table 10000-1: Skillman/Audelia Interchange Geometric Design Criteria

Items [1]	Skillman Street	Audelia Road (North)	Audelia Road (South)	Whitehurst Drive	Adleta Court	U-turn
Roadway Classification	Urban Arterial	Urban Arterial	Urban Arterial	Major Collector	Local Access	Urban Arterial
Type of Facility	Low-Speed	Low-Speed	Low-Speed	Low-Speed	Low-Speed	Low-Speed
Design Speed (mph)	40 mph	40 mph	35 mph	30 mph	30 mph	15 mph
Horizontal Alignment						
Stopping Sight Distance (ft)	305	305	250	200	200	80
Min Radius NC (w/o superelevation)	762	762	510	333	333	50
Min Radius RC	593	593	408	273	273	44
Superelevation Rate (%)	e(Max) = 4%	e(Max) = 4%	e(Max) = 4%	e(Max) = 4%	e(Max) = 4%	e(Max)=4%
Relative Grade for Super Transition	0.58% Relative Gradient	0.58% Relative Gradient	0.62% Relative Gradient	0.66% Relative Gradient	0.66% Relative Gradient	0.78% Relative Gradient
Vertical Alignment						
Type of Terrain	Level	Level	Level	Level	Level	Level
Longitudinal Gradient	0.35% Min 7% Max	0.35% Min 7% Max	0.35% Min 7% Max	0.35% Min 9% Max	0.35% Min 5% Max, 8% Max (Commercial)	0.35% Min 7% Max
K Value for Crest Curves, Min	44	44	29	19	19	3
K Value for Sag Curves, Min	64	64	49	37	37	10
Grade Change without a Vertical Curve	1.0 % Max	1.0 % Max	1.0 % Max	1.0 % Max	1.0 % Max	1.0% Max
Vertical Clearance						
Roadways	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"	16'-6"
Cross-Sectional Elements						
Normal Cross Slope	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Width of Travel Lanes **[2]**	11' Min 14' Min Outside Shared Use	11' Min 14' Min Outside Shared Use	11' Min 14' Min Outside Shared Use	11' Min 14' Min Outside Shared Use	11' Min	20' Min
Width of Bike Lanes	N/A	5' Clear from Face of Curb	5' Clear from Face of Curb	N/A	5' Clear from Face of Curb	N/A
Buffer for the Bike Lane	N/A	2'	2'	N/A	2'	N/A
Width of Two Way Cycle Track	8'	N/A	N/A	N/A	N/A	N/A
Buffer for the Two Way Cycle Track **[3]**	5'	N/A	N/A	N/A	N/A	N/A
Shoulder Widths						
Inside	N/A	N/A	N/A	N/A	N/A	N/A
Outside	N/A	N/A	N/A	N/A	N/A	N/A
Width of Speed Change Lane	10' Min	10' Min	10' Min	10' Min	9' Min	N/A
Medians/Managed Lane Separation	Raised 6' Min	Raised 6' Min	Raised 6' Min	Raised 6' Min	Raised 6' Min	N/A
Offset to Face of Curb	1' Min, 2' Des	1' Min, 2' Des	1' Min, 2' Des	1' Min, 2' Des	1' Min, 2' Des	1' Min, 2' Des
Clear Zone Width	Curb: 4' Min, 6' Des Uncurbed: 10'	Curb: 4' Min, 6' Des Uncurbed: 10'	Curb: 4' Min, 6' Des Uncurbed: 10'	Curb: 4' Min, 6' Des Uncurbed: 10'	Curb: 4' Min, 6' Des Uncurbed: 10'	Curb: 4' Min, 6' Des Uncurbed: 10'
Side Slopes						
Within Clear Zone	4:1 Max	4:1 Max	4:1 Max	4:1Max	4:1 Max	4:1 Max
Outside Clear Zone	3:1 Max	3:1 Max	3:1 Max	3:1 Max	3:1 Max	3:1 Max
Sidewalk Width **[4]**	5' Min (with 4' to 6' buffer) 6' Min (Adjacent to Curb)	5' Min (with 4' to 6' buffer) 6' Min (Adjacent to Curb)	5' Min (with 4' to 6' buffer) 6' Min (Adjacent to Curb)	5' Min (with 4' to 6' buffer) 6' Min (Adjacent to Curb)	5' Min (with 4' to 6' buffer) 6' Min (Adjacent to Curb)	N/A
Border Width **[6]**	15' Min, 20' Des	15' Min, 20' Des	15' Min, 20' Des	15' Min, 20' Des	15' Min, 20' Des	N/A
Intersections						
Cross Streets Corner Radii Design Vehicles	WB-62	WB-62	WB-62	WB-62	WB-62	WB-62
Intersection Sight Distance	Intersection sight distance to be determined by the various cases shown in AASHTO.					
Driveways Corner Radii **[5]**	25'	25'	25'	25'	25'	25'

Notes:

[1] References: TxDOT *Roadway Design Manual* (April 2018); AASHTO *A Policy on Geometric Design of Highways and Streets* (2004); TxDOT *Bridge Project Development Manual* (December 2012); AASHTO *HOV Guide* (2004); AASHTO *A Policy on Geometric Design of Highways and Streets* (2011); AASHTO *Guide for the Development of Bicycle Facilities* (2012).

[2] If dedicated bicycle lanes are utilized in lieu of shared-use lanes, the bike lane should provide 5 ft. clear from face of curb plus a 2-foot buffer to the nearest travel lane. The 14-foot outside share use lane is measured from the longitudinal joint of the gutter pan to lane stripe. The gutter pan/curb offset is not included as part of the usable width.

[3] A traffic barrier or railing shall be provided between the cycle track and the roadway along the Skillman bridge structure. A traffic barrier or railing should be provided between the cycle track and the roadway if a 5-foot buffer cannot be provided.

[4] A traffic barrier or railing shall be provided between the sidewalk and the roadway along the Skillman bridge structure. Sidewalk designs including street and driveway crossing should be ADA compliant.

[5] Driveway corner radii shall not be less than the existing radii.

[6] Border width less than the minimum requirement of 15 feet will be allowed only at locations shown on the TxDOT Schematic Design.

10000.3 **Structures General Requirements**

DB Contractor shall design and construct the Skillman/Audelia bridge in accordance with the requirements set forth in Item 21, "Structures," this Item 10,000, current TxDOT policies and procedures, design manuals, and TxDOT Standard Specifications and Special Specifications. Fracture critical members shall not be used unless approved by TxDOT. The design of the Skillman/Audelia bridge shall meet the aesthetic and visual intent of the requirements set forth below and the preliminary set of plans located in the RIDs.

10000.4 **Structures Design Requirements**

Deviations from requirements in this Item 10,000 shall not be permitted unless review and approved by TxDOT at its sole discretion.

DB Contractor shall design and construct the Skillman/Audelia bridge to be comprised of two exterior arches with two exterior arch bottom chords, a partial center arch with a center girder, beam bracings and a series of arch cables as shown in Figure 1 and Figure 4.

The alignment of the Skillman/Audelia bridge shall not deviate more than 10 feet from the centerline at any point along the entire length of the alignment shown on the TxDOT Schematic Design.

DB Contractor shall design the arches to address the vehicular collision force requirements as described in the TxDOT *Bridge Design Manual – LRFD,* Chapter 2, Section 2. DB Contractor shall fabricate all tension steel members subject to live loads using a fracture control plan in accordance with the American Welding Society (AWS) *D1.5, Bridge Welding Code*.

The hanger cables shall be protected from vehicular impacts.

10000.4.1 **Bridge Deck and Superstructures**

The Skillman/Audelia bridge over I-635 shall be designed as a single-span structure with an appearance of a tied-arch structure. The bridge shall span all general purpose lanes, ramps, and managed lanes from center-to-center of bearing and maintain a minimum 16'-6" vertical clearance below the bridge low chord to the proposed roadway below.

The total width of the bridge, with the inclusion of a traffic rail along the left and right edges, shall be designed to include all travel lanes, including both u-turns, bicycle lanes, two-way cycle tracks, and sidewalks as shown on the TxDOT Schematic Design and in accordance with the requirements set forth in Item 19, "Roadways," Item 28, "Bicycle and Pedestrian Facilities," and this Item 10,000. The total width of the bridge shall increase near the abutments to accommodate the turning radius of the design vehicle listed in the specifications.

The bridge shall consist of two exterior tied arches and a center partial arch. The exterior arches shall be sloped inward from a minimum of 10° to a maximum of 20° from the vertical and measure a minimum of 60'-6" from the profile grade line (PGL) to the crown. The center partial arch shall measure a minimum of 60'-6" from the PGL to outside crown and have a minimum vertical clearance of 32'-0" above the PGL at each end. DB Contractor shall design the partial arch to support a center girder via hanger cables and determine the number of cables required.

The depth of the superstructure shall be limited to:

- 6' below the top of finished deck at the centerline of the center girder
- 6'– 5" above the top of finished deck at the centerline of the exterior girders
- a maximum of 33" for the floor beams

The cross slope of the bridge deck shall be designed to a maximum of 2%.

The geometry of the arch structural elements is described below in Figure 2. All steel arches and girders shall have a typical box section as shown in Figure 3 below.

10000.4.1.1 **Hanger Cables**

Cables shall be arrayed as described in the sections, figures, and tables below.

10000.4.1.2 **West and East Arches**

DB Contractor shall design and construct the west and east arches with a series of hanger cables. Half of the total hangers shall be located inside the arch centerline and the other half shall be located outside the

arch centerline. Each hanger cable shall have a minimum of an equivalent outside diameter of a cable consisting of 22 ~ 0.6" diameter tendons. The hanger geometry is detailed below. The inside hangers shall all slope in the same general direction and the outside hangers shall all slope in the opposite direction. The west and east arches shall be constructed with hangers that match the geometry described in this section and Figure 1 through Figure 4.

10000.4.1.3 Center Arch

Each hanger cable at the partial arch shall be vertical and have a minimum of an equivalent outside diameter of a cable consisting of 43 ~ 0.6" diameter tendons. The hangers shall be located symmetrically along the length of the partial arch and shall be spaced evenly across the partial center arch. The partial arch and center girder shall be constructed with hangers that match the geometry described in this section and Figure 1 through Figure 5.

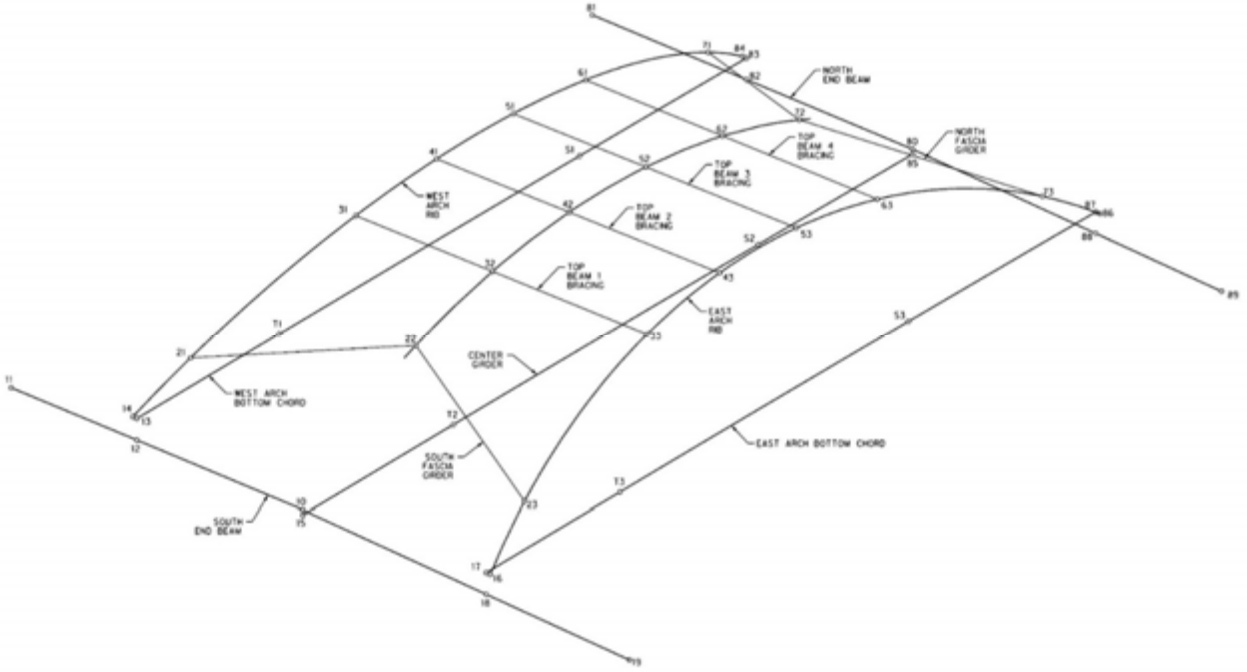

Figure 1: Bridge Frame

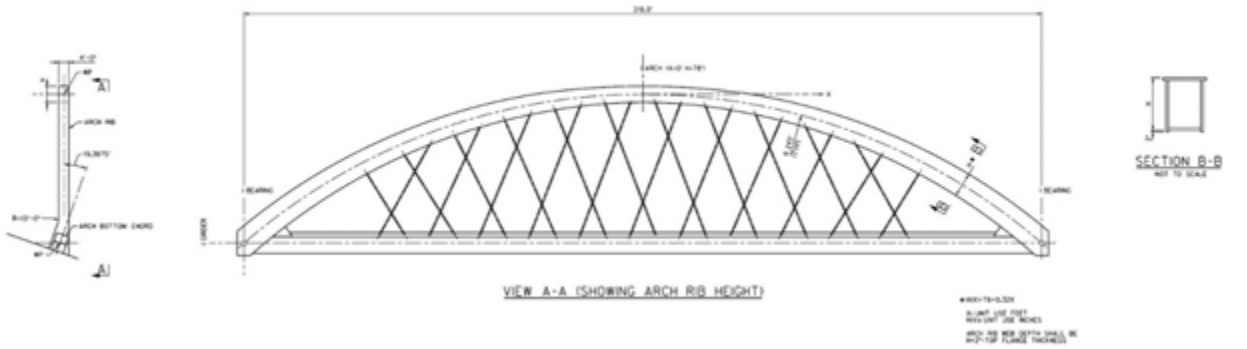

Figure 2: Arch Framing Geometry

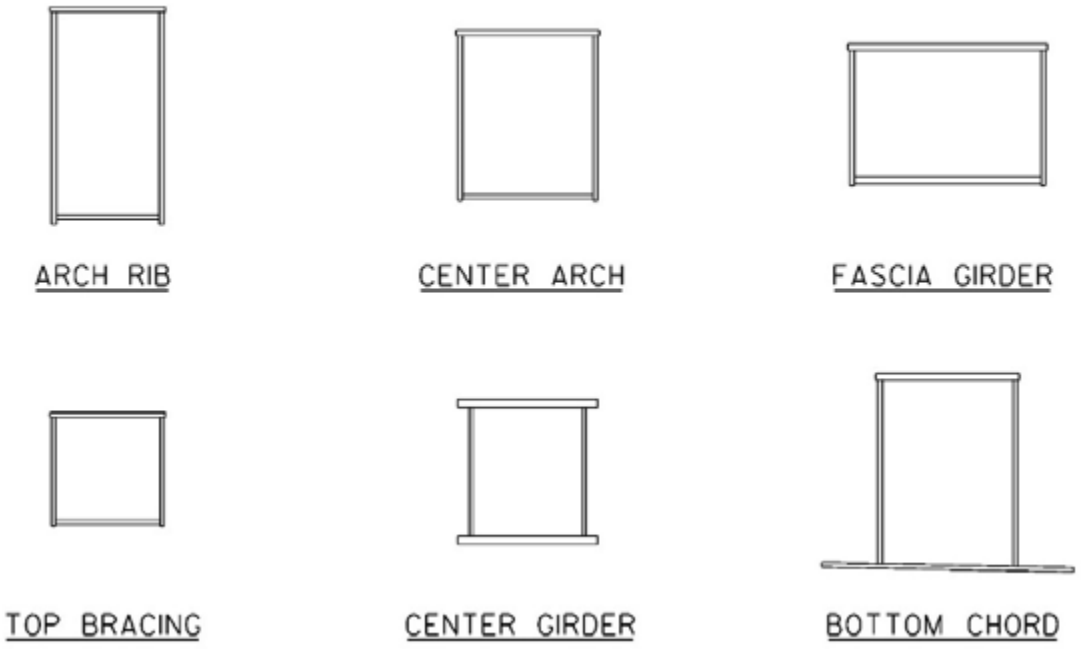

Figure 3: Typical Arch and Girder Sections

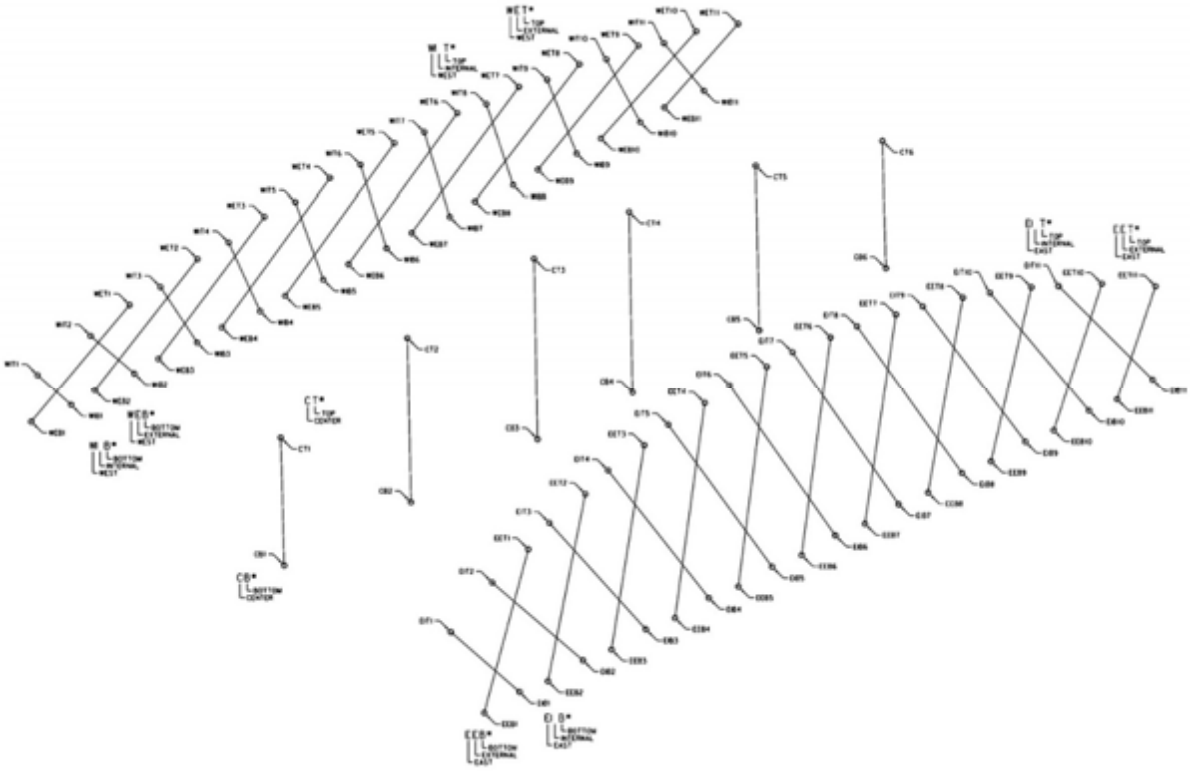

Figure 4: Isometric Hanger Cable View

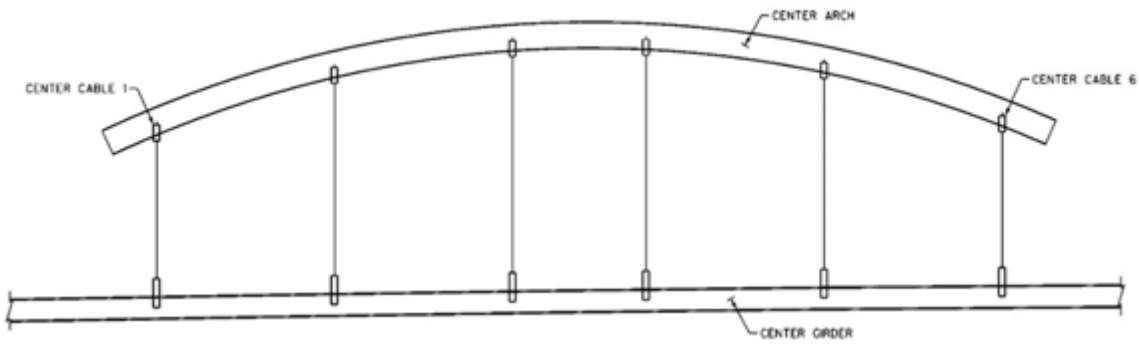

Figure 5: Center Arch Hanger Cables

10000.4.2 **Concrete Design**

Concrete design shall be in accordance with Item 21, "Structures."

10000.4.3 **Post-Tensioning Design**

Post-Tension strands shall be designed in accordance with TxDOT *Standard Specification Item 426*.

10000.4.4 **Bridge Substructure**

10000.4.4.1 **Abutments**

Each bridge abutment shall be a vertical abutment. DB Contractor shall design and construct retaining walls in accordance with Item 21, "Structures."

10000.4.5 **In-Service Design Documentations**

DB Contractor shall develop, engineer and submit the design calculations for the in-service structure. Design documentations shall include, but is not limited to, the following design calculations:

- Minimum and maximum vertical and horizontal reactions at all support locations
- The expected maximum bearing, shear, compression and tensile stresses in the arch as produced by the in-service condition.
- Design of arch and deck camber curves
- Cable design loads and stressing sequence
- Vortex shedding investigation and potential dynamic amplification

10000.5 **Construction Requirements**

Construction shall be in accordance with Item 21, "Structures," TxDOT Standard Specifications, and is supplemented by the following:

10000.5.1 **Erection Manual**

DB Contractor shall develop, engineer, and submit a detailed erection manual for the fabrication and erection of the following:

- Arch and temporary column foundations
- Arches
- Longitudinal girders
- Floor beams and bracing
- Precast concrete panels
- Cast-in-place concrete deck
- Bearings
- Cables

The erection manual shall follow the applicable portions of the current TxDOT Standard Specifications and this Item 10,000.

A Professional Engineer licensed in the State of Texas (DB Contractor's erection engineer) is required to prepare and seal all design calculations, plans, methods and procedures to be used in the submitted erection manual for approval. The DB Contractor's structural engineer shall have proven experience in the erection engineering of arch bridges or other cable supported structures.

Submit the erection manual to the Engineer of Record for approval prior to fabrication and construction of the Skillman/Audelia bridge. The erection manual will outline the intended methods of constructing the bridge components.

Any deviation from the approved construction loads and erection sequence shall be submitted to the Engineer of Record for review prior to those steps occurring. Work shall not start prior to receipt by the DB Contractor of the Engineer of Record's review and approval of the proposed changes to the erection manual.

10000.5.1.1 Erection Design Details

The erection manual shall include, but not be limited to, the following design details:

- Complete sequence of erection for temporary and permanent structures
- All erection equipment to be used on site
- All shored excavations
- Installation procedures and schedules for all temporary falsework supports, including any proposed limits of required excavation and subsequent recompaction of the temporary staging work areas
- Crane mats and other temporary foundations including size and locations
- Temporary falsework supports of the steel superstructure
- Temporary bracing and falsework as required for the erection of the arch
- Cable system, including bridge cables, anchors, HDPE pipes and jacks
- All proposed bolting procedures
- All proposed field welding procedures
- Falsework removal plan
- Deck and Arch required camber
- Traffic Control Plan for all construction phases

10000.5.1.2 Methods and Procedures for Erection

The erection manual shall include, but not be limited to, the following methods and procedures:

- Details and limits of any structures including temporary falsework supports and open excavations
- Sequence for installing temporary falsework supports, permanent bearings, removing temporary falsework supports and transferring loads to permanent bearings at the abutments
- Sequence and manner of erecting arch segments and supporting components prior to installation of cables including details indicating provisions for stability of the partially erected arches
- Sequence and schedule for erection of the composite concrete and steel deck system including all intermediate procedures relating to staging of steel erection, placement of precast deck panels and concrete slab pouring sequence
- Sequence and manner for performing, testing and inspecting all bolted connections
- Sequence and manner for performing, testing and inspecting all field welding procedures including provisions for protecting welding operations from exposure to inclement weather conditions
- Sequence and manner of installing and stressing cables including details of cable fabrication, stressing monitoring, cable lengths, shims, stressing order as well as a complete history of the initial jacking force, any supplemental jacking forces and incremental loads for each cable
- Details of the disposition and use of special erection equipment, falsework, temporary supports, including all loads or reactions from such equipment applied to the structure during erection and sequences and timings of these effects in accordance with the erection schedule; details shall address method of attachments to any permanent structure element and subsequent removal of attachments

10000.5.1.3 **Factors of Safety**

The erection manual shall include the factors of safety for all applicable equipment and procedures to be used as agreed upon by the Engineer of Record. These factors of safety shall be specified by the DB Contractor's erection engineer.

10000.5.1.4 **Erection Design Calculations**

The erection manual shall include, but not be limited to, the following design calculations:

- Design and details of any temporary falsework support foundations and shored excavations
- Design and details of all temporary falsework supports and temporary bracing and subsequent temporary connections to the permanent structures
- Minimum and maximum vertical and horizontal reactions at all temporary falsework support locations
- The expected maximum bearing, shear, compression and tensile stresses in the steel arch as may be produced with the Contractor's proposed sequences and methods of erection
- Verification that the permanent structure is not overstressed during erection including computations of moments, shears, axial loads and other forces in the arches and composite superstructure at a sufficient number of points to demonstrate that the load demand will not exceed the capacity and allowable stresses for erection
- Design of arch and deck camber curves
- Methods and procedures for verifying and correcting any discrepancies in the arch alignment; absolute tolerance in arch alignment is ± 0.02%
- Methods and procedures for verifying and correcting any discrepancies in the elevations of the deck after completion of erection; absolute tolerance in deck elevation cable attachment points shall follow, within a tolerance of ± 0.05 ft., a smooth parabolic curve passing through the final deck elevation at the centerline of bridge
- Methods and procedures for verifying and correcting any discrepancies in the cable loads after completion of erection; cables shall be adjusted for the dead load condition such that each individual cable shall not exceed values at ± 5% of the cable dead load computed from approved working drawings (it is possible that one individual cable may have to be adjusted to lesser tolerances to prevent stress in other cables from exceeding the ± 5% tolerance)
- Final cable adjustments, if required, shall be performed after all other dead loads are in place

10000.6 **Cable Assemblies**

Cable assemblies shall be constructed in a manner that will allow the force in the cable to be adjusted at the live end and allow the cable to be completely de-tensioned and removed during the service life of the bridge without damaging the surrounding structure.

10000.6.1 **Strand Fabrication**

Strands shall be made on machines of sufficient size to ensure good workmanship and shall be fabricated in the greatest length possible. Once the manufacture of the strand has been started, no changes shall be made to the grade of wire, construction, or lay of strand, or other factors which affect the uniformity of the product.

Strand and assemblies shall show a well-defined and uniform elastic stretch and recovery under stressing as measured during proof loading operations.

10000.6.2 **Anchorage Fabrication**

All anchorages shall be designed to meet or exceed the specified minimum strand breaking strength and allow for addition of damping as necessary.

10000.6.3 **Installation**

Install strands and anchorages in accordance with the approved shop drawings.

10000.6.4 **Cable Testing**

DB Contractor shall develop cable testing criteria and procedures, and acceptance and rejection criteria and submit to the Engineer of Record for review and approval prior to fabrication of cable anchorages or installation of cable assemblies. This work shall consist of the furnishing of all materials, anchors, cable specimens, strand specimens and all labor and equipment for fatigue, ultimate fatigue strength, ductility and static load testing as follows:

- Fatigue and ultimate strength of fully assembled cables for acceptance of the anchorage system
- Ductility and fatigue strength of individual strand for acceptance of strand to be incorporated into the final structure

The testing shall include but not be limited to the following:

- Cable Acceptance Test
- Fatigue Acceptance Test
- Quality Control Testing of Cable Materials
- Tensile Fatigue and Static Testing
- Ductility Testing

10000.6.5 **Painting**

Paint all structure using color "09010" per the RAL color chart in accordance with TxDOT *Standard Specifications Item 441, Item 446 and Item 427* depending on the material selected.

DB Contractor shall coat steel components in accordance with following:

- Paint all steel structural elements, except the arch and box girders using protective System IV paint in accordance with TxDOT *Standard Specifications Item 446*. There is no Federal Standard 595b color that matches the architectural color requirement; use color "09010" per the RAL color chart.

Paint the arch and box girders with the following paint specification:

- Outside of arch and box girders only:
  - 3 mils DFT - Zinc rich primer
  - 5 mils DFT - Polysiloxane appearance coat
- Inside of arch and box girders only:
  - 3 mils DFT - Zinc rich primer

After all concrete placement has been completed, DB Contractor shall remove any concrete or other contaminate from the structural steel members by hand cleaning methods so as not to damage the primer and then water blast/ wash with a minimum of 2,500 psi pressure.

Faying surfaces shall have a Class B slip coefficient. If this cannot be achieved with the selected prime coat, DB Contractor shall leave faying surfaces unpainted and blast clean to achieve a Class B slip coefficient.

DB Contractor shall coat concrete components, except the deck, with silicone based paint in accordance with TxDOT *Standard Specification Item 427* using the color indicated above.

Finish concrete structures surface area "I" with an opaque sealer of RAL color "09010" in accordance TxDOT *Standard Specification Item 427*.

DB Contractor shall ensure that surfaces are free of weak surface material, curing compounds and other surface contaminants prior to coating.

DB Contractor shall provide a sample panel(s) with the specified color and paint system for review and approval prior to the painting of the bridge. The panel(s) will be a minimum of 2' x 2' on the same steel grade selected for fabrication.

10000.7 **Maintenance and Inspection**

An owner's manual shall be developed to include maintenance and inspection procedures and frequencies of all components of the bridge, and submitted to TxDOT**.** The inspection procedures shall follow the National Bridge Inspection requirements.

10000.8 **Shop Drawings**

DB Contractor shall submit shop drawings for review and approval to the Engineer of Record prior to any fabrication. Shop drawings must be signed and sealed by a Professional Engineer licensed in the State of Texas and provide the following:

- Specification of the structural strands and anchors to be used
- Connection details between the strand to the structure including boots, spacers, bands/fasteners, and other accessories
- Initial and final tensioning methods
- Sequencing for cable erection

DB Contractor shall provide documents demonstrating that the manufacturer has satisfactory experience in fabricating and erecting the structural strand assembly in at least five projects during the past ten years and capability in performing the work.

DB Contractor shall provide a twelve-inch (12") sample of the structural strand as well as hardware assemblies required for the project for review and approval to the Engineer of Record.

DB Contractor shall provide test reports from an independent laboratory certifying that the structural strand assemblies proposed for use have been tested and met all requirements shown on the plans and set forth in this specification. Structural strand testing shall meet requirements of ASTM A 416. All costs for testing will be borne by the DB Contractor.

Once the shop drawings are approved, DB Contractor shall include manufacturer's manuals for installation, inspection, and maintenance as part of the owner's manual to TxDOT for review and approval.

10000.9 **Utilities**

The existing 24" water pipe elevated on a utility bridge adjacent to the Skillman/Audelia bridge shall be relocated to underground across the proposed I-635 mainlanes and managed lanes. The existing 24" water pipe shall be upgraded to a 36" water pipe and designed to meet the design requirement s set forth in Item 21, "Structures," and Dallas Water Utilities (DWU) design standards. DWU will be responsible for the cost of the betterment to upgrade the water pipe from the existing 24" to 36".

10000.10 **Aesthetic Concepts General Requirements**

DB Contractor shall design and construct the Skillman/Audelia interchange aesthetic treatments for the roadway, illumination, structures and landscaping elements in accordance with this Item 10,000 and Item 23, "Aesthetics and Landscaping," along with the approved I-635 LBJ East Aesthetic Technical Guidelines, Skillman-Audelia Hardscape and Landscape Aesthetic Concept Plan, and Skillman-Audelia Lighting Concept and Fixtures located in the RIDs.

10000.10.1 **Landscaping**

DB Contractor shall reserve the following areas at the Skillman/Audelia Interchange as shown on the Skillman-Audelia Hardscape and Landscape Aesthetic Concept, located in the RIDs, for City of Dallas's future landscaping

- Southeast corner of the proposed Skillman Street/Audelia Roade intersection, south of I-635
- Northwest corner of the proposed Skillman Street/Audelia Road intersection, north of I-635, and
- Along proposed Skillman Road and Audelia Road 30 feet from back of curb or ROW line from back of curve, whichever one is smaller

DB Contractor is not anticipated to be responsible for the actual planting in the reserved areas for future planting by City of Dallas other than the sodding requirements of Item 18, "Grading," Item 23, "Aesthetics and Landscaping," and TxDOT Standard Specifications.

DB Contractor shall install irrigation sleeves within the Project's ROW for City of Dallas' future planting as shown in the Skillman-Audelia Hardscape and Landscape Aesthetic Concept, located in the RIDs. DB Contractor shall not be responsible for irrigation sleeves that fall outside of the Project ROW.

10000.10.2 **Walls and Sign Columns**

DB Contractor shall design noise/sound walls and retaining walls located within the limits of the Skillman/Audelia interchange with the color, texture, style and aesthetic treatment presented in the approved I-635 LBJ East Aesthetic Technical Guidelines. DB Contractor shall apply aesthetic treatments to the vertical surfaces of retaining and noise/sound and the retaining walls where the surface is visible from the roadway or adjacent residential dwelling units. Consistent treatments shall be used for retaining and noise/sound walls and exposed concrete column sign structures that articulate the design themes established. DB Contractor shall clearly detail and identify how wall patterns shall be incorporated into the chosen design solution.

The roadside face of noise/sound walls and the side of the noise/sounds walls facing away from the roadway shall follow the aesthetic appearance in the approved I-635 LBJ East Aesthetic Technical Guidelines.

Large sign columns shall be designed with the color, texture, style and aesthetic treatment presented in the approved I-635 LBJ East Aesthetic Technical Guidelines.

10000.10.3 **Bridge**

All aesthetic treatments for structural Elements shall be designed and constructed in accordance with this Item 10,000 and coordinated with DB Contractor's structural designer team to facilitate constructability and maintain safety requirements.

Color specifications for the Skillman/Audelia bridge are defined in this Item 10,000.

10000.10.4 **Trees, Shrubs, and Other Plant Materials**

DB Contractor shall adhere to Item 23, "Aesthetics and Landscaping."

10000.10.5 **Riprap, Paving, and Pavers**

DB Contractor shall design and construct the hardscape for pedestrian and roadway in accordance with the Skillman-Audelia Hardscape and Landscape Aesthetic Concept located in the RIDs and Item 23, "Aesthetics and Landscaping."

Hardscape installations shall be included at the following locations:

- Intersection at Skillman Street/Whitehurst Drive/Audelia Road
- Intersection at Skillman Street/Eastbound Frontage Road
- Skillman Street Bridge
- Intersection at Skillman Street/Westbound Frontage Road
- Intersection at Skillman Street/Audelia Road/Adleta Court

DB Contractor shall provide concrete paving and paver hardscape elements that meet the intent presented in the Skillman-Audelia Hardscape and Landscape Aesthetic Concepts located in the RIDs and meet the requirements of TxDOT *Standard Specification Item 528, Colored Textured Concrete and Landscape Pavers*. Color specifications for hardscape elements including pavers and concrete paving are defined in the Skillman-Audelia Hardscape and Landscape Aesthetic Concept located in the RIDs.

10000.10.6 **Color Palette**

DB Contractor shall submit a plan that indicates where color is to be applied based on the I-635 LBJ East Aesthetic Technical Guidelines and the aesthetic requirements listed in this Item 10,000. This plan can be diagrammatic in nature, but shall list each element and its colors. In addition to integrated colors, painting, and staining, DB Contractor may use colored lighting in selected areas to add color.

10000.10.7 **Illumination Concept**

DB Contractor shall prepare an illumination aesthetic plan that meets the intent of the Skillman-Audelia Lighting Concept and Fixtures located in the RIDs. The illumination aesthetic plan shall identify each light fixture (i.e., roadside lighting, bridge lighting, and under bridge fixture) and type of light fixture (i.e., Light Emitting Diode (LED) lighting, point source lighting, and High Intensity Discharge lamps). DB Contractor shall perform photometric design of all proposed lighting, including high mast lighting, continuous lighting,

underpass lighting, pedestrian lighting and aesthetic bridge lighting to meet the requirements in TxDOT's *Highway Illumination Manual*. Highway illumination on I-635 shall not detract from the Skillman/Audelia bridge aesthetic lighting while meeting TxDOT's safety lighting requirements. No lighting fixtures shall intrude on the sidewalk. The illumination design shall meet the requirements of TxDOT *Standard Specification Item 610, Roadway Illumination Assemblies*.

10000.10.7.1 **Skillman/Audelia Bridge Lighting**

The illumination layout plan shall meet the intent of Lighting Concept 1 for the Skillman/Audelia bridge in the Skillman-Audelia Lighting Concept and Fixtures located in the RIDs. The illumination layout plan shall identify bridge lighting fixtures that can provide the same lighting effect as the bridge lighting fixtures selected in the Skillman-Audelia Lighting Concept and Fixtures, or provide approved equivalent.

The bridge illumination shall be comprised of a color changing DMX aesthetic lighting system that features three main light fixtures to enhance the three main structural features of the arch bridge as the following:

- Outer Arches and Cables
- Cross-ribs
- Center Arch

10000.10.7.2 **Roadway and Pedestrian Lighting**

The illumination layout plan shall include pedestrian lighting along Skillman Street and Audelia Road. City of Dallas Master Spec Dwg. No. 131-19176-003 (Poulson NYPA/59W LED/4000K/120-277V/BLK 734/TRI/TWIN/12'/BLK 734/DIMMING 7 POLE PC-RECP/TAMPER PROOF) shall be used as the pedestrian lighting fixture. Pedestrian lighting fixture shall be installed every 75' along Skillman Street and Audelia Road.

Continuous roadway lighting shall be provided along either side of Audelia Road (within the construction limits).

Continuous roadway lighting shall be provided within the median of Skillman Street. Additionally, pedestrian lighting shall be provided adjacent to the sidewalks on Skillman Street. No lighting fixtures shall intrude into sidewalks.

10000.10.8 **Construction Requirements**

DB Contractor shall follow the construction requirements outlined in Item 23, "Aesthetics and Landscaping," and as identified this Item 10,000.

10000.11 **Submittals**

All submittals described in this Item 10,000 shall be in accordance with the schedule and for the purpose (approval, review and comment, for information) set forth in Table 10,000-2.

Table 10,000-2: Submittals to TxDOT

Submittals	Submittal Schedule	TxDOT Action	Reference Section
In-Service Design Documentations	Prior to completion of bridge construction	For Information	10,000.4.5
Erection Manual	Prior to bridge construction	For Information	10,000.5.1
Cable Material and Assemblies Testing Results	Prior to bridge construction	For Information	10,000.6.4
Owner's Manual	Prior to completion of bridge construction	Review and Approval	10,000.7

Table 10,000-2: Submittals to TxDOT

Submittals	Submittal Schedule	TxDOT Action	Reference Section
Shop Drawings	Prior to fabrication of the bridge	For Information	10,000.8
Illumination Aesthetic Plan	Prior to lighting installation	Review and Approval	10,000.10.7

Design-Build Special Specification Item 10,002
LBJ Infrastructure Group Owned Tolling Elements

10002.1 **General Requirements**

DB Contractor shall perform all civil work necessary and coordinate with LBJ Infrastructure Group (LBJIG) to construct and install the LBJIG-owned ETCS Elements that are in conflict with the Project, providing continuous access between the Project and the LBJIG managed lanes. The LBJIG ETCS must remain operational throughout the Term of the Project.

A listing of DB Contractor and LBJIG responsibilities are provided in Attachment 10,002-1 (LBJ Infrastructure Group Toll Facility Responsibility Matrix).

10002.1.1 **DB Contractor's Coordination Responsibilities**

DB Contractor shall coordinate the design and construction with TxDOT and LBJIG to accommodate the design and systems operating software, and ensure the Project schedule incorporates the time required to design, construct, procure, install, integrate and test all LBJIG-owned equipment impacted by the Project, to be used during tolling operations and maintenance of the LBJIG managed lanes.

DB Contractor's facilities coordination responsibilities include, but are not limited to, the following:

DB Contractor shall coordinate closely with TxDOT and LBJIG to ensure the DB Contractor's design corresponds with the LBJIG's requirements and is equivalent to the existing LBJIG equipment and infrastructure.

DB Contractor shall coordinate with TxDOT and LBJIG during the design and construction phases of the Project and shall provide notice of any changes in design within and in close proximity to LBJIG Toll Zones.

DB Contractor shall coordinate construction activities with LBJIG to construct the LBJIG-owned ETCS Elements for LBJIG Toll Zones concurrent with the DB Contractor's Work.

DB Contractor shall provide traffic control plans, devices and safe working conditions during the installation of all LBJIG ETCS and LBJIG-owned ETCS Elements impacted by the Project.

10002.2 **Administrative Requirements**

DB Contractor shall meet regularly with TxDOT and LBJIG to coordinate design and construction of LBJIG Toll Zones and infrastructure needed to support the LBJIG ETCS and LBJIG-owned ETCS Elements.

10002.3 **Design Requirements**

Throughout the design phase DB Contractor shall coordinate Design Work at LBJIG Toll Zones and LBJIG-owned ETCS Elements with TxDOT and LBJIG to determine design requirements specific to LBJIG Toll Zones and LBJIG-owned ETCS Elements impacted by the Project.

DB Contractor shall be responsible for designing all civil, electrical, and communications infrastructure at each LBJIG Toll Zone and LBJIG-owned ETCS Elements impacted by the Project as determined by TxDOT in coordination with LBJIG. DB Contractor responsibilities include, but are not limited to the following:

- Concrete traffic barrier and foundation
- Toll gantry structures, foundations, and lightning protection
- Concrete pads, and riprap around concrete pads, for the roadside LBJIG-owned ETCS Elements
- Conduit
- Power and communications services
- Other typical roadway items included in DB Contractor's Work to support the LBJIG ETCS

DB Contractor shall construct concrete traffic barrier for roadways adjacent to backup power systems. The maintenance drive shall permit safe use by maintenance personnel and their vehicles. The toll maintenance area shall be free of ditches or other obstructions which could damage or diminish the function of the LBJIG-owned ETCS Elements. DB Contractor's design shall be coordinated with TxDOT and LBJIG to ensure that

the design and construction meets LBJIG's specifications and is equivalent to the existing LBJIG infrastructure.

If applicable, LBJIG shall provide LBJIG's Toll Zone in-pavement loop sensors layouts for each Toll Zone within the Project limits to DB Contractor during design and work closely with DB Contractor to coordinate design. The DB Contractor's design of the impacted LBJIG Toll Zone shall include but it is not limited to toll gantry; concrete pads for roadside equipment cabinets, generators, and fuel tanks; rip-rap, ETCS equipment power and communications; and conduit and other elements. DB Contractor shall design and construct the LBJIG Toll Zone in accordance with LBJIG's requirements and ensure it is equivalent to the existing LBJIG infrastructure. The location of the concrete pad foundation for roadside toll equipment cabinet shall be coordinated throughout the design process with TxDOT and LBJIG. LBJIG shall be responsible for providing and installing the roadside toll equipment cabinets.

The location of the tolling communication termination cabinet shall be determined in coordination with LBJIG. DB Contractor will work closely with LBJIG to identify the detailed specifications for each element of work. DB Contractor shall incorporate LBJIG's ETCS requirements into the civil, electrical, and communications designs and submit the designs to TxDOT and LBJIG for concurrent review.

10002.3.1 LBJIG-Owned Toll Signing

DB Contractor shall be responsible for all signing related to the impacted LBJIG-owned ETCS Elements (with the exception of Toll Zone maintenance drive signing) including toll rate signs, toll entrance ramp signs, and advance toll information signs in accordance with Item 24, "Signing, Delineation, Pavement Marking, Signalization, and Lighting." DB Contractor shall coordinate with TxDOT and LBJIG in determining the locations for advance toll information signs to be installed within the Project limits. At a minimum, advance toll information signs shall be installed at the following locations:

- At all locations where there is a change in toll policy such as the transition between TxDOT operated segments of the facility and abutting non-TxDOT operated segments of the facility
- At all locations where an existing roadway provides public access to the Project
- Prior to all entrance ramps to the LBJIG managed lanes
- At locations consistent with the Dallas Fort Worth (DFW) managed lane signing guidelines located in the RIDs

DB Contractor shall provide TxDOT with the preliminary and final operational signing schematic for review and approval. DB Contractor shall submit any signing design revisions to TxDOT for review and approval.

10002.3.2 LBJIG-Owned Toll Gantry and Overhead Support for Toll Equipment

If applicable, DB Contractor shall provide toll gantries and overhead support for LBJIG-owned ETCS Elements within the Project limits in accordance with LBJIG's requirements and equivalent to the existing LBJIG-owned infrastructure. Toll gantry locations shall be coordinated with TxDOT and LBJIG throughout the design process. TxDOT shall provide approval of the final toll gantry locations. Any change to the final toll gantry locations shall be approved by TxDOT. All design and construction of structural foundations, geotechnical analysis, lightning protection, aesthetic treatment, columns/towers and overhead spans shall be the responsibility of the DB Contractor. DB Contractor toll gantries shall meet LBJIG's specifications for:

- Spacing between toll gantries
- Vertical clearance
- Conduit on/within the gantry column
- Spacing and placement of toll gantries relative to the roadside equipment cabinet
- Weight of overhead toll equipment, mounting apparatus and conduit
- Avoiding interference by any devices or signing mounted to the toll gantry span
- Vibration
- Equipment mounting brackets and locations

DB Contractor shall determine foundation types and design sign foundations based upon geotechnical surveys/tests using Good Industry Practices. Designs for gantry support structures shall also comply with requirements in Item 21, "Structures," Item 23, "Aesthetics and Landscaping," and Item 24, "Signing, Delineation, Pavement Marking, Signalization, and Lighting."

Lightning protection shall be installed immediately following the construction of each gantry in accordance with the Toll Zone and ETCS Element Milestones. DB Contractor shall provide TxDOT and LBJIG with lightning protection shop drawings for review. Lightning protection certifications meeting UL standards shall be provided to TxDOT and LBJIG upon completion of each gantry.

DB Contractor shall either provide barrier for the toll gantries or shall integrate the toll gantries directly into the barrier.

10002.3.3 **Pavement**

If applicable, DB Contractor shall provide LBJIG Toll Zone pavement sections in accordance with LBJIG's requirements and equivalent to the existing LBJIG Toll Zone pavement. Pavement joint locations in the LBJIG Toll Zone pavement shall be coordinated with TxDOT and LBJIG and shall not interfere with in-pavement loop sensors.

10002.3.4 **LBJIG-Owned Tolling Conduit**

DB Contractor shall provide all conduit for LBJIG tolling communication cable and electrical conductor at each LBJIG Toll Zone in accordance with LBJIG's requirements and equivalent to the existing LBJIG tolling communication cable and electrical conductors.

DB Contractor shall provide concrete encased duct banks, termination cabinet, concrete pad and tolling communication cable conduit in accordance with LBJIG's requirements.

10002.3.5 **LBJIG-Owned Tolling Communications Requirements**

DB Contractor shall provide tolling communication cable for LBJIG Tolling Zone in accordance with LBJIG's requirements and equivalent to the existing LBJIG tolling communication cable. To access the existing LBJIG tolling communications network, when applicable, DB Contractor shall coordinate with TxDOT and LBJIG and provide a connection of the proposed tolling communication cable to LBJIG hub buildings, existing or new, within the Project limits. Daisy-chaining, defined as having the same fibers going into multiple Toll Zones and carrying the data for multiple Toll Zones, of fiber will not be allowed.

DB Contractor shall provide tolling communication cable from the duct bank to a termination cabinet located on the roadside equipment pad. The fiber backbone shall be terminated inside a termination cabinet with an appropriately sized fiber optic patch panel.

LBJIG shall be responsible for providing tolling communication cable from the termination cabinets to LBJIG-owned ETCS equipment. LBJIG shall terminate all tolling communication cable from roadside equipment cabinets to LBJIG's ETCS equipment.

All tolling communication cable and conduit designed and constructed by DB Contractor for LBJIG-owned toll systems shall follow LBJIG's requirements and be equivalent to the existing LBJIG tolling communication cable and conduit.

10002.3.6 **LBJIG-Owned Tolling Electrical Service**

At each LBJIG Toll Zone, DB Contractor shall be responsible for providing the electrical conductor between the metered power service and LBJIG's roadside equipment in accordance with LBJIG's requirements and be equivalent to the existing LBJIG electrical conductor.

The length of electrical conductor in the ground box will be dependent on the placement of the ground box and its proximity to the ETCS Element.

LBJIG shall be responsible for providing electrical conductor from the ground box adjacent to the roadside equipment pad to LBJIG ETCS equipment. LBJIG will terminate all electrical conductors from roadside equipment cabinets to the LBJIG's ETCS equipment.

10002.4 **Construction Requirements**

DB Contractor shall coordinate Construction Work at LBJIG Toll Zones and LBJIG-owned ETCS Elements with TxDOT and LBJIG to determine construction requirements specific to LBJIG Toll Zones and LBJIG-owned ETCS Elements. DB Contractor shall provide and maintain continuous and useable access and coordinate with LBJIG during construction to allow for LBJIG Toll Zones and LBJIG-owned ETCS Elements' work to occur concurrently with DB Contractor's Work, in accordance with the Contract Documents.

DB Contractor shall remove all existing civil, electrical and communications infrastructure at each LBJIG Toll Zone as shown in Attachment 10,002-1 (LBJ Infrastructure Group Toll Facility Responsibility Matrix). DB Contractor is not responsible for removal of LBJIG-owned ETCS Elements impacted by the Project. DB Contractor shall coordinate with LBJIG prior to removal effort in order to accommodate the removal of ETCS Elements owned by LBJIG.

DB Contractor shall coordinate construction schedules with TxDOT and LBJIG for Work taking place within LBJIG Toll Zones and limits of LBJIG-owned ETCS Elements with specific regard for conduit, toll gantry overhead structures, and grounding under structures and in-pavement loop sensors within the Project limits.

DB Contractor shall coordinate with LBJIG to ensure that there are no power lines or radio frequency (RF) elements that could cause interference to LBJIG-owned ETCS Elements and systems. The clearance between power lines and ETCS Elements shall meet NEC requirements. DB Contractor shall provide LBJIG with a list of RF elements and their associated frequencies to ensure no conflict exists.

Additionally, DB Contractor shall coordinate with LBJIG to ensure that the following do not exist in LBJIG Toll Zone pavement areas reserved for in-pavement loop sensors:

- Surface drains or grates within 6 feet of sensors
- Buried drains or water pipes in the area reserved for sensors to a depth of 6 feet
- Underground power lines or buried utilities beneath the Toll Zone that could cause interference to the toll systems
- Non-coated rebar (glass fiber reinforced polymer bar or epoxy-coated steel with separation requirements are acceptable)

LBJIG Toll Zones and ETCS must be operational throughout construction.

10002.4.1 **Pavement**

DB Contractor shall provide and maintain usable unobstructed access for LBJIG at each LBJIG-owned ETCS Element during LBJIG's pavement sensor / equipment installation and toll systems testing. DB Contractor shall provide a minimum of 500 feet of unobstructed access, as illustrated in Attachment 29-2 (Typical Toll Zone Layout) or equivalent to existing LBJIG Toll Zone requirements, from each end of the LBJIG Toll Zone pavement section to allow for LBJIG's testing of the toll systems for the main lane LBJIG Toll Zones. During LBJIG's testing of the toll systems, the pavement within the limits of the unobstructed access shall be free of DB Contractor equipment, materials, or other obstacles in the DB Contractors control. At each LBJIG-owned ETCS element, an area of 30 feet around all equipment enclosures, equipment pads, and structures shall be clear of DB Contractor equipment, materials, or other obstacles in the DB Contractors control, unless previously cleared with the LBJIG onsite personnel. For Toll Zones on ramps, unobstructed access shall be provided for the entire length of the ramp. These 500-foot sections are not required to be constructed using the special Toll Zone pavement section defined in Attachment 29-3 (Toll Zone Pavement Details).

10002.4.2 **Communications Requirements**

The tolling communication cable shall be tested end to end and bi-directionally by Optical Time Domain Reflectometer (OTDR) and light meter, or in accordance with LBJIG's requirements. DB Contractor in coordination with LBJIG shall complete all testing and provide testing results to TxDOT and LBJIG prior to Substantial Completion.

10002.4.3 **Tolling Communication Cable End-to-End Testing**

DB Contractor shall provide notice and coordinate with TxDOT and LBJIG to allow for end-to-end testing of the tolling communication cable prior to Substantial Completion. DB Contractor shall be responsible, at a minimum, for the following:

- Coordinating the end-to-end testing with TxDOT and LBJIG to ensure that there will be no conflicts between TxDOT, LBJIG, their affiliated contractors, and DB Contractor's staff
- Providing temporary advance signing (if needed and concurred by LBJIG) stating that the facility is closed, and testing is occurring
- Providing MOT/traffic control (if needed) at all necessary locations for the testing duration
- Providing access to the facility for authorized TxDOT and LBJIG staff and contractors

- Repairing any issues found with DB Contractor's work within three (3) Days unless otherwise approved by TxDOT

DB Contractor shall not expect to have access to, nor conduct work within, the Project during the end-to-end testing, with the exception of providing services as described above. TxDOT may, at its own discretion, provide DB Contractor access to the Project to conduct work outside the services described above.

10002.4.4 **Tolling Electrical Service**

DB Contractor shall be responsible for the installation and access to power required to operate the LBJIG-owned Toll System devices including all utility costs until Substantial Completion and Final Acceptance by TxDOT. DB Contractor shall coordinate with the Utility Owner(s) and ensure power service is initiated and maintained for all LBJIG-owned ETCS Elements impacted by the Project prior to Substantial Completion. DB Contractor shall have completed all testing and acceptance requirements for electrical networks prior to Substantial Completion and prior to the start of end-to-end testing.

Design Special Specification Item 10,003
LBJ Infrastructure Group Managed Lanes

10003.1 **General Requirements**

All requirements contained in Item 10,002, "LBJ Infrastructure Group Owned Tolling Elements" shall apply in addition to the requirements specified in this Item 10,003, "LBJ Infrastructure Group Managed Lanes." In the event of a conflict between Item 10,002, "LBJ Infrastructure Group Owned Tolling Elements" and this Item 10,003, "LBJ Infrastructure Group Managed Lanes," the requirements of Item 10,002, "LBJ Infrastructure Group Owned Tolling Elements" shall take precedence.

A listing of DB Contractor and LBJIG responsibilities is provided in Attachment 10,002-1 (LBJ Infrastructure Group Toll Facility Responsibility Matrix) and Attachment 10,003-1 (LBJ Infrastructure Group Managed Lane Facility Responsibility Matrix).

10003.1.1 **DB Contractor's Coordination Responsibilities**

Coordinate construction activities with TxDOT and LBJIG to construct and install the LBJIG-owned ETCS Elements for the LBJIG managed lanes impacted by the Project concurrent with DB Contractor's Work.

DB Contractor shall incorporate LBJIG Toll Zone and LBJIG-owned ETCS Element construction as part of the Toll Zone and ETCS Element Milestones in the Project in accordance with Item 30, "Managed Lanes".

10003.2 **Administrative Requirements**

DB Contractor shall meet regularly with TxDOT and LBJIG to coordinate the design and construction of each LBJIG Toll Zone and infrastructure needed to support the LBJIG-owned ETCS Elements for the LBJIG managed lanes impacted by the Project.

10003.3 **Design Requirements**

Support infrastructure for LBJIG-owned Toll Rate DMS and ETCS speed / volume detection equipment to be provided by DB Contractor at LBJIG-owned ETCS locations includes, but is not limited to: concrete pads for the controller cabinets, all conduit for electrical conductor and tolling communication cable, ground boxes, tolling communication cable and electrical conductor to the controller cabinet in accordance with LBJIG's requirements and equivalent to the existing LBJIG infrastructure.

DB Contractor's support infrastructure for LBJIG-owned ETCS Elements shall meet LBJIG's specifications and be equivalent to the existing LBJIG infrastructure. The location for the controller cabinet pad at the LBJIG-owned Toll Rate DMS shall be coordinated with LBJIG and TxDOT, and shall be designed in accordance with LBJIG's specifications and equivalent to the existing LBJIG infrastructure. The controller cabinet pad shall, where possible, be within line of sight to the front of the Toll Rate DMS. The location of the controller cabinet shall be coordinated throughout the design process with TxDOT and LBJIG. Toll Rate DMS design shall be consistent with LBJIG's requirements and equivalent with the existing LBJIG infrastructure.

The locations for LBJIG-owned ETCS speed / volume detection sites shall be determined by DB Contractor and shall be coordinated with LBJIG and TxDOT. ETCS speed / volume detection equipment shall be placed, at a minimum, at all entrance access points and at similar locations as the existing LBJIG infrastructure. Distance between ETCS speed / volume detection equipment shall follow LBJIG's requirements and be located at similar locations as the existing LBJIG infrastructure. The location for the controller cabinet pad at the site shall be determined by DB Contractor and shall be coordinated throughout the design process with TxDOT and LBJIG. The controller cabinet pad shall be designed in accordance with LBJIG's requirements and equivalent to the existing LBJIG infrastructure.

10003.3.1 **LBJIG-Owned Toll Signing**

DB Contractor shall be responsible for location, design, and construction of the static portion of the LBJIG-owned Toll Rate DMS and advance toll signs impacted by the Project, in accordance with Item 24, "Signing, Delineation, Pavement Marking, Signalization, and Lighting." DB Contractor shall coordinate with LBJIG and TxDOT throughout the design process. DB Contractor shall be responsible for the Toll Rate DMS foundation and sign support structure. DB Contractor shall provide TxDOT with the preliminary operational signing

schematic for review and approval. DB Contractor shall submit any signing design revisions to TxDOT for review and approval.

LBJIG shall be responsible for providing, installing, integrating, and testing controller cabinets, dynamic LED modules, and electronics for the Toll Rate DMS.

10003.3.2 **LBJIG-Owned Overhead Support for ETCS Speed / Volume Equipment and Toll Rate DMS**

At the LBJIG-owned ETCS locations for ETCS speed / volume detection impacted by the Project, DB Contractor shall design and construct the complete overhead support structure for the ETCS speed / volume detection equipment and mounting hardware in accordance with LBJIG's requirements and equivalent to the existing LBJIG infrastructure. DB Contractor overhead supports shall meet LBJIG's specifications for:

- Vertical clearance
- Conduit on/within the support structure (i.e. column/pole)
- Support structure needed to achieve adequate lane coverage in accordance with LBJIG's specifications
- Maximum distance between the ETCS speed / volume detection equipment and roadside equipment cabinet
- Weight of overhead ETCS speed / volume detection equipment, mount and conduit
- Avoiding interference by any non-toll appurtenances or signing mounted to the toll gantry span

10003.3.3 **LBJIG-Owned Tolling Conduit**

DB Contractor shall provide conduit for tolling communication cable and electrical conductor at each ETCS Element and within LBJIG managed lanes limits in accordance with LBJIG's requirements and equivalent to the existing LBJIG infrastructure. DB Contractor shall provide concrete encased duct banks for the section of LBJIG's managed lanes impacted by the Project in conformance with applicable LBJIG's specifications and equivalent to the existing LBJIG duct banks.

10003.3.4 **LBJIG-Owned Tolling Communications Requirements**

DB Contractor shall provide tolling communication cable for LBJIG-owned Toll Rate DMS in accordance with LBJIG's requirements and equivalent to the existing LBJIG tolling communication cable. To access the LBJIG tolling communications network, when applicable, DB Contractor shall coordinate with LBJIG and provide a connection of the proposed tolling communication cable to LBJIG hub buildings, existing or new, within the Project and LBJIG managed lanes limits. Daisy-chaining, defined as having the same fibers going into multiple ETCS speed / volume detection zones and Toll Rate DMS sites of fiber will not be allowed.

DB Contractor shall provide tolling communication cable from the duct bank to a ground box adjacent to the controller cabinet pad. The fiber backbone shall be terminated inside the ground box to Lucent connector (LC) for testing. LBJIG will be responsible for pulling the fiber from the ground box into the LBJIG-owned equipment enclosure using the DB Contractor provided conduit.

All tolling communication cable and conduit designed and constructed by DB Contractor for LBJIG-owned toll systems shall follow LBJIG's requirements and be equivalent to the existing LBJIG tolling communication cable and conduit.

10003.3.5 **ETCS Infrastructure Requirements**

10003.3.5.1 **LBJIG-Owned Managed Lane Tolling**

LBJIG-owned managed lanes and slip ramp tolling shall consist of ETCS at LBJIG's tolling locations.

10003.3.6 **LBJIG-Owned Tolling Electrical Service**

At each LBJIG-owned ETCS Element for the LBJIG managed lanes that is impacted by the Project, DB Contractor shall be responsible for providing the electrical conductor between the electrical service connection and the designated DB Contractor provided electrical conductor ground boxes adjacent to LBJIG's controller cabinet pad, in accordance with LBJIG's specifications and equivalent to the existing LBJIG infrastructure. DB Contractor shall provide electrical conductor in accordance with LBJIG power requirements for each LBJIG-owned ETCS Element.

10003.3.7 **LBJIG-Owned Tolling Communication Cable End-to-End Testing**

DB Contractor shall provide notice and coordinate with TxDOT and LBJIG to allow for end-to-end testing of the tolling communication cable prior to Substantial Completion. DB Contractor shall be responsible, at a minimum, for the following:

- Coordinating the end-to-end testing with TxDOT and LBJIG to ensure that there will be no conflicts between TxDOT and LBJIG, and DB Contractor's staff
- Providing temporary advance signing (if needed and concurred by LBJIG) stating that the facility is closed, and testing is occurring
- Providing maintenance of traffic/traffic control (if needed) at all necessary locations for the testing duration. Providing access to the facility for authorized TxDOT staff and LBJIG staff and contractors
- Repairing any issues found with DB Contractor's work within three (3) Days unless otherwise approved by TxDOT.

DB Contractor shall not expect to have access to, nor conduct work within, the Project during the end-to-end testing, with the exception of providing services as described above. TxDOT may, at its own discretion, provide DB Contractor access to the Project to conduct work outside the services described above.