TECHNICAL SPECIAL PROVISION

FOR

FIBER REINFORCED CONCRETE FOR TOLL LOOP PAVEMENT

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T350
FIBER REINFORCED CONCRETE FOR TOLL LOOP PAVEMENT

T350-1 Description.

Construct non-metallic Fiber Reinforced Portland cement concrete pavement for roadway and shoulder, in one course, on a prepared subgrade or base. Use either the fixed-form or the slip-form method of construction.

If any uncontrolled cracks appear during the life of the Contract, remove and replace the cracked concrete at no expense to the Department. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of the Engineer.

T350-2 Materials.

T350-2.1 General: Meet the following Standard Specifications requirements except as modified herein:

Coarse Aggregate	Section 901
Fine Aggregate*	Section 902
Portland Cement and Blended Cement	Section 921
Water	Section 923
Admixtures**	Section 924
Curing Materials**	Section 925
Embedded Items	Section 931
Fiber-reinforced Polymer Macro-Fibers***	ASTM C 1116, Type III

*Use only silica sand except as provided in Section 902 of the Specifications.

**Use products listed on the Department's Approved Product List (APL).

*** Use basalt or carbon FRP macro-fibers meeting the component material composition requirements of Section 932-4 of the Specifications.

Do not use materials containing hard lumps, crusts, or frozen matter, or that is contaminated with materials exceeding the specified limits in the above listed Sections.

T350-2.2 Fibers: Fibers are to be used for concrete pavement. To ensure uniformity throughout the mix, fibers must be added at the concrete plant, unless otherwise specified by the Engineer:

1. The concrete must be enhanced with temperature/shrinkage and flexural reinforcement by means of polymeric fibers. Reinforcing fibers must be a synergistic blend of high performance macro-monofilaments with sinusoidal deformations and collated-fibrillated polypropylene fibers. The blend of fibers must be packaged in degradable bags of five (5) pounds net contents and mixed into the concrete at a proportion of 5 pounds (1 bag) per cubic yard or 0.33 percent by volume.

2. Fibrous concrete must produce an Average Residual Strength (ARS) of no less than 215 psi from a test set of five beams in accordance with ASTM C1399 Test Method for Determining Average Residual Strength of Fiber Reinforced Concrete. The ARS test must be performed at the time the mix design is developed.

3. Fibers must be added to the concrete as recommended by the supplier. Fiber supplier must provide installation and finishing guidelines.

T350-2.3 Concrete: Use concrete meeting the requirements of Section 346 of the Specifications, Class I, unless requirements herein or on plans are more stringent.

1. Composition of concrete. Master Proportion Table must be as follows:
    a. Grade of Coarse Aggregate:.....Grade 57
    b. Maximum Water/Cement Ratio:.....0.40 lbs/lb
    c. Minimum Cement Content: ..... 16 lbs/ft^3 conc. mix
    d. Slump Range:..... 1.5 – 4.5 inches
    e. Amount of Entrained Air: .....1% – 6 %
    f. Fibers: .....5 lbs/yd^3 (polypropylene)
2. Provide concrete with a minimum compressive strength of 2,500 psi prior to placing traffic on the slab and a minimum 28-day compressive strength of 3,000 psi and maximum water to cementitious materials ratio of 0.50 unless plans call for more stringent requirements.
3. In fiber reinforced concrete mixes, use Type D water-reducing and retarding admixture, and shrinkage reducing admixture (SRA) meeting the requirements of Section 924 of the Specifications.
4. For concrete pavement placed using the slip-form method of construction, utilize concrete with a target slump of 1.5 inches plus or minus 1 inch. For concrete pavement placed by hand in constructed forms, utilize concrete with a target slump of 3 inches plus or minus 1.5 inches. Air content testing for concrete pavement mixes is not required.
5. Utilize concrete with a target slump of 3 inches plus or minus 1.5 inches.
6. Notify the Engineer if any of the component quantities are adjusted. If any material sources change, resubmit the mix design to the Engineer for approval prior to use.
7. The Department will exercise control over the concrete by rigid inspection of the consistency, yield, strength of concrete, and of the air content where applicable.

T350-2.4 Glass Fiber Reinforced Polymer (GFRP) Dowel Bars: Provide round and straight glass fiber reinforced polymer dowel bar:

1. Fibers must be in the form of unidirectional rovings of appropriate size or weight. Fiber sizings and coupling agents shall be appropriate for the resin system used. The fiber type will determine the physical properties of the FRP bar; therefore, the FRP bars shall be designated according to fiber composition with the first letter of the acronym designating fiber types as follows: Glass Fiber Reinforced Polymer rebar (GFRP), Carbon Fiber Reinforced Polymer rebar (CFRP), Aramid Fiber Reinforced Polymer rebar (AFRP), etc. Each bar type must meet the pertinent properties for that type of FRP bar as contained within this specification.
2. Matrix Resins: Commercial grades of vinylester thermosetting are permitted, provided the finished product meets the physical and durability requirements of this specification. A vinylester resin is defined as a thermosetting reaction product of an epoxy resin with an unsaturated acid, usually methacrylic acid, which is then diluted with a reactive monomer, usually styrene (ASTM C904). The base polymer in the resin system must not contain any polyester. Blending of vinylester resins is permitted. Styrene may be added to the polymer resin during processing. The amount of styrene, as a weight percentage of the polymer resin, added during processing shall be reported. Added styrene shall be less than 10% by weight of resin (pph resin).
3. Fillers: Commercial grade inorganic fillers such as kaolin clay, calcium carbonate, and aluminum trihydrate are permitted and shall not exceed 30% by weight of the polymer resin constituent. Commercial grade additives and process-aids, such as release agents,

low-profile shrink additives, initiators, promoters, hardeners, catalysts, pigments, fire-retardants, and ultra-violet inhibitors are permitted as appropriate for the processing method.

4. Shrink additives shall be less than 10% by weight of the polymer resin. Commercial grade inorganic or organic non-woven surfacing mats or veils are permitted.

5. Manufacturing Process: GFRP Dowels are to be produced with any variation of the pultrusion process. FRP rebar manufacturer shall report the date of production and the lot size.

6. Fiber Content: The FRP rebar manufacturer shall report the fiber content by volume of the end product. The minimum acceptable fiber content shall not be less 70% by weight as measured by ASTM D2584.

7. Glass Transition Temperature: The glass transition temperature (Tg) of the resin used shall be reported. The minimum acceptable Tg shall not be less than 230°F (110°C) using Dynamic Mechanical Analysis (DMA) per Test Method D7028. This number does not equate to maximum use temperature. ACI 440.1R-03 does not currently designate maximum use temperatures of FRP bars. Individual manufacturers shall be consulted to verify appropriate use temperatures.

8. Material Properties:

a. Size: The size of GFRP bars shall be designated as the diameter of the cross section of the dowel. When the GFRP bar is not of the conventional solid round shape (that is, elliptical or oval), the outside diameter of the bar or the maximum outside dimension of the bar will be provided in addition to the equivalent nominal diameter. The nominal diameter of these unconventional GFRP bars would be equivalent to that of a solid plain round bar having the same area. See Table 3, ASTM D8444-24 for Nominal Dimensions for a given bar size.

b. Transverse Shear Strength (perpendicular to the bar): The mean transverse shear strength of GFRP bars from the tested lot shall meet or exceed the following values, as determined by Test Method D7617 and in accordance with ASTM D8444-24.

Table 1- Mean Transverse Shear Strength of GFRP Dowels

Mean Transverse Shear Strength of GFRP Dowels	
Psi	MPa
≥23,200	≥160

c. Apparent Horizontal Shear Strength: The mean apparent horizontal shear strength, or shear-beam shear strength parallel to the longitudinal axis of GFRP bars from the tested lot shall meet or exceed the following values, as determined by Test Method D4475 and in accordance with ASTM D8444-24.

Table 2- Mean Apparent Horizontal Shear Strength of GFRP Dowels

Mean Horizontal Shear Strength of GFRP Dowels	
Psi	MPa
≥7,250	≥50

d. Bond Strength: The bond strength shall be determined on the as-manufactured dowel bar (no bond breaking agents, or other coatings may be used) by test

method in Annex A1, ASTM D8444-24. The mean bond strength shall not exceed the maximum limit given in Table 3, ASTM D8444-24.

e. Moisture Absorption: As a short-term indicator of long-term durability, samples of the GFRP dowels shall be subject to a mass uptake by moisture per ASTM D570.

Table 3- Moisture Absorption

Moisture Absorption Maximum – 1%

9. Presence of voids, hollow fibers or thermal cracks: The procedures outlined in ASTM D5117 shall be followed to check for voids, continuous hollow fibers or thermal cracks in the longitudinal direction of the dowel. Any continuous defect will reduce long-term durability of the dowel and shall not be present.

10. Testing: FRP bars produced for a project shall have representative samples (as agreed upon between the FRP rebar manufacturer and engineer) tested for the properties listed above. Testing shall be performed in accordance with procedures outlined above. The FRP dowel manufacturer shall furnish documentation showing the composition, and typical test values for the type of FRP dowels being furnished.

11. Documentation: For all FRP bars to be used on a project, the FRP Dowel Bar Manufacturer shall furnish the Engineer two (2) copies of written certification that the FRP bars meet the requirements of this Technical Special Provision. In addition, the certification shall list the test values of the FRP bars, test date, and location where testing was performed. Certifications shall bear the signature of a responsible authorized representative of the FRP rebar Manufacturer. Each bundle of FRP bars shall be identified with a corresponding lot number. Lot numbers shall be affixed to each bundle by means of a durable tag.

12. Identification: Dowels shall be identified in accordance with ACI 440.IR-03. Each FRP Dowel Manufacturer shall label the FRP dowel container or packaging with the following information:

a. A symbol to identify the manufacturer/producer.

b. Information to indicate the type of fiber:

i. **g** for glass

ii. **c** for carbon

iii. **a** for aramid

iv. **h** for hybrid

c. The dowel bar diameter.

d. Markings shall be used at the construction site to verify that the specified type, grades, and bar sizes are being used.

13. Chairs: Chair for supporting GFRP dowels shall be non-metallic as recommended by dowel manufacturer for required placement and spacing. Refer to the Plans for dowel locations and additional information concerning dowel size, length, and spacing.

14. Delivery and Storage: Handle and store GFRP dowels in accordance with manufacturer's instructions. Place the dowel on wood pallets so they are maintained free from dirt and mud. Dowels must be stored under an opaque cover to avoid direct sunlight and chemical substances.

T350-2.5 Glass Fiber Reinforced Polymer (GFRP) Tie Bars: Provide round deformed (undulations) and sand coated glass fiber reinforced polymer tie bar surface to affect a mechanical and chemical bond to concrete. Ensure that the resin used to manufacture the bars

consists of an acrylic modified epoxy resin with a minimum of 5 percent and a maximum of 7 percent tensile elongation at break. Ensure that the minimum glass fiber content is 70 percent by weight. Refer to the Plans for bar locations and additional information concerning bar size, length, and spacing:

1. Binding Material: The binding material is composed of Vinylester resin, which is homogeneous throughout the cross section of the bar.

2. Fiber Reinforcement: Fiber is continuous E-CR glass fibers with a volume fraction of 70 percent minimum per ASTM D2584.

3. Manufacturing: Bars shall be manufactured using a pultrusion process and the glass rovings are drawn through a resin bath, surface undulations and sand are applied prior to thermo set of the polymeric resin.

4. Chairs: Chair for supporting GFRP bars shall be non-metallic as recommended by bar manufacturer for required placement and spacing. Refer to the plans for bar locations and additional information concerning bar size, length, and spacing.

5. Ties Wire: All ties will be made with nylon or plastic wire (zip) ties. No metal ties will be allowed.

6. Allowable Damage to Bars: When the visible damage in a linear foot of a bar exceeds 2% of the surface areas in that linear foot or the depth of damage exceeds 0.04 inches, the bar cannot be used. Repair of the bar shall not be allowed, and it shall be immediately removed from the project.

7. Field Modification of Bars: follow Section 415 of the Specifications.

8. Delivery and Storage: Handle and store GFRP bars in accordance with manufacturer's instructions. Place the bars on wood pallets so they are maintained free from dirt and mud. Bars must be stored under an opaque cover to avoid direct sunlight and chemical substances. When handling the bars use equipment that avoids damaging or abrading them and lift bundles at multiple pickup points. Do not drop or drag the bars.

T350-2.6 Forms: Provide forms in accordance with Section 350 of the Specifications.

1. **Form Release Agent:** Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2. **Form Ties:** Use factory-fabricated, adjustable-length, and removable only metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

   a. Snap-off metal ties must not be used in fiber-reinforced concrete.
   b. Ties must not remain within concrete.

T350-3 Delivery Certification.

Comply with the requirements of Section 346-6 of the Specifications.

For fiber reinforced concrete, start the finishing and curing process prior to the drying of the concrete surface. Include the details of the mixing, batching, delivery, placement, finishing and curing methods of the fiber reinforced concrete in the quality control plan.

T350-4 Submittals and Shop Drawings.

Submit Concrete Pavement Mix Design for fiber reinforced concrete per Section 346 of the Specifications and the following:

1. Laboratory Test Reports: Submit copies of laboratory test reports for concrete materials and mix design test as specified or explicitly state the pre-approved mix design already furnished to the Engineer will be used.

2. Material Certificates: It is preferable to provide copies of materials certificates in lieu of materials laboratory test reports when permitted by the Department. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

3. Product Data: Submit product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by the Department.

4. Submit manufacturer's printed product data to indicate proposed polymeric, steel, or FRP macro-fiber-reinforced concrete materials including application rate per cubic yard of concrete.

5. Submit manufacturer's printed batching and mixing instructions.

6. Submit manufacturer's Certification of performance meeting the requirements of ASTM C1116.

T350-4.1 Fiber: A submittal package for fibers must accompany the concrete mix design for approval by the Engineer before any concrete can be placed. ARS test results must be submitted with the mix design. The fiber submittal package must contain the following:

1. Product literature describing a blend of macro-filaments and collated-fibrillated fibers.

2. Assertion that fibers comply with ASTM C1116, Type III fibers.

T350-4.2 GFRP Dowel Bars: A submittal package for GFRP dowel bars must accompany the concrete mix design for approval by the Engineer. The dowel package must be approved before any concrete can be placed. The dowel bar submittal package must contain the following:

1. Manufacturer's product data, including material, mechanical properties, test results and all other items to show compliance with the items indicated above.

2. Independent test reports for material and mechanical properties performed by an independent testing agency for:

a. Each dowel size

b. Each type of fiber reinforcement specified

c. Certification from the manufacturer that all products meet the requirements of this Technical Special Provision Section in accordance with Section 6 of the Specifications.

T350-4.3 GFRP Tie Bar: A submittal package for GFRP tie bars must accompany the concrete mix design submittal. The tie bar package must be approved before any concrete can be placed. The GFRP tie bar submittal package must contain the following:

1. Manufacturer's product data, including material, mechanical properties, test results and all other items to show compliance with the items indicated above.

2. Independent test reports for material and mechanical properties performed by an independent testing agency for the items listed below. The Contractor must account for lead times for testing:

a. Each bar size.

b. Each type of fiber reinforcement specified.

3. Certification from the manufacturer that all products meet the requirements of this Technical Special Provision in accordance with Section 6 of the Specifications.

T350-4.4 Joint Layout: A submittal package for joint layout within the toll loop pavement area must accompany the concrete mix design for approval by the Engineer and Turnpike Tolls Design before any concrete can be placed. Joint types must be identified with applicable details. Coordinate joint layout with Turnpike Tolls Design for site specific TEC loop layout to ensure that toll loops do not cross joints. Show loop conduit protection methodology.

T350-5 Mixing and Delivering Concrete.

Comply with the requirements of Section 346 of the Specifications that are applicable to fiber reinforced concrete.

When ready mix concrete is used, the concrete ingredients including the fibers must be added to the truck mixer at the plant. Obtain approval of the Engineer if fibers or admixtures are to be added at the jobsite. The fibers must be added per manufacturer's written instructions.

T350-5.1 Fiber Reinforced Concrete Mixing: Follow the requirements of the manufacturer's recommendation for mixing sequence, number of revolutions at mixing speed, and mixing procedure. Do not exceed the limits defined in Chapter 9.2 of the Materials Manual. Batch fiber reinforced concrete in whole cubic yard quantities. Add fibers at the concrete plant.

Limit the batch volume to three-quarters of the rated capacity of the transit mixer. Ensure that no fiber clumps enter the mix. Demonstrate a satisfactory method of introducing the fibers into the mixture during the field demonstration batch.

T350-5.2 Laboratory Trial Batch of Fiber Reinforced Concrete Mix: Perform a laboratory trial batch meeting the requirements of Section 346-6.2 of the Specifications. Ensure the fiber reinforced concrete meets the plastic and hardened properties of this Technical Special Provision and the applicable provisions of ASTM C1116.

During the development of the laboratory trial batch, and where macro fibers are required, prepare a set of at least 5 beams from each sample of fresh or hardened concrete meeting the requirements of ASTM C1399. Deliver the samples of concrete beams to the State Materials Office for an ARS test at the time the mix design is being developed.

T350-5.3 Field Demonstration of Fiber Reinforced Concrete Mix: Subsequent to the satisfactory laboratory trial batch, perform a field demonstration of the proposed mix design by production and placement of at least one demonstration batch (3 cubic yards minimum) for approval by the Engineer. During the development of the field trial batch, and where macro fibers are required, prepare a set of at least five beams from each sample of fresh or hardened concrete meeting the requirements of ASTM C1399. Deliver the samples of concrete beams to the State Materials Office for an ARS test within 7 days of casting the samples.

The Engineer's approval will be based on the acceptable results of the plastic and hardened concrete samples and an acceptable surface finish of the field demonstration concrete and the ability to introduce fibers without clumping.

T350-5.4 Fiber Reinforced Concrete Placement and Curing: Ensure fiber reinforced concrete delivered to the project conforms to the applicable provisions of ASTM C1116.

Place and cure the fiber reinforced concrete in accordance with Section 400 of the Specifications.

T350-5.5 Test Requirements: Comply with the requirements of Section 346 of the Specifications and the following:

1. Test cylinders, made in accordance with ASTM C31. One set of fifteen test cylinders (diam.: 4 inches, height: 8 inches) must be made per each lot for fiber reinforced

concrete. A set of three cylinders must be tested in accordance with ASTM C39, prior to the time of opening to traffic, but no earlier than 24 hours, (cure these test cylinders in a manner identical to the corresponding section of pavement). The remaining set of cylinders must be tested at the age of 28-days.

2. Provide a strength-maturity relationship curve as outlined by FM 3-C1074 for opening to traffic determined during design mix verification. Use the maturity method specified in this Technical Special Provision to determine if the concrete has achieved 2,500 psi and can be opened to traffic.

If the average of the first set of cylinders compressive strength is less than 2,500 psi, then the pavement must remain closed. The Engineer and the Contractor must schedule times for testing the next three (3) sets. When the average of a set of cylinders achieve 2,500 psi or higher, the Engineer may open pavement to traffic, but only if this will facilitate the Contractor's operations.

a. Verify the strength of the last slab of each day's placement.

b. The specified 28-day strength for fiber reinforced concrete, based on the average of three cylinders, is 3,000 psi.

3. Fabricate three test cylinders for strength and maturity curve correlation testing. The compressive strength cylinders and maturity curve correlation testing will be performed at the first day of production or at the discretion of the Engineer.

4. Thickness determinations: Use non-destructive testing as identified in Section 350 of the Specifications.

T350-6 Construction Requirements.

T350-6.1 Restrictions: Do not use metal in the toll loop pavement.

T350-6.2 Equipment: Equipment must meet the requirements of Section 350-3 of the Specifications as applicable to non-metallic fiber reinforced concrete.

T350-6.3 Excavation and Subgrade Preparation: Excavate to the required depth and compact the foundation material upon which these items are to be placed. Shape and compact the foundation materials to a firm, even surface, true to grade and cross-slope. Compact areas that have been excavated more than 6 inches below the bottom of the concrete, to a minimum of 95% of AASHTO T99 density. The area to be compacted includes the area directly under and 1 foot beyond each side of the toll loop pavement, when right-of-way allows.

Maintain the finished subgrade in a smooth, compact condition. Restore any areas which are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

Uniformly moisten the subgrade surface ahead of the paving operations with no standing water.

Geotextile Fabric: When called for in the plans, place geotextile fabric in accordance with Section 514 of the Specifications.

Coordinate stub-up locations through concrete slab for electrical toll loop placement and ensure associated conduit with pull strings are installed prior to placing concrete.

T350-6.4 Protection of Toll Loop Conduits: Take special care to prevent conduit loop damage from heat during the installation of any asphalt base used in the rigid pavement design.

Loop conduits and loop conduit stub-ups must be positionally secured and protected from physical damage and / or movement during the concrete pouring operation.

T350-6.5 Setting Forms: Conform to the requirements of Section 350-5 of the Specifications. Metal forms and ties must be removed from the non-metallic fiber reinforced pavement.

T350-6.6 Protection From Weather: Conform to the requirements of Section 350-6 of the Specifications.

T350-6.7 Placement Widths: Conform to the requirements of Section 350-7 of the Specifications.

T350-6.8 Delivery Certifications: Conform to the requirements of Section 350-8 of the Specifications.

T350-6.9 Sampling and Testing Methods: Conform to the requirements of Section 350-9 of the Specifications.

T350-6.10 Striking Off, Consolidating and Finishing Concrete: Place concrete with striking-off, consolidation and finishing per applicable requirements of Sections 350-10 and 350-11 of the Specifications.

T350-6.11 Curing: The concrete overlay must be cured immediately after placement using white, water- based curing compound at a rate as recommended by the manufacturer. Follow by wet curing to maintain a wet condition at all times as specified in Section 350-12 of the Specifications.

Burlap Mats: Particular care must be taken to apply the burlap as early as possible and to maintain it in a saturated condition at all times. Wet burlap curing must be maintained a minimum of 72 hours or until the pavement is opened to traffic, whichever event happens first. The Contractor may propose for approval an alternate curing method.

T350-6.12 Joints: Comply with applicable joint requirements of Section 350 of the Specifications and as the following:

1. Location: Joints must be constructed in accordance with the location shown in the approved joint layout package and with the details shown on the plans.

a. The joints must be sawed using the early saw cut method such as but not exclusively the “Soff-Cut” method. The joints must be cut as soon as the saw equipment can be used without damaging surface concrete and when there is no chance the pavement will be scarred by cutting or raveling of the joint.

b. No wet cutting will be allowed without the approval of the Engineer.

c. No overrun in joint will remain untreated. In cases of overrun, the overrun area must be repaired using an approved epoxy compound.

d. Sufficient saw machines must be available at the jobsite to prevent delay in joint sawing.

e. Equipment will be approved by the Engineer.

2. Construction Joints: The joint sawing must be accomplished in two steps. The initial cut must be 1/8-inch-wide to full depth indicated on the Plans. The second saw cut must form the joint groove according to the dimensions indicated in the Plans.

a. After final sawing and formation of the joint groove, the joint must be cleaned and sealed as specified in Section 350 of the Specifications.

b. The backer rods must be used where required in the Plans. The backer rods must have an adequate diameter to effectively seal the joint groove and must be placed in joint groove so as to satisfy the sealant depth required in the Plans.

c. All work will be approved by the Engineer.

3. Cracked or Broken Panels: At the Contractor’s expense, remove and replace concrete panels that develop cracks prior to opening to traffic. The joints must be sealed in accordance with the Plans.

T350-7 Final Surface Finish.

Concrete pavement surface and finish must comply with applicable requirements of Section 350 of the Specifications.

T350-8 Opening Pavement to Traffic.

Comply with the applicable requirements of Section 350 of the Specifications.

T350-9 Acceptance.

Testing of thickness and compressive strength of concrete and acceptance of fiber reinforced concrete pavement will be in accordance with requirements listed herein and the applicable sections of Section 350 of the Specifications.

T350-10 Method of Measurement.

The quantities to be paid for will be the plan quantity, in square yards, of Reinforced Cement Concrete Pavement,12" Thick, Type III Synthetic Fiber Reinforced, omitting any areas not allowed for payment under the provisions of Section 350-16.3 of the Specifications and adjusted for average thickness as provided herein.

For purposes of payment, the average thickness of pavement will determine the final pay quantities for this pavement as follows:

The area of pavement represented by the difference between the calculated average thickness and the specified thickness will be converted into equivalent square yards of specified thickness pavement, and the quantity thereby obtained will be added to, or deducted from, the quantity of pavement to be paid for, subject to the limitation that the maximum average of over-thickness permitted in the adjustment of the quantity of pavement to be paid for will be 1/2 inch.

T350-11 Basis of Payment.

The Contract unit price for Reinforced Cement Concrete Pavement, 12" Thick, Type III Synthetic Fiber Reinforced, includes all labor, testing, materials, and equipment necessary for a complete and accepted installation. Excavation for new installations will be paid for under the items for the grading work on the project.

Payment will be made under:

Item No 350-	Reinforced Cement Concrete Pavement, 12" Thick, Type III Synthetic Fiber Reinforced - per square yard

TECHNICAL SPECIAL PROVISION

FOR

TOLL SITE EQUIPMENT SLABS AND FOUNDATIONS

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____

Fla. License No.: _____

Firm Name: _____

Firm Address: _____

City, State, Zip Code: _____

SECTION T400
TOLL SITE EQUIPMENT SLABS AND FOUNDATIONS

T400-1 Description.

Construct Portland cement reinforced concrete slab to support toll equipment, toll equipment buildings, generator, and fuel tank foundations, on a prepared subgrade or base. Use concrete reinforced with steel bars or welded wire reinforcement, in accordance with details and notes shown in the Plans.

T400-2 Materials.

T400-2.1 General: Ensure that the materials used for the construction of slabs have certification statements from each source, showing that they meet the applicable requirements of the following:

T400-2.2 Concrete: Use concrete meeting the requirements of Section 346 of the Specifications, Class I, unless requirements herein or on plans are more stringent.

Utilize concrete with a target slump of 3 inches plus or minus 1.5 inches.

Provide concrete with a minimum 28-day compressive strength of 3,000 psi and maximum water to cementitious materials ratio of 0.50, unless plans call for more stringent requirements.

The requirements of Sections 346-3 and 346-4 of the Specifications do not apply unless called for on plans.

Notify the Engineer if any of the component quantities are adjusted. If any material sources change, resubmit the mix design to the Engineer for approval prior to use.

T400-2.3 Reinforcement: For all steel reinforcement required by the Plans, meet the requirements of Section 415 of the Specifications.

T400-2.4 Joint Materials: Meet the requirements of Section 932 of the Specifications.

T400-2.5 Geotextile: If specified, meet the requirements of Section 514 of the Specifications.

T400-2.6 Forms: Provide forms in accordance with Section 520-3 of the Specifications.

T400-2.7 Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

T400-2.8 Form Ties: Use factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

Unless otherwise indicated and except as noted, provide ties so portion remaining within concrete after removal is 1-1/2 inches inside concrete and will not leave holes larger than 1-inch diameter in concrete surface.

T400-3 Submittals and Shop Drawings.

1. Product Data: Submit product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by the Department.

2. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Conform to ACI Detailing Manual MNL-66, showing bar schedules,

stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required and formed openings through concrete structures.

3. Laboratory Test Reports: Submit copies of laboratory test reports for concrete materials and mix design test as specified or explicitly state the pre-approved mix design already furnished to the Engineer will be used.

4. Material Certificates: It is preferable to provide copies of materials certificates in lieu of materials laboratory test reports when permitted by the Department. Material certificates shall be signed by Manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

T400-4 Construction Requirements.

T400-4.1 General: Perform concrete structures work in accordance with Section 400 of the Specifications.

T400-4.2 Excavation and Subgrade Preparation: Excavate to the required depth and compact the foundation material upon which these items are to be placed. Shape and compact the foundation materials to a firm, even surface, true to grade and cross-slope. Compact areas that have been excavated more than 6 inches below the bottom of the concrete, to a minimum of 95% of AASHTO T99 density. The area to be compacted includes the area directly under and 1 foot beyond each side of the toll site equipment slab, when right-of-way allows.

Maintain the finished subgrade in a smooth, compact condition. Restore any areas which are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

When called for in the plans, place geotextile fabric in accordance with Section 514 of the Specifications.

Coordinate conduit stub-up locations through the concrete slab for electrical toll equipment placement and ensure associated conduit are installed prior to placing concrete.

T400-4.3 Placing Concrete: Place the concrete in the forms, and tamp and spade it to prevent honeycombing, and until the top of the structure can be floated smooth and the edges rounded to the radius shown in the Plans.

Protect unhardened concrete from effects of inclement weather. Cease operations in rain. The following will apply when placing in cold and hot weather:

1. During the cold weather, do not mix or place concrete when the air temperature is below 40ºF. Protect the fresh concrete from freezing in accordance with Standard Specifications Section 400 until the concrete reaches a minimum compressive strength of 1,500 psi.

2. During placing in hot weather, cool the aggregates and mixing water as necessary to maintain the concrete temperature at not more than 100ºF at time of placement with the protective covering.

Install expansion and contraction joints in accordance with the Plans and Section 520-6 of the Specifications. In addition to the requirements of Section 520-6.2 of the Specifications, construct expansion joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as upright pedestals, foundation walls, grade beams, foundations, pull boxes, and elsewhere as indicated.

T400-4.4 Finishing:

1. Screeding: Strike-off the concrete by means of a wood or metal screed, used perpendicular to the forms, to obtain the required grade and remove surplus water and laitance.

2. Surface Requirements: Finish all exposed surfaces while the concrete is still green. Provide a broom finish unless noted otherwise on plans. Ensure that the surface variations

are not more than 1/4 inch under a 10-foot straightedge or more than 1/8 inch on a 5 foot transverse section. Finish the outer edges of the concrete with an edging tool having a radius of 1/2 inch unless noted otherwise on plans.

3. Curing: Cure the concrete as specified in Section 520-8 of the Specifications.

4. Backfilling and Compaction: After the concrete has set sufficiently, but not later than three days after pouring, install backfill around the toll equipment slab in accordance with the plans, to the required elevation with suitable material. Place and thoroughly compact the material in layers not thicker than 6 inches.

T400-5 Method of Measurement.

Toll equipment building foundations will not be measured separately and will be considered as incidental work.

The quantity to be paid for toll site equipment slabs will be plan quantity, in square yards, completed and accepted.

T400-6 Basis of Payment.

The toll equipment building foundation as specified in this Section will not be paid for directly but will be considered as incidental work.

Price and payment will be full compensation for work specified in this Section for toll site equipment slabs. Excavation for new installations will be paid for under the items for the grading work on the project.

Payment will be made under:

Item No. 400-45-5	Reinforced Concrete, Toll Site Equipment Slab, 12" Thick - per square yard

TECHNICAL SPECIAL PROVISION

FOR

PIPE BOLLARDS

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T519
PIPE BOLLARDS

T519-1 Description.

Construct pipe bollards in accordance with this Section and the Plans.

T519-2 Materials.

T519-2.1 General: Meet the following requirements:

1. Concrete .....Section 347
2. HDPE Sleeve ..... ASTM D4976-PE235(1)
3. Galvanized Steel .....Section 962
    a. Steel Pipe: Conform to ASTM A 53, Type S, Grade B, Schedule 40, galvanized.
4. Hardware
    a. Nuts and bolts shall be regular hexagon type conforming to ASTM A307, Grade A.
5. Gravel.....No. 57 Stone
6. Weed block ..... Polypropylene or Polyester Fabrics

(1) - HDPE must be designed for impact strength and UV resistance. UV Stabilizer must be combined with the HDPE.

T519-3 Construction Requirements.

T519-3.1 Removable Pipe Bollard:

1. Construct concrete foundation with embedded galvanized steel pipe sleeve and bolt in accordance with the Plans.
2. Construct pipe bollard in accordance with the Plans.
3. Attach pre-manufactured yellow high-density polyethylene sleeve (per manufacturer's instructions).
4. Provide gravel surrounded with weed block at locations depicted in the Plans.

T519-3.2 Permanent Pipe Bollard:

1. Construct concrete foundation with embedded galvanized steel pipe in accordance with the Plans.
2. Fill bollard with concrete in accordance with the plans. Round off top.
3. Attach pre-manufactured yellow high-density polyethylene sleeve (per manufacturer's instructions).

T519-4 Method of Measurement.

The quantity paid for will be the number of each type as designated, constructed, in place, and accepted. Includes foundations, sleeves, gravel, and weed block.

T519-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including all materials, hardware, labor, and incidentals required to complete the installation.

Payment will be made under:

Item No. 519- 78 Bollard - each

LEVEL 3

TECHNICAL SPECIAL PROVISION

FOR

ACCESSIBLE GANTRY GEAR BOXES

FINANCIAL PROJECT NO.: _____-_-__-__

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LEVEL 3

SECTION T734
ACCESSIBLE GANTRY GEAR BOXES

T734-1 Description.

Furnish and install the accessible gantry gear boxes in accordance with the Plans and Specifications.

T734-2 Materials.

Provide AUMA GS gear boxes for accessible gantries with:

1. Model no. 100.3/VZ 4.3
2. F-16 Bolt Pattern
3. No end stops
4. Specify left -KN-LR or right -KN-RL, as shown on the Plans
5. Total reduction ratio shall be 208:1 maximum.
6. Minimum working output torque: 2,065 ft-lb.
7. Provide unit with a locking device such that the output rotation can be stopped at no more than 10-degree intervals.
8. Unit shall be permanently lubricated, weatherproof, and suitable for unsheltered outdoor service.
9. Supply unit without output mounting flange.
10. Provide NEMA 4/6 standard housing with KN corrosion protection.
11. Output gear head shall be machined to match the “Gear Box Output Shaft”.
12. Provide unit with a 1.5” bore and (2) two 0.375” keyways.

T734-3 Submittals and Shop Drawings.

Provide catalog cut sheets and / or data sheets for the accessible gantry gear boxes. Shop drawings for accessible gantries must depict the actual hardware used.

T734-4 Method of Measurement.

The work specified in this Section will not be measured but will be included in the pay items for each accessible gantry, and each J-arm assembly for accessible gantry.

T734-5 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

TOLL GANTRIES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T735
TOLL GANTRIES

T735-1 Description.

Furnish and erect toll gantries at the locations identified in accordance with the Plans. Furnish and install J-arm assemblies and associated hardware on existing gantries. Furnish and install J-arm assemblies, gear boxes, and associated hardware on existing accessible gantries.

The Department designates a toll gantry with a walkway as an accessible toll gantry.

The Department designates a toll gantry without a walkway as a non-accessible toll gantry and may further classify it as a cantilever or span structure.

Meet the requirements shown in the following Standard Plan Indices:

Non-Accessible Cantilever Toll Gantry……. Standard Plans Index 700-040
Non-Accessible Span Toll Gantry.…….…. Standard Plans Index 700-041
Accessible Span Toll Gantry…….……. Standard Plans Index 700-041

T735-1.1 Supporting Hardware: Provide the following as shown on the Plans:

1. Non-accessible toll gantry supporting hardware:
    a. W-Sections
    b. Horizontal support pipes
    c. Attachment hardware for connection to structure chords, J-Arms, W-Sections and horizontal support pipes
2. Accessible toll gantry supporting hardware, structure chords, including associated mounting hardware:
    a. Swing gate assemblies
    b. Walkway system
    c. Fall arrest system
    d. Access stair assembly
    e. Equipment retraction assemblies including toll equipment support systems
    f. Electrical infrastructure

T735-2 Materials.

T735-2.1 General Requirements: Meet the general material requirements of Section 700-2.1 of the Specifications and the Overhead Signs material requirements of Section 700-2.4.3 of the Specifications unless otherwise noted in Section 735-2.2 of the Specifications. Hot-dip galvanized steel, in accordance with Section 962-11 of the Specifications.

T735-2.2 Supporting Hardware: Meet the requirements of Standard Specifications Section 962-11 when galvanizing for fittings and appurtenances for all structural steel, fasteners, and hardware.

All aluminum materials must meet the requirements of Section 965 of the Specifications. Weld aluminum structures in accordance with Section 965 of the Specifications.

Metallic mounting assemblies must meet ASTM B117 for corrosion resistance.

Provide supporting hardware meeting the requirements of this Technical Special Provision and Table T735-1.

TABLE T735-1 MATERIALS FOR SUPPORT HARDWARE AND FITTINGS

ITEM	MATERIALS
Steel U-Bolts	ASTM A449 or ASTM 193 B7 with minimum yield strength of 55,000 psi and a minimum ultimate strength of 90,000 psi
Aluminum bars, plates, stiffeners backing ring, shims and shapes Bar, Rod, and Shapes	Alloy 6061-T6 per ASTM B308
Stainless Steel Plates	Type 304L per ASTM A240
Stainless Steel Structural Shapes, Bars, and U-Bolt	Type 316L per ASTM A276
Stainless Steel screws, bolts, washers, and nuts	18-8 Stainless Steel unless otherwise noted
SEMS Machine Screws with washers and nuts for Upper Platform End Panel and Swing Gates	18-8 Stainless Steel with Phillips Pan Head with internal tooth-lock washer #10-32 threading
1" Fiberglass Grating for Upper Grating and Lower Grating	Fiberglass grating, pultruded, I-bar, SPF polyester resin, gray, 1.000" height x 0.600" top flange width I-bar bearing bars, spaced 1.500" on center with 0.900" clear space between bearing bar top flanges, anti-skid surface and fully sealed, bearing bars run parallel to length of panel, gray cross-rods spaced 6" on center, 60% open area, flame retardant to UL94V0 and ASTM E84 Class 1 or Class A compliant
Stainless Steel Wire Mesh (above lower grating and inside fall restraint assembly)	Wire mesh, square weave, stainless steel Type 316 woven construction, mill finish, 6x6 square mesh, 0.1317" x 0.1317" opening, 0.0350"wire
Stair Treads	Welded bar grating, hot-dipped galvanized, stair tread, 19-W-4 spacing, minimum 1-1/4" height x 3/16" thick rectangular bearing bars, serrated, run parallel to length of stair tread; with checkered plate 90-degree nosing; load capacity 400 lbs.
Upper Stair Landing and Access Platform Lower Landing Grating	Welded bar grating, hot-dipped galvanized, GW-150 smooth, welded fabrication, 19-W-4 spacing, 1-1/2” x 3/16” bearing bars, 77% open area, spaced 1-3/16” on centers, cross bars, 4" on centers; grating must support a uniform load of 500 lbs. over a clear span of 48" with a deflection of less than 0.2"
Access Platform Grating	Welded bar grating, hot-dipped galvanized, GW-150 smooth, welded fabrication, 19-W-4 spacing, 1-1/2” x 3/16” bearing bars, 77% open area, spaced 1-3/16” on center, regular cross bars, 4" on center, width 36"; grating must support a minimum uniform load of 237 lbs. over a clear span of 72" with a deflection of less than 0.45"

TABLE T735-1 MATERIALS FOR SUPPORT HARDWARE AND FITTINGS ITEM	MATERIALS
Self-Closing Hinge for Access Platform Gate	Stainless Steel Type 304, self-closing full mortise-mount spring hinge, with adjustable tension, rounded corners, 1-3/4" thickness, 4-1/2" x 4" overall dimensions with 2 leaves
Aluminum Screening	Wire mesh, square, aluminum alloy, mill finish, woven-intercrimp weave, 2” x 2” mesh (square), 0.4370" x 0.4370" opening (square), 0.063" thick (16 gauge) wire diameter, 76% open area
Full Mortise Pin & Barrel, Continuous hinge for Swing Gate	Stainless Steel Type 304, full mortise pin and barrel continuous hinge, supporting a minimum door weight of 300 lbs.
Rivet Nut for Swing Gate Latch assembly	Aluminum twist resistant locking rivet nut
Hex Head Screw for Gate Latch Post Connection Plate	Galvanized Flanged Hex Head Screws Medium-Strength
Retaining Rings for Gear Box Output Shaft	Stainless Steel
Fasteners for Swing Gate Hinge	Stainless steel – size and type per hinge manufacturer
PTFE Tape (polytetrafluoroethylene) For fall arrest system	Slippery PTFE Bar, with a slippery surface on one side and an etched texture on one side. The etched texture is scuffed to readily accept adhesive. Chemical Resistant, Impact Resistant, Low Water Absorption, Slippery, Wear Resistant, Weather Resistant. Use outdoor rated silicone adhesive made for attaching PTFE to stainless steel
Bushing for Gear Box Output Shaft	HDPE
Bushing for Gear Box Bushing Plate	Slip fit acetal plastic flanged sleeve bearing
Silicone Rubber adhesive Latch plate and Stop Plate	High-Temperature Silicone Rubber Strip with Adhesive-Back, Outdoor rated, Tensile Strength Min. 700 psi
Brass Keys for Output Shaft and Gear Box Input Adapter	Marine Grade Brass 485 meeting ASTM B21 or approved alloy: Corrosion resistant brass alloy appropriate for industrial applications and rated for deployment in an outdoor marine environment
Input Adapter for AUMA Gearbox	Input adapter shall be brass and machined to match input of AUMA gearbox. Input shall be configured to accept a standard ½” square socket wrench with appropriate tolerances

Conform to American Gear Manufacturers Association AGMA-9002 Bores and Keyways for Flexible Couplings (Inch Series) for sizes and tolerances of keys, keyways, key seats, key shafts, and key hubs/bores.

All flanged hex head screws must be serrated.

T735-2.3 Toll Gantry Foundations, Fabrication, Installation, and Erection: Meet the requirements of Section 700.3.2 and Section 700-3.3.3 of the Specifications**.**

T735-3 Toll Equipment Attachment Infrastructure.

T735-3.1 Toll Equipment J-Arms: Furnish and install J-Arms and all associated hardware in accordance with the Plans.

J-Arms must be fabricated within the following tolerance limits:

1. Outside diameter of 2.875 inches with an ovality tolerance of +/- 0.015 inch along the straight sections of the arm. (ANSI H35.2)

2. The minimum and maximum outside diameter within the curved section of the J-Arm must be 2.790" and 2.904" respectively.

3. J-Arm pipe bending must be in accordance with the requirements specified in Pipe Fabrication Institute Standard ES-24, Pipe Bending Methods, Tolerances, Process and Material Requirements.

4. Equipment retraction assembly for accessible toll gantries.

Furnish and install equipment retraction assemblies and all associated hardware in accordance with the Plans and Specifications.

T735-3.2 J-Arm Fasteners and Attachment Hardware: All U-bolts must be furnished with double nuts and a saddle. Weld aluminum structures in accordance with Section 965 of the Specifications. Install u-bolts, nuts, and washer assemblies in accordance with Section 460-5 of the Specifications.

J-Arm attachment for gantries includes non-accessible gantry hardware and accessible gantry hardware as shown in the Plans and Specifications.

T735-3.3 Sampling and Testing: Test J-Arm roundness, yield, and tensile strength at the fabrication facility before shipping to the jobsite in accordance with the Producer's Quality Control Plan.

Provide a sample J-Arm from each J-Arm fabricator for testing and acceptance by the Engineer, prior to fabricating any J-Arms for the project. Sample J-Arm(s) that meet criteria may be used as production J-Arms.

T735-3.4 Installation of Supporting Hardware: Furnish and install supporting hardware in accordance with the Plans and Specifications.

T735-3.5 Delivery of Spare Equipment: Toll facilities gantry subcomponent plans will provide the quantity of spare equipment required. Deliver spare equipment to the Department's Central Repair Depot at Florida's Turnpike Milepost 99. Provide two weeks advance notice prior to delivering the spare items. Deliver the equipment in the original manufacturer's storage packaging. If the manufacturer does not use packaging for storage, wrap in heavy duty industrial grade clear plastic and label. Place hardware in boxes and label.

T735-4 Toll Gantry Electrical Infrastructure.

Toll gantry electrical infrastructure includes the following as shown on the Plans and Specifications:

1. Raceways (including conduits, wireways, and cable trays) for power, AVI, data, and CCTV, associated fittings, and accessories located on the toll gantry, which includes but is not limited to, the pull ropes, grounding wire, strut channel frames and all associated attachment hardware.

2. Fixtures, raceway, and conductors for lighting, lighting control, wiring devices, strut channel frames, and all associated attachment hardware.

3. AVI Reader frames as well as all wire troughs and associated strut channel frames, at the base of the toll gantry.

4. Lightning protection at the toll site, except for the toll equipment building lightning protection and the generator equipotential bonding.

5. Grounding and bonding for electrical systems at the gantry.

All toll gantry electrical infrastructure must be rated NEMA 3R or NEMA 4.

T735-5 Shop Drawings and Certifications.

Submit shop drawings in accordance with Section 5 of the Specifications. Include fabrication and connection details including field splice locations and material certifications. Prior to the submittal of the shop drawings, determine the actual in-place dimensions for all toll gantry structures on the basis of existing field conditions and include in the shop drawings.

Include gantry toll equipment locations with respect to the lane lines on the pavement below and the uprights.

Each J-Arm fabricator must be an approved fabricator of aluminum products per Sections 105-3 of the Specifications. Provide a letter from each J-Arm fabricator to the Department stating that the fabricator is currently equipped/capable of fabricating the J-Arms. This letter must be provided at least one month in advance of providing the sample J-Arm.

T735-6 Method of Measurement.

Contract unit price for each toll gantry, furnished and installed, will include furnishing the truss, uprights, columns, foundation(s), support hardware, toll gantry electrical infrastructure, accessible gantry gear boxes (where called for on the Plans), and all equipment, labor, and materials necessary for a complete and accepted installation.

Unit price for each J-arm assembly with associated hardware will be measured as each.

Unit price for each J-arm assembly, and gear box, with associated hardware on an accessible gantry will be measured as each.

T735-7 Basis of Payment.

Price and payment will be full compensation for furnishing all materials and completing all work described in the Plans and Specifications.

Payment will be made under:

Item No. 735-1-	Toll Gantry - each
Item No. 735-1-95	J-arm assembly, Non-accessible Gantry - each
Item No. 735-1-96	J-arm retraction assembly, Accessible Gantry - each

TECHNICAL SPECIAL PROVISION

FOR

CABLE TRAYS FOR TOLL GANTRIES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T735A
CABLE TRAYS FOR TOLL GANTRIES

T735A-1 Description.

Furnish all labor, materials, services, testing, and equipment necessary to provide and install cable trays including cable trays and accessories for use on toll gantries.

T735A-2 Materials.

T735A-2.1 General: Furnish materials from a company specializing in manufacturing the products specified in this section with minimum three years of experience, and with service facilities within 100 miles of Project.

T735A-2.2 Cable Tray Requirements for Gantries: Provide manufacturer's standard clamps, hangers, brackets, splice plates, expansion joints, reducer plates, blind ends, barrier strips, connectors, conduit to tray adaptors, ladder drop-out fittings, and grounding straps for all gantry cable trays.

T735A-2.2.1 Longitudinal Ladder Style Cable Trays:

1. Loading depth: 4” NEMA VE 1 with 5” total rail height.
2. The aluminum cable tray side rails will be manufactured from aluminum alloy extrusions that meet the material specifications of the Aluminum Association Alloy #6063-T6.
3. Ensure the cable tray system is designed to safely support a uniformly distributed load of 100 pounds per foot with 6-foot support spans. When loaded at 100 pounds per foot, the maximum deflection of the cable tray shall not exceed ½ inch at any point.
4. The UL cross sectional area of each side rail shall be 1 square inches minimum.
5. Finish: Aluminum, non-painted.
6. Inside width:
    a. Accessible Gantries: (2) 24" for data, (2) 6" for power centered symmetrically about the gantry centerline..
    b. Non-Accessible Gantries: See Plans.
7. Cable tray dividers:
    a. Accessible Gantries: The DATA cable tray must be equipped with a center divider to separate the future tolling data cables from the AVI coaxial cables.
    b. Non-Accessible Gantries: The cable tray must be equipped with two dividers to separate the future tolling data cables, AVI coaxial cables, and power cables.
8. Straight Section Rung Spacing: 6 inches on center.

T735A-2.2.2 Transverse & Ventilated Channel Style Cable Tray:

1. Loading depth: 1-3/4” height.
2. The aluminum cable tray will be manufactured from aluminum alloy that meets the material specifications of the Aluminum Association Alloy #6063-T6.
3. Ensure the cable tray system is designed to safely support a uniformly distributed load of 30 pounds per foot with 6-foot support spans.
4. The UL cross sectional area of each side rail shall be 0.4 square inches minimum.
5. Finish: Aluminum, non-painted.

6. Inside width: 4”.

T735A-2.3 Warning Signs for Cable Trays: Provide engraved nameplates for cable trays in accordance with the following:

1. 1/2-inch black letters on yellow laminated plastic nameplate
2. Engrave cable tray nameplates with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

T735A-3 Shop Drawings and Submittals.

1. Product Data: Provide data for fittings and accessories.
2. Shop Drawings: Indicate tray type, metal type, rung spacing, loading depth in accordance with NEMA VE 1, dimensions, support types, support points, accessories, and finishes.
3. Provide documentation of Manufacturer's Instructions as follows:
   a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
   b. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

T735A-4 Construction Requirements.

Verify that field measurements are as indicated on shop drawings, and as instructed by the manufacturer.

Install metallic cable tray in accordance with NEMA VE 1. Provide supports at each connection point, at the end of each run, at other points to maintain spacing between supports of 6 ft maximum, and as required by the manufacturer. Use expansion connectors where required where joints are crossed.

Ground and bond cable tray. Provide electrical continuity between all tray components. For ladder type cable tray: Install a 10 AWG copper equipment grounding conductor from the service entrance ground bus to the cable tray. Use Cu/Al rated mechanical lugs at the end of the grounding conductor to bond it to the cable tray. For ladder type cable tray at outdoor gantries: Bond the cable tray and each metal conduit with grounding bushings and a #10 AWG, minimum bare copper equipment grounding conductor. Bond all metallic conduits terminating at the tray by using bonding type bushings. Install to create a continuous, low-resistance, electrical ground return path in accordance with the requirements of the NEC.

Use anti-oxidant compound to prepare aluminum contact surfaces before assembly. Electrical connections to the cable tray shall be made with Cu/Al rated lugs. Carefully coordinate the cable tray installation with other trades to avoid interferences and maintain proper NEC clearances.

Install the cable tray at plan locations and heights and as required by field connections. Cable tray wire shall not be spliced at the tray or inside the tray.

T735A-5 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

SURFACE RACEWAYS AND WIRE TROUGHS AT TOLL GANTRIES

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SECTION T735B
SURFACE RACEWAYS AND WIRE TROUGHS AT TOLL GANTRIES

T735B-1 Description.

Furnish of all labor, materials, services, testing, and equipment necessary to provide and install surface raceways and wire troughs at each toll site.

T735B-2 Qualifications.

Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years of experience.

T735B-3 Materials.

T735B-3.1 Wireways Installed Outdoors:

1. Wireways installed outdoors shall be manufactured from temperature and chemically resistant fiberglass material and shall be rated NEMA 3R, NEMA 12, and IP55.

2. Vertically mounted wireways shall be listed for vertical installation and the removable covers shall be equipped with captivated monel cover screws and oil resistant gaskets.

3. Wireways shall be fastened in place using the manufacturers brackets or hangers and in accordance with the manufacturer's installation instructions.

T735B-3.2 Wire Troughs:

1. Wire troughs installed indoors in dry locations shall have a minimum cross section of 12 inches by 12 inches and be manufactured from 14-gauge steel and then phosphatized before painting inside and outside with ANSI 61 gray colored polyester paint.

a. Indoor wire troughs shall be equipped with slip-on removable covers and embossed mounting holes on the back of the enclosure.

b. Do not field drill mounting holes in the enclosure. Use the embossed mounting holes provided by the manufacturer.

2. Wire troughs installed outdoors or in wet locations shall have a minimum cross section of 12 inches by 12 inches and shall be manufactured from 14-gauge galvanized steel and then phosphatized before painting inside and outside with ANSI 61 gray colored polyester paint.

a. Outdoor wire troughs shall include an integral drip-shield along the top, and seam free sides, front, and back.

b. The removable front cover shall be a "slip on" type metal cover with corrosion resistant fasteners along the bottom of the cover. The fasteners shall be captive and held to the cover. The removable cover shall include provisions for padlocking.

c. Factory provided mounting holes on the back of the wire troughs shall be embossed. Field drilled mounting holes are not acceptable.

d. The wire troughs shall be UL 870 listed, and rated NEMA 3R or NEMA 4X.

T735B-4 Submittals and Shop Drawings.

1. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.

2. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of

Product.

T735B-5 Quality Assurance.

1. Perform Work in accordance with National Electrical Contractors Association NECA Standard of Installation.
2. Maintain one copy of document on site.

T735B-6 Construction Requirements.

T735B-6.1 Installation:

1. Install products in accordance with manufacturer's instructions.
2. Wireways and wire troughs shall be mounted plumb and level.
3. Wireways shall be secured to the structure using the original equipment manufacturer’s brackets and/or hangers.
4. The ends of all wireways shall be closed using the original equipment manufacturers fittings.
5. Field drilling for mounting galvanized metal enclosures, or wire troughs is not acceptable. Use factory provided mounting holes only.
6. Do not terminate conduits and wireways into the top of a wire trough where installed outdoors.

T735B-7 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

DRILLED SHAFT ANCHOR BOLTS AT TOLL GANTRIES

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SECTION T735C
DRILLED SHAFT ANCHOR BOLTS AT TOLL GANTRIES

T735C-1 Description.

Furnish all labor, materials, services, testing, and equipment necessary to provide and install drilled shaft anchor bolts for each toll gantry foundation.

T735C-2 Materials.

Anchor bolt nut and washer assemblies must meet the requirements of ASTM F3125, Grade A325.

T735C-3 Submittals and Shop Drawings.

Submit shop drawings in accordance with Section 5 of the Specifications.

Product Data: Provide dimensions, sizes and locations, materials, fabrication details, finishes, and accessories.

T735C-4 Construction Requirements.

Meet the requirements of Technical Specifications Section T735-2.3.

Install anchor bolt, nut and washer assemblies in accordance with 460-5, except that 460-5.4.2 Preparation of Faying Surfaces is not required.

T735C-5 Method of Measurement.

No separate payment will be made for the drilled shaft anchor bolts at toll gantries; payment is included with the pay item of each toll gantry.

T735C-6 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

AS-BUILT SURVEY OF INSTALLED ANCHOR BOLTS AT TOLL GANTRIES

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SECTION T735D
AS-BUILT SURVEY OF INSTALLED ANCHOR BOLTS AT TOLL GANTRIES

T735D-1 Description.

Provide an as-built survey of the installed anchor bolts and foundation for each toll gantry foundation.

T735D-2 Submittals and Shop Drawings.

Submit shop drawings in accordance with Section 5 of the Specifications.

Provide the following as-built information:

1. Station and offsets of the center of the anchor bolt circle(s)
2. Orientation of the anchor bolt circle(s)
3. Elevation(s) of the top of foundation(s)
4. Any other as-built requirements identified in Standard Plans 700-041.

T735D-3 Method of Measurement.

No separate payment will be made for the as-built survey of installed anchor bolts at toll gantries; payment is included with the pay item of each toll gantry.

T735D-4 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.