

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

**Concessions
New Construction and
Modifications**

Design Standards

Project Submittal & Review

Table of Contents

Section	Page
1.0 Purpose	3
2.0 Scope	3
3.0 Responsibilities	3
A. Concessions.....	3
B. DOA Planning & Development (P&D).....	3
C. Concessions/Designer of Record.....	4
4.0 Procedure	4
A. Project Submittals.....	4
B. Review Timing	5
C. Review Responsibility	5
5.0 Project Requirements	5
A. Design/Construction Standards.....	6
B. Building Permit.....	6
C. As-Builts.....	6
6.0 Appendices	6
A. Appendix A Design Review Process for Concessions Projects.....	7

1.0 PURPOSE

The purpose of these standards is to provide DOA Concessions, Airport Concessions & their Designers of Record with procedures for submitting a project to the Department of Aviation's Planning & Development Bureau (P&D) for technical review and acceptance. All new construction and modifications to any airport's concessions space, including the addition/remodeling of new & temporary kiosks at Hartsfield-Jackson Atlanta International Airport (ATL) shall follow these standards.

2.0 SCOPE

These standards apply to DOA Concessions, airport Concessions & their Designers of Record, contractors and sub-contractors.

3.0 RESPONSIBILITIES

A. DOA Concessions

1. DOA Concessions shall be responsible for REVIEWING / APPROVING all Concessions new construction, modifications, and new/temporary kiosk project submittals before submitting to P&D for review.
2. DOA Concessions shall be responsible for NOTIFYING P&D that the project submittal(s) submitted/uploaded electronically to P&D by the Concessions/Designer of Record can proceed with the technical review.
3. DOA Concessions shall be responsible for all communication(s) and scheduling of required meetings with the Concessions and/or Designers of Record to resolve design issues, unless requested otherwise by DOA Concessions.
4. DOA Concessions shall be responsible for coordinating and assisting in the resolution of all design issues.

B. DOA Planning & Development Bureau (P&D)

1. P&D shall be responsible for the Architectural/Engineering technical review of all project submittals submitted to P&D by DOA Concessions, Concessions and/or their Designers of Record. Code reviews, Fire/Life Safety code and Grease Interceptor requirement reviews are the responsibility of the City of Atlanta Office of Buildings (OOB), Atlanta Fire Department (AFD) and Department of Watershed Management (DWM) respectively.
2. P&D shall be responsible for ensuring that all project submittals comply with the latest ATL P&D's Concessions New Construction, Design Modifications and Construction Standards located at: (<https://atlstandards.com>)
3. P&D shall be responsible for electronically transmitting technical review comments to DOA Concessions and their Designers of Record (SagesGov).
4. P&D shall be responsible for electronically issuing the final P&D/AFD stamped

accepted project submittals to DOA Concessions, Concessions and their Designers of Record.

C. Concessions/Designers of Record

5. Concessions/Designers of Record shall be responsible for submitting all project submittals to P&D by P&D's Design Review Process, (Appendix A).
6. Concessions/Designers of Record shall be responsible for complying with the latest ATL P&D's Concessions New Construction, Design Modifications and Construction Standards located at: (<https://atlstandards.com>)
7. Concessions/Designers of Record shall be responsible for submitting to P&D and DOA Concessions, all revisions and/or modifications to the P&D stamped/accepted documents, for review and acceptance.
8. Concessions/Designers of Record shall be responsible for obtaining all required building permits from appropriate agencies before the start of any construction work. The City of Atlanta Office of Buildings shall not accept any submittals for permitting without the P&D/AFD stamped/accepted seal.

4.0 PROCEDURE

A. Project Submittals

1. Delivery of Submittals

- a. All submittals shall be submitted electronically by P&D's SagesGov Design Software.
- b. Review process. Process for Concessions Projects (Appendix A).

2. Submittals to P&D

- a. Concept Design (30%)
- b. Final Design (Initial review submittal).
- c. Sealed drawings by the State of Georgia Engineer/Architect of Record are not required for this submittal.
- d. Final Design Re-Submittal (Revised drawings and specifications incorporating all review comments).
- e. Sealed drawings by the State of Georgia Engineer/Architect of Record are not required for this submittal.
- f. Issue for Construction Drawings and Specifications. (Final Conformed set of documents).
 - i. Sealed drawings by the State of Georgia Engineer/Architect of Record are required for this submittal.
 - ii. Submit (upload) PDF and CAD (.dwg) format of the sealed, signed plans.
 - iii. Upload sealed, signed Specifications in .pdf and word (.docx)

- iv. Submit one (1) USB Flash drive containing Revit (.rvt) files if Revit was used for drawings or File Share with the Design review Coordinator

B. Review Timing

1. P&D's initial review time shall be fifteen (15) business days.
2. Submitter/Designer comment response shall be ten (10) business days for cycle 1 and five (5) business days for any additional comment response submittals.
3. P&D's re-submittal review time shall be a maximum of five (5) business days.
4. P&D/AFD final Issue for Construction stamp acceptance of digital drawings and Release Notification letter shall be a maximum of five (5) business days.
5. AFD's review time and their resolution of issues are not controlled by P&D. These conditions may be subject to additional review time and full acceptance of the documents.

C. Review Responsibility

1. P&D's technical review and stamped acceptance of documents is solely for compliance with the latest ATL P&D's Concessions New Construction, Design Modifications and Construction Standards located at: (<https://atlstandards.com>)
2. City of Atlanta Office of Buildings, Atlanta Fire Department and Department of Watershed Management are responsible for code reviews. Compliance with City, State and Federal Codes, Regulations and Ordinances shall be the responsibility of the Concessions/Designers of Record.
3. Concessions/Designers of Record shall be responsible for any liability resulting from their design and construction. And for any errors, omissions and any other conditions resulting from the submitted Issue for Construction documents.

5.0 PROJECT REQUIREMENTS

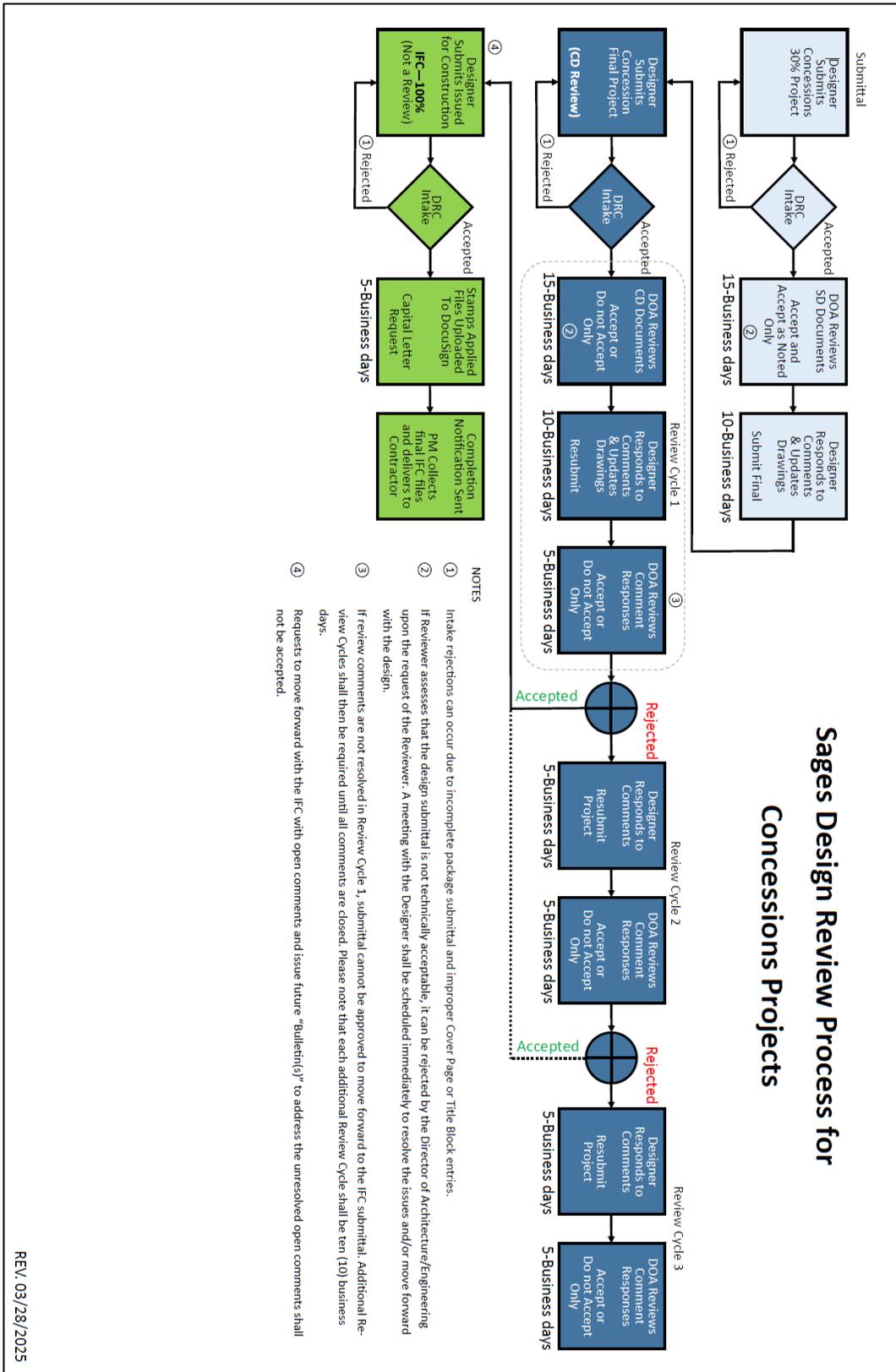
- A. Design/Construction Standards: Concessions/Designers of Record shall be responsible for adhering to all the latest ATL P&D's Concessions New Construction, Design Modifications and Construction Standards located at: (<https://atlstandards.com>)
- B. Building Permit: Concessions/Designer of Record shall be responsible for submitting the P&D/AFD stamped accepted documents and the copy of P&D's Release Letter (per OOB request) to OOB for permitting. OOB will not accept any submittal and/or issue a permit without the P&D/AFD stamped acceptance and copy of P&D's Release Letter.
- C. As-Builts: At project completion, Designer shall be responsible for submitting As-Builts to DOA Concessions and P&D the following:
 1. Two (2) USB Flash drives, one (1) for DOA Concessions and one (1) for P&D, containing the final As-Built drawings in CAD/PDF format and specifications in Word/PDF format.

6.0 APPENDICES

Appendix A - Electronic Design Review Process, Concessions/Tenants

APPENDIX A

Sages Design Review Process for Concessions Projects



Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

Concessions

New Construction and Modifications

Design Standards

Civil Engineering

Design Standards Civil

Table of Contents

Section	Page
1.0 Purpose	3
2.0 General	3
A. DOA/P&D Civil Design Standards	3
B. DOA/P&D Civil Design Specifications	3
SECTION 02085 INTERCEPTORS	16
SECTION D-701 PIPE FOR STORM DRAINS	20
SECTION D-705 - PIPE FOR UNDERDRAINS	30
SECTION D-751 MANHOLES, CATCH BASINS AND INLETS	40
SECTION P-150 - REMOVAL OF PAVEMENTS AND MISCELLANEOUS ITEMS	45
SECTION P-152 EXCAVATION AND EMBANKMENT	46
Appendix 1	56
SECTION P-209 - CRUSHED AGGREGATE BASE COURSE	57
SECTION P-501 PORTLAND CEMENT CONCRETE PAVEMENT	62
SECTION P-504- HIGH EARLY STRENGTH CEMENT CONCRETE PAVEMENT	83
SECTION P-605 JOINT SEALING FILLER	93
SECTION P-610 - STRUCTURAL PORTLAND CEMENT CONCRETE	100
SECTION P-615 SITE CONCRETE	107
SECTION P-621 - PAVEMENT MARKINGS AND MARKING REMOVAL	109
SECTION P-660 CONCRETE FILLED STEEL GUARD POSTS	113

Design Standards Civil

1.0 Purpose

- A. The purpose of this document is to provide the Concessionaire/Designer of Record with the Department of Aviation (DOA) Civil Engineering standard details and specifications to be used for any new construction and/or modification concessions project at the Airport.

2.0 General

- A. All design work shall be performed in accordance with generally accepted professional principles and practices for civil engineering and in compliance with all applicable Federal, State, and City of Atlanta Codes, Guidelines, Standards, and Regulations and the following DOA Civil Engineering Standards and Specifications:

1. DOA Civil Design Standards (Attached)

- a. STD-01-301 Underdrain Details-Replacement Projects
- b. STD-01-400 In Pavement Manholes
- c. STD-01-700 Pavement Joint Details-Replacement Projects-1
- d. STD-01-701 Pavement Joint Details-Replacement Projects-2
- e. STD-03-300 Typical Grease Interceptor Installation (Top of Interceptor Flush with Pavement Surface Designed for Tug Loading) – Case 1
- f. STD-03-301 Typical Grease Interceptor Installation (Top of Interceptor Below Pavement, Designed for Tug Loading) - Case 2
- g. STD-03-302 Below Pavement Grease Interceptor Details (Interceptor Not Designed for Tug Loading) - Case 3
- h. STD-03-303 Utility Slab Detail for Interceptor Below Pavement
- i. STD-03-304 Additional Pavement Removal
- j. STD-03-404 Miscellaneous Pipe Details
- k. STD-03-600 Bollard Detail

2. DOA Civil Design Specifications (Attached)
 - a. Section 02085 Interceptors
 - b. Section D-701 Pipe for Storm Drains.
 - c. Section D-705 Pipe for Underdrains
 - d. Section D-750 Sanitary Sewers
 - e. Section D-751 Manholes, Catch Basins, and Inlets
 - f. Section P-150 Removal of Pavements and Miscellaneous Items
 - g. Section P-152 Excavation and Embankment
 - h. Section P-209 Crushed Aggregate Base Course
 - i. Section P-501 Portland Cement Concrete Pavement
 - j. Section P-504 High Early Strength Cement Concrete Pavement
 - k. Section P-605 Joint Sealing Filler
 - l. Section P-610 Structural Portland Cement Concrete.pdf
 - m. Section P-615 Site Concrete
 - n. Section P-621 Pavement Markings and Marking Removal
 - o. Section P-660 Concrete Filled Steel Guard Post

UNDERDRAIN TIE-IN COUPLING

PLAN

TRANSVERSE UNDERDRAIN UNDER TAXIWAY

NOTES:

1. THE CONTRACTOR SHALL USE #89 STONE FOR THE POROUS UNDERDRAIN BACKFILL.
2. UNDERDRAIN INVERT ELEVATIONS SHALL MATCH EXISTING. EXISTING INVERTS ARE

UNDERDRAIN CLEANOUT

ELEVATION

(SHOW FOR INSTALLATION IN CONCRETE)

- A. INSTALL L-888 BASE WITH 1/8" STEEL MUD PLATE AND FINISHING RING ON IN PLACE.
- B. IMMEDIATELY AFTER PAIVING MACHINE PASSES AND CLEAR OUT ALL LOOSE MATERIAL LEAVING STEEL COVER IN PLACE.
- C. DO NOT REUSE SHIPPING BOLTS FOR COVER INSTALLATION.
- D. CONTRACTOR IS CHARGED TO OBSERVE THE INSTALLATION AND MAKE NECESSARY ADJUSTMENTS. PROVISIONS MUST BE MADE FOR STABILIZED BASSES IN GEMENT STABILIZED SUBGRADE MATERIAL.
- E. CONTRACTOR SHALL INSTALL AND FINISH TOP OF L-888 BASE AFTER COVER INSTALLATION.
- F. THE FOLLOWING TYPES OF BOLTS SHALL BE FURNISHED AND INSTALLED WITH EACH BASE:
 - a. SHIPPING BOLTS, 1/2" LONG DISPOSABLE THICKNESS OF JOE (DETERMINED BY CONTRACTOR).
 - b. STAINLESS STEEL FINISHING BOLTS, LENGTH AS REQUIRED TO HOLD IN COVER AND FINISHING RING, AS REQUIRED.
- G. ALL TIES SHOWN FOR THE BASES SHALL BE INSTALLED AND FINISHED WITH FINISHING RING SHALL BE FINISHED AND INSTALLED TO THE COVER FINISH UP TO THE SPECIFIED ELEVATION.
- H. CLEANOUTS SHALL BE AT LEAST 24" CLEAR OF THE NEAREST PCC JOINT LINE.

UNDERDRAIN CLEANOUT

ELEVATION

(SHOW FOR INSTALLATION IN CONCRETE)

1. THE CONTRACTOR SHOULD BE AWARE THAT DUE TO PREPARATIONS WILL BE NECESSARY BEFORE PCC IS PLACED, AS FOLLOWS:
 - A. THE CONNECTION SHOULD BE IN PLACE AND B. THE CLEANOUT RISER SHOULD EXTEND TO 6" (MAX) BELOW THE SURFACE LEVEL OF THE PAVEMENT AND BEING FROM EXISTING UNDERDRAIN SYSTEM.
2. ALL PAVEMENT AND GROUND AREA DISTURBED DURING CONSTRUCTION SHALL BE RETURNED TO ORIGINAL CONDITION BY THE CONTRACTOR.
3. SEE JOINT FILER SPECIFICATION SECTION FOR SCALANT.
4. THE WORDS "UNDERDRAIN C.O." SHALL BE RELIED IN LETTERS ON THE PLATE BY THE CONTRACTOR. THE PLATE SHALL BE HOT-DIPPED AND GALVANIZED. THE SHALL BE CUT 9" DIAMETER HOLE IN THE BOTTOM OF CAN PROVIDE FOR CLEAN OUT RISER CONNECTION.
5. FOR INSTALLATION OF UNDERDRAIN CLEANOUT IN TYPICAL INSTALLATION REFER TO DETAILS OF TYPICAL INSTALLATION FOR THE L-888 BASE IN DETAILING DRAWING.
6. INSTALL L-888 BASE WITH 1/8" STEEL MUD PLATE AND FINISHING RING ON IN PLACE.
7. IMMEDIATELY AFTER PAIVING MACHINE PASSES AND CLEAR OUT ALL LOOSE MATERIAL LEAVING STEEL COVER IN PLACE.
8. DO NOT REUSE SHIPPING BOLTS FOR COVER INSTALLATION.
9. CONTRACTOR IS CHARGED TO OBSERVE THE INSTALLATION AND MAKE NECESSARY ADJUSTMENTS. PROVISIONS MUST BE MADE FOR STABILIZED BASSES IN GEMENT STABILIZED SUBGRADE MATERIAL.
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 - b. STAINLESS STEEL FINISHING BOLTS, LENGTH AS REQUIRED TO HOLD IN COVER AND FINISHING RING, AS REQUIRED.
12. ALL TIES SHOWN FOR THE BASES SHALL BE INSTALLED AND FINISHED WITH FINISHING RING SHALL BE FINISHED AND INSTALLED TO THE COVER FINISH UP TO THE SPECIFIED ELEVATION.
13. CLEANOUTS SHALL BE AT LEAST 24" CLEAR OF THE NEAREST PCC JOINT LINE.

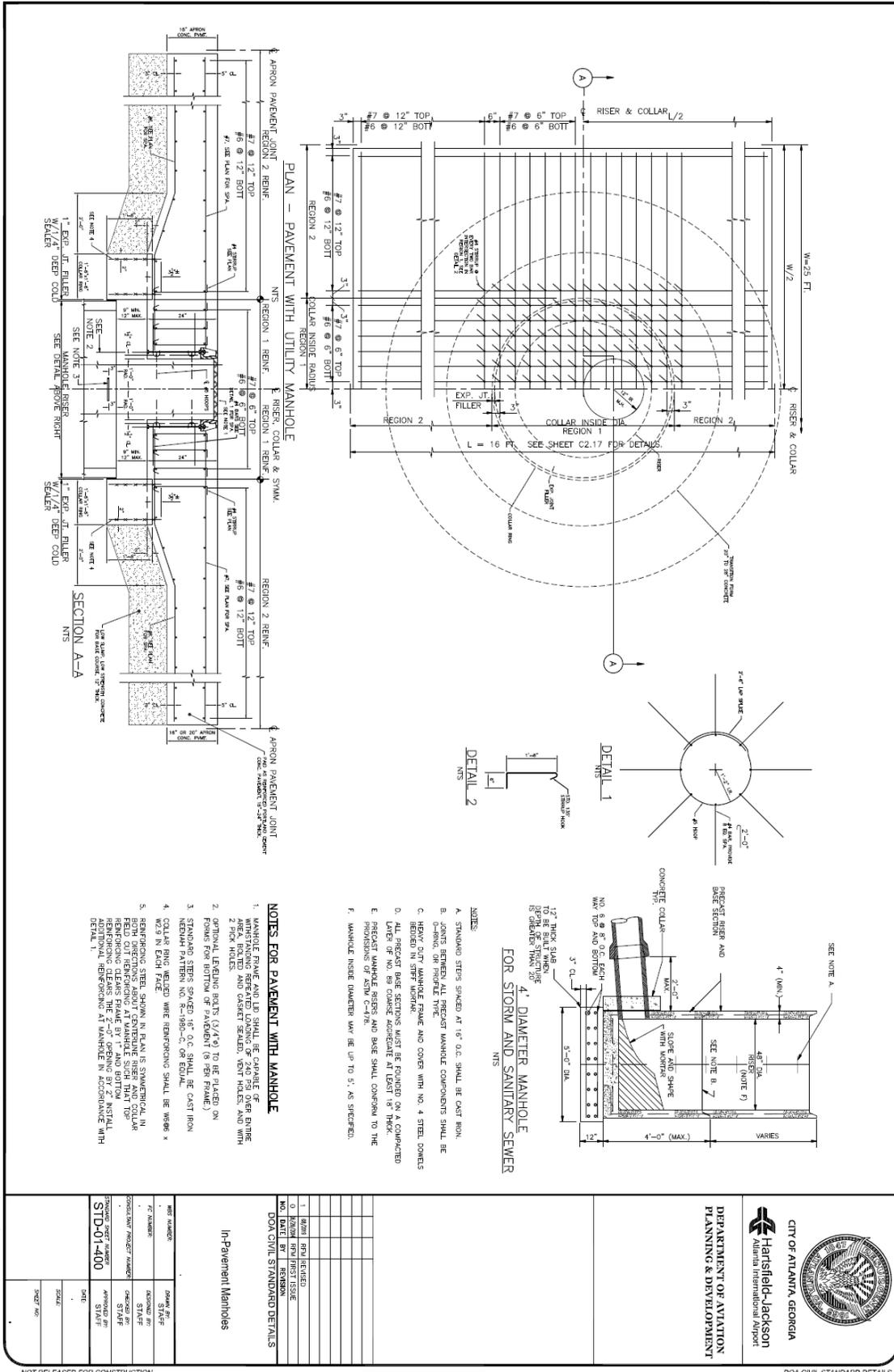
DETAILS ON THIS SHEET ARE INTENDED FOR USE IN PAVEMENT REPLACEMENT AND RETROFIT PROJECTS.

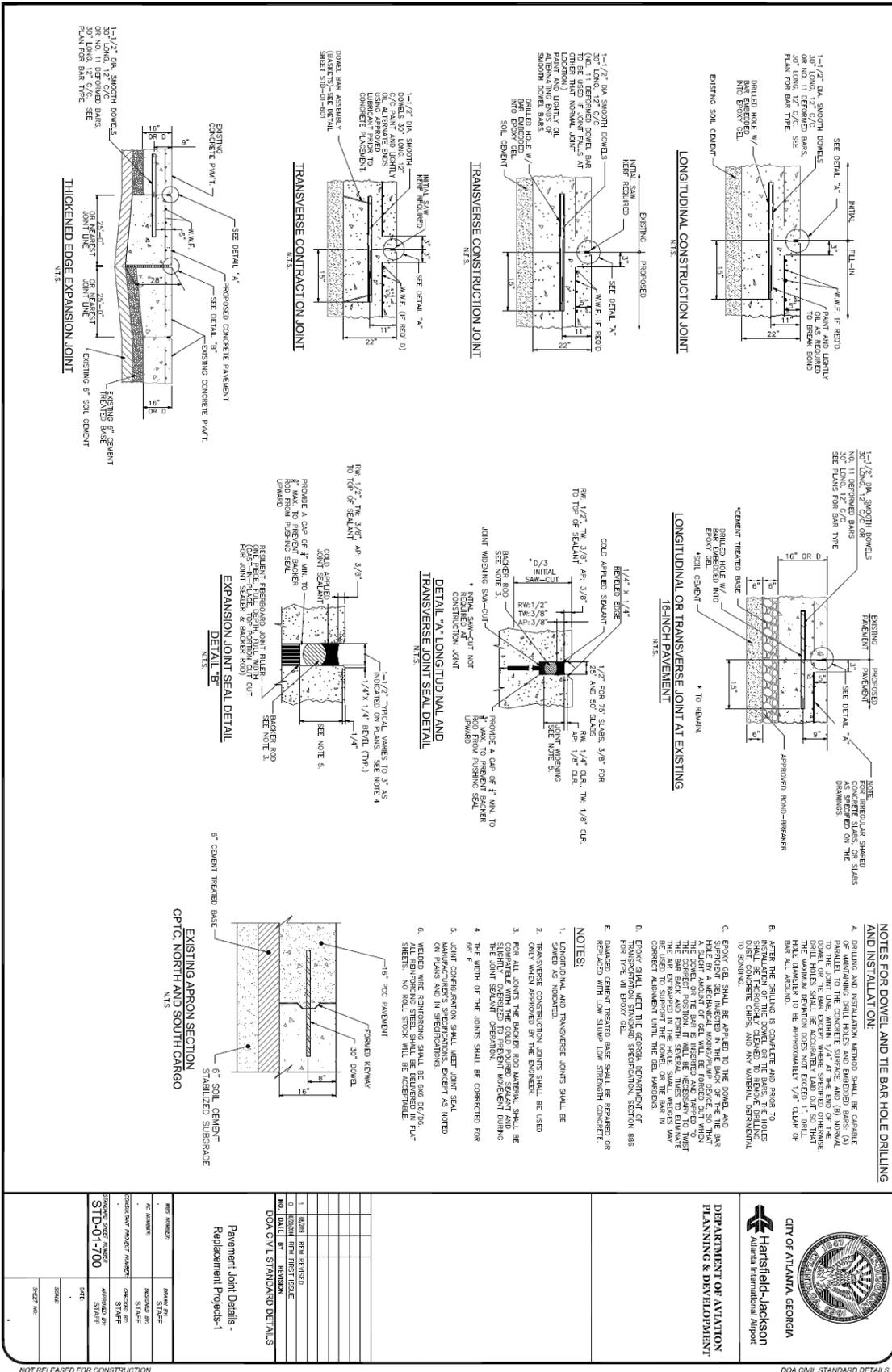
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Hartsfield-Jackson
Atlanta International Airport

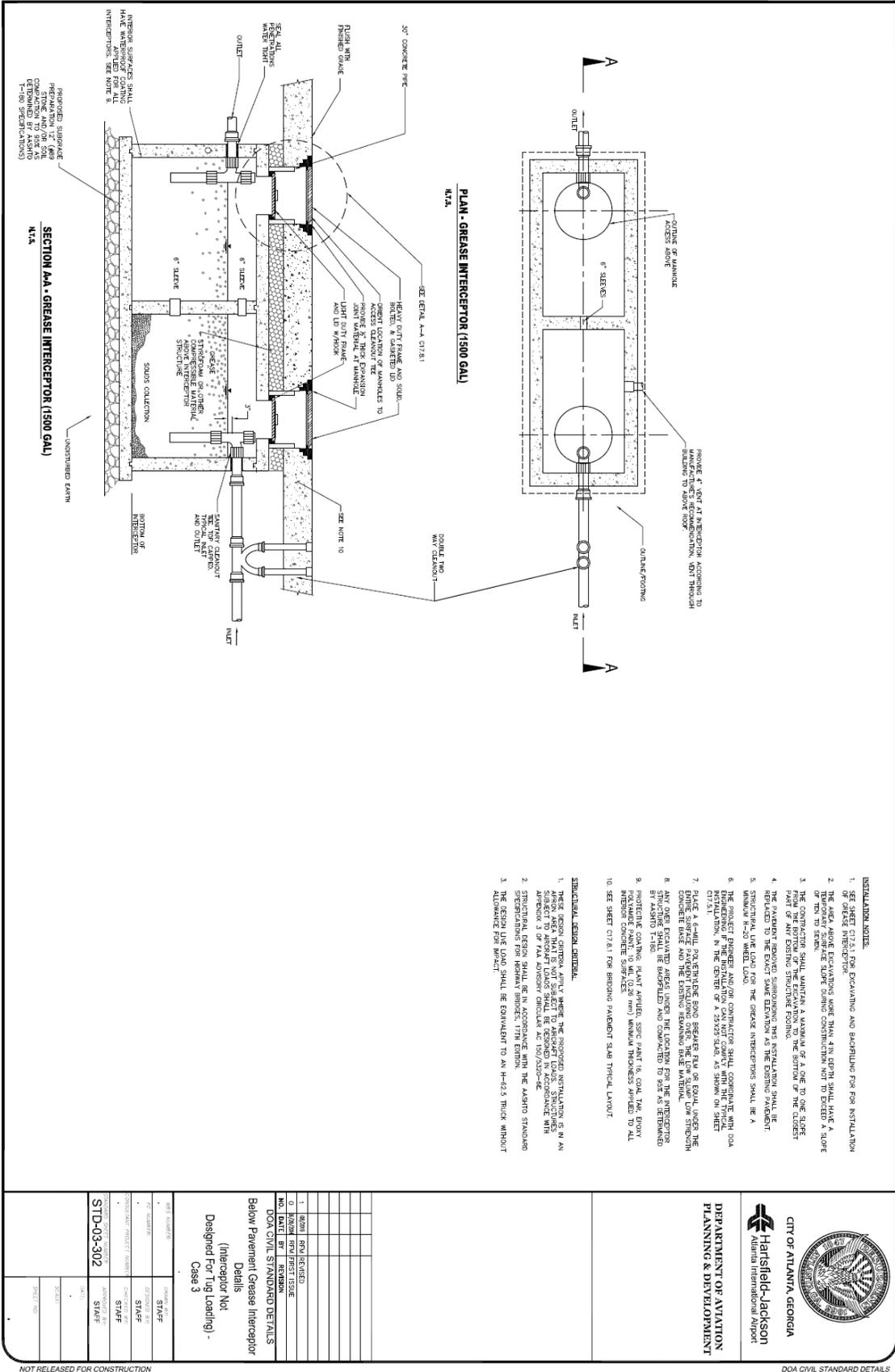
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PLANNING & DEVELOPMENT**

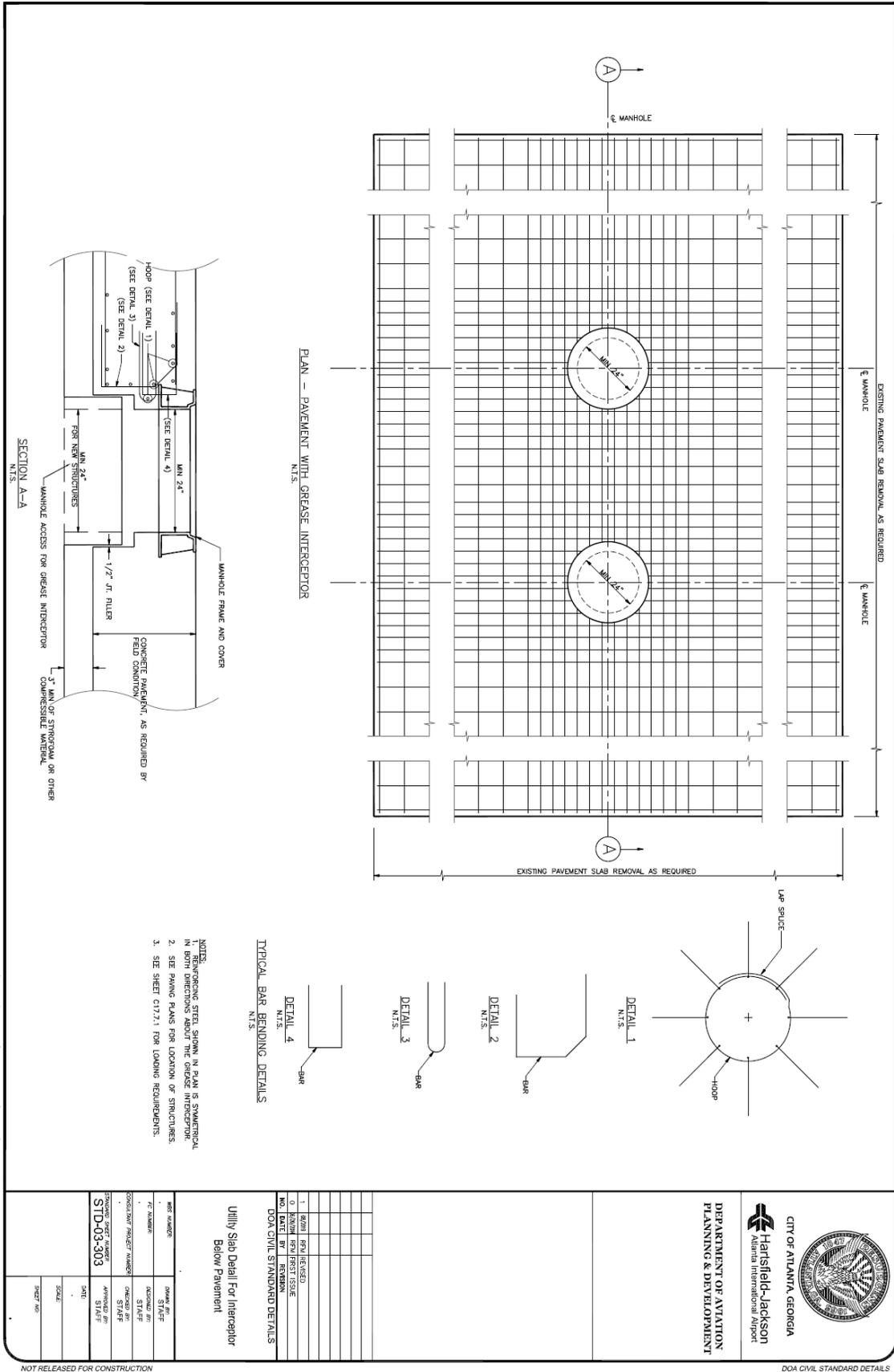
DOA CIVIL STANDARD DETAILS

NOT RELEASED FOR CONSTRUCTION

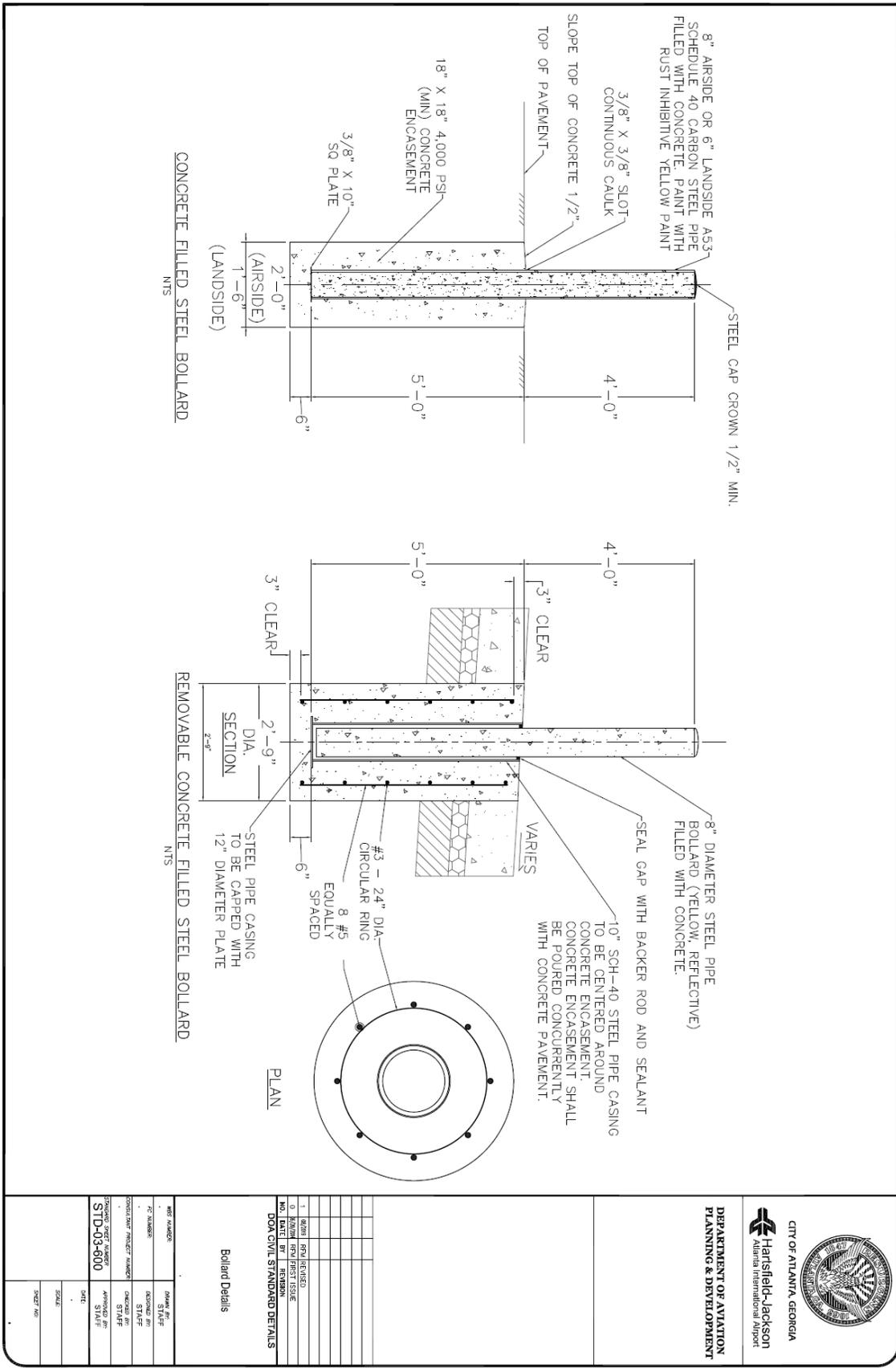








© Virginia Transportation Division Standard/Version: Std-03-303 Utility Slab Detail for Interceptor Below Pavement.dwg



d:\work\pav\engineering\design_standards\standard\3D-03-600 bollard details.dwg

 <p>CITY OF ATLANTA, GEORGIA Hartsfield-Jackson Atlanta International Airport</p>		<p>DEPARTMENT OF AVIATION PLANNING & DEVELOPMENT</p>	
<p>DOA CIVIL STANDARD DETAILS</p>			
<p>Bollard Details</p>			
<p>DATE: _____</p> <p>SCALE: _____</p> <p>SHEET NO: _____</p>	<p>DESIGNED BY: _____</p> <p>CHECKED BY: _____</p> <p>APPROVED BY: _____</p>	<p>PROJECT NUMBER: _____</p> <p>CONTRACT NUMBER: _____</p> <p>STANDARD: STD-03-600</p>	<p>DATE: _____</p> <p>SCALE: _____</p> <p>SHEET NO: _____</p>

NOT RELEASED FOR CONSTRUCTION

DOA CIVIL STANDARD DETAILS

SECTION 02085 INTERCEPTORS

1.0 PART 1 GENERAL

A. SUMMARY

1. This Section consists of grease interceptors located outside the building. The City of Atlanta Grease Management Ordinance Article V, Section 154-297 is hereby incorporated by reference.

B. ABBREVIATIONS

1. FRP: Fiberglass-reinforced plastic.
2. HDPE: High-density polyethylene plastic.
3. PE: Polyethylene plastic.
4. PP: Polypropylene plastic.

C. SUBMITTALS

1. Shop Drawings: For each type and size of cast-in-place-concrete interceptor indicated.
 - a. Include materials of construction, dimensions, elevations, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.
 - b. Include reports and calculations for design mixes of concrete.
2. Shop Drawings: For each type and size of precast concrete interceptor indicated.
 - a. Include materials of construction, dimensions, elevations, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.
3. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - a. Interceptors.
 - b. Piping connections. Include size, location, and elevation of each.
 - c. Interface with underground structures and utility services.

D. PROJECT CONDITIONS

1. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
 - a. Notify ENGINEER no fewer than five (5) days in advance of proposed interruption of service.
 - b. Do not proceed with interruption of sewer services without ENGINEER'S written permission.

c. PART 2 PRODUCTS

i. GREASE INTERCEPTORS

- (1) Grease Interceptors: Cast-in-place-concrete or pre-cast concrete structure complying with requirements of City of Atlanta. Size should be 1500 gallon or as specified on the Drawings.
- (2) Grease Interceptors: Construct bottom, sidewalls, and top of reinforced, cast-in- place concrete. Wall thickness and thickness of bottom slab to be designed according to Drawings. Include manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
 - (a) Concrete: Comply with ACI 318/318R, ACI 350R.
 - (i) Design Mix: 4000 psig (27.6 MPa) minimum, with 0.45 maximum water-to-cementitious materials ratio.
 - (ii) Portland Cement: ASTM C 150, Type II.
 - (iii) Fine Aggregate: ASTM C 33, sand.
 - (iv) Coarse Aggregate: ASTM C 33, crushed gravel.
 - (v) Water: Potable.
 - (vi) Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - (vii) Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.
 - (3) Grease Interceptors: Pre-cast concrete complying with ASTM C 913. Include rubber-gasketed joints, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
 - (a) Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all interior concrete surfaces.
 - (b) Structural Design Loads: Shall be as shown on drawings.
 - (c) Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
 - (d) Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
 - (e) Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - (f) Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26- inch- (660-mm-) diameter cover.
 - (i) Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise

indicated.

- (ii) Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
- (iii) Include indented top design with lettering cast into cover, using wording equivalent to SANITARY SEWER.
- (iv) Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all ferrous surfaces.

ii. MISCELLANEOUS MATERIALS

- (1) Concrete Paint: SSPC-Paint 16, coal-tar, epoxy polyamide.
- (2) Metal Paint: SSPC-Paint 16, coal-tar, epoxy polyamide.
- (3) PE Film: ASTM D 4397, 0.10-inch (0.25-mm) thickness sheet.

d. PART 3 EXECUTION

E. EARTHWORK

- 1. Excavating, trenching, and backfilling are specified in D-701-Pipe For Storm Drains and D-751 Manholes, Catch Basins, and Inlets.

F. INSTALLATION

- 1. Install interceptor inlets and outlets at elevations indicated.
- 2. For cast in place concrete interceptors, refer to Section 500 and 511 of GDOT Standard Specifications for formwork, reinforcement, and structural concrete. Concrete strength shall be 5000 psi at 28 days
- 3. Install pre-cast concrete interceptors according to ASTM C 891. Set level and plumb.
- 4. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- 5. Set tops of manhole frames and covers flush with finished surface in pavements.
- 6. Set tops of grating frames and grates flush with finished surface.
- 7. Clean and prepare concrete surfaces to be field painted. Remove loose efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:
 - a. Cast-in-Place-Concrete Interceptors: All exterior, except bottom and all interiors.
 - b. Precast Concrete Interceptors: All interiors.
- 8. Install sheet PE film on earth where cast-in-place-concrete interceptors are to be built.
- 9. Clean and prepare metal surfaces to be field painted according to SSPC- PA 1. Paint the following metal surfaces according to SSPC-PA 1 and SSPC-Paint 16:
 - a. Metal Interceptors: All surfaces except baskets, screens, and strainers.
 - b. Plastic Interceptors: All metal surfaces except baskets, screens, and strainers.

- c. Metal Manhole Frames and Covers: All surfaces.
 - d. Do not paint metal surfaces with factory-applied, corrosion-resistant coating.
10. Set interceptors level and plumb.
 11. Set tops of metal interceptor covers flush with finished surface in pavements. Prepare and paint metal components, to be field painted, according to SSPC- Paint 16.
 12. Repair and restore protective coatings to original condition.

G. CONNECTIONS

1. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Make piping connections between interceptors and piping systems.

END OF SECTION

SECTION D-701 PIPE FOR STORM DRAINS

1.0 DESCRIPTION

- A. This item shall consist of pipe of the types, classes, sizes and dimensions required on the plans, furnished and installed at the places designated on the plans and profiles, or by the Engineer, in accordance with these specifications and with the lines and grades given.
1. The item shall include the furnishing and installation of pipe in place, all excavation and backfill, furnishing and installing all trench bracing, all fittings required to complete the pipe drain as shown on the plans and the material for the making of all joints, including all connections to existing drainage pipe and structures
- B. The Contractor shall submit detailed shop drawings for the pipe laying plan to the Engineer for approval. Include pipe strength class, joint lengths, and trench types.
- C. This item shall also include all work associated with the protection of all trenches and excavations required to perform the work under all sections of the specifications, including procedures, inspections, reports, installations, modifications and all else required to complete the work.

2.0 MATERIALS

A. General

Materials shall meet the requirements shown on the plans and as specified below.

1. All reinforced pipe shall be strength Class IV unless noted otherwise on the plans. Pipe strength classes are referenced to ASTM C-76. Gaskets for joints shall be as specified in Article 02(e) of this section.
 2. Reinforced concrete pipe shall be furnished in six-foot minimum laying lengths, except that two-foot spacer lengths shall be used as required to orient tee sections in the correct locations where these are specified on the plans. Two-foot sections shall also be used in making connections to drainage structures.
 3. In addition to strength testing, all pipe and pipe joints on reinforced concrete pipe 48" diameter and smaller shall be certified as having been tested in accordance with ASTM Designation C-76 and C-443, respectively, for absorption and joint leakage. At least 1% of the pipe lengths and joints of each diameter from a given pipe run by a given manufacturer and not less than two pipe lengths or two joints of each diameter and run shall be so tested and certified. No runs of pipe failing to meet the absorption and leakage test requirements will be accepted.
 4. Lift holes will be permitted on all concrete pipe. Lift holes shall be sealed with 5 Star Non-Shrink Grout conforming to ASTM C-827 for shrinkage; have reached its initial set time within 45 minutes of mixing and initial set conforming to ASTM C-191; and with minimum compressive strength of 2,000 psi in one day and 7,000 psi at 28 days conforming to ASTM C-109.
- B. Pipe. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements:
- Reinforced Concrete Pipe ASTM C 76
 - Standard Specification for Corrugated Steel Pipe, ASTM A 760 Metallic Coated for Sewers and Drains

- Standard Specification for Post-Applied Coatings, ASTM A 849 Paving's, and Linings for Corrugated Steel Sewer and
 - Drainage Pipe
- C. Concrete. All concrete shall conform to Class A as defined in Section 500 of the Georgia DOT Standard Specifications.
- D. Mortar. Mortar for connections to other drainage structures shall be composed of one part, by volume, of Portland cement and 2 parts of mortar sand. The Portland cement shall conform to the requirements of AASHTO M-85, Type 1. The sand shall conform to the requirements of AASHTO M-45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C-6.
- E. Rubber Gasket Joints. Rubber-type gaskets for concrete non-pressure pipe shall conform to the requirements of ASTM C-443.
1. Gaskets shall be "O" ring or profile type, Neoprene, fuel resistant.
 2. All gaskets proposed as fuel resistant equals shall be tested for swelling in the presence of petroleum products in accordance with Federal Standard 601, Method 6001 and 6211. When the latter method is used with No. 3 oil for 70 hours at 212⁰F, the swelling shall not exceed 100 percent by volume.
- F. Pipe Fittings. Pipe fittings for reinforced concrete pipe shall be fabricated from standard lengths of reinforced concrete pipe of the specified class. All fabricated connections of the reinforcing steel cages shall be connected by welding. Pipe fittings shall be as follows:
1. Tees shall be furnished with groove-end on the branch of the tee.
 2. Reducing Section shall be furnished with the groove-end on the smaller diameter end.
- G. Bedding material for unstable trench excavation shall meet the requirements for No. 89 Coarse Aggregate Underdrain Backfill as specified in Section 800.2.01 of Georgia DOT Specifications for Construction of Transportation Systems.

3.0 CONSTRUCTION METHODS

- A. Equipment. All equipment necessary and required for the proper construction of storm sewers and culverts shall be on the project, in first-class working condition and approved by the Engineer before construction is permitted to start.

The Contractor shall provide appropriate hoisting equipment to handle the pipe while unloading and placing it in its final position without damaging the pipe.

The Contractor shall provide hand tampers and pneumatic tampers to obtain the required compaction of the pipe bed and the backfill, as specified.

- B. Excavation. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under the pipe and of the backfill around the pipe but shall not be less than the external diameter of the pipe plus 6" on each side. The trench walls shall be approximately vertical below the top of the pipe, unless otherwise approved by the Engineer. The maximum allowable width of the trench shall not exceed 18" on each side of the pipe when placed, unless otherwise approved by the Engineer.

Where rock, hardpan, or other unyielding material is encountered at the bottom of pipe trench, such material shall be removed below the foundation grade for a depth of at least 12" or 1/2" for

each foot of fill over the top of the pipe, whichever is greater, but not more than 3/4 of the nominal diameter of the pipe. The material shall be removed across the full width of the trench and replaced with suitable granular material obtained from excavation within the project, compacted and shaped to fit the lower 1/4 of the pipe diameter.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil or from buried trash, rubble or garbage, the unstable soil or unsuitable material shall be removed and replaced with suitable granular material obtained from excavation for the full trench width. The limits of excavation of unstable material shall be as directed by the Engineer, but in no case will the required depth of excavation of unstable material below the bottom of the pipe exceed 1/2 the inside diameter of the pipe being installed, or 24" whichever is the lesser. All trash encountered at and below the pipe invert shall be removed and replaced. The Contractor shall dispose of trash, rubble and garbage removed from the trench outside Airport boundaries.

Excavated material that is neither required nor acceptable for backfill shall be disposed of by the Contractor as directed by the Engineer. Common excavation shall not be carried below the required depth; but when it is, the trench shall be backfilled at the Contractor's expense with material approved by the Engineer and compacted to a density of not less than 90% of the maximum dry density for the material as determined by AASHTO T-180. The excavation for pipes that are placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans. The bed for the pipe shall be so shaped that at least the lower quarter of the pipe circumference shall be in continuous contact with the bottom of the trench.

- C. Trench and Excavation Protection. The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. The bracing, sheathing, or shoring shall not be removed in one operation but shall be done in successive stages as determined by the Engineer to prevent overloading of the pipe during backfilling operations. The Contractor shall submit an excavation plan, certifying that the excavation methods conform to all appropriate governing laws. The plan shall be prepared by a Professional Engineer registered in the State of Georgia.

The Contractor shall employ the services of a Professional Engineer registered in the State of Georgia to inspect the various trenches and excavations on the project on at least a weekly basis and certify as to meeting all the appropriate laws. A report will be promptly submitted to the Engineer detailing the results of the inspections. If problem areas are observed, the inspections shall be conducted daily until such time as the trenches and excavations meet all the appropriate governing laws. No work is to be accomplished until the problem areas are corrected.

If changes in the planned pipe gradients are directed by the Engineer, which result in trenching depths more than 12" greater or lesser than the planned trench depth, the increased or decreased cost of the work shall be provided for in a supplemental agreement. Changes of a lesser extent will be considered incidental to the contract, without lesser or additional compensation.

- D. Bedding. The pipe bedding shall conform to the class specified on the plans. When no bedding class is specified or detailed on the plans, the requirements for Class C bedding shall apply.

1. Rigid Pipe

- a. Class B or C Bedding shall consist of bedding the pipe in a granular foundation in accordance with details shown on the plans. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

- b. Bedding details shown on the plans are an integral part of the pipe design, with respect to load bearing capacity of the various sizes and classes of pipe. The contractor has the option of constructing these beddings in accordance with the details shown on the plans or alternatively may produce his own designs for bedding and concrete pipe systems that will meet the D-load requirements of ASTM C-76, for the given fill heights and weights. If this second option is chosen, these designs are to be prepared, signed and sealed by a professional engineer registered in the state of Georgia, and submitted to the Owner for review and approval. Imperfect backfill will not be considered as an alternative to a conventional trench-type bedding and/or special design pipe.

2. Flexible Pipe

For flexible pipe, the bed shall be roughly shaped to fit the pipe and a bedding blanket of sand or fine granular material shall be provided as follows:

<u>Pipe Corrugation Depth</u> Inches	<u>Minimum Bedding Inches</u> Inches
1/2	1
1	2
2-1/2	2-1/2

- 3. PVC and Polyethylene Pipe. For PVC and polyethylene pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 inch. For pipes installed under paved areas, no more than 12% of the material shall pass the #200 sieve. For all other areas, no more than 50% of the material shall pass the #200 sieve. The bedding shall have a thickness of at least 6 inches below the bottom of the pipe and extend up around the pipe for a depth of not less than 50% of its vertical outside diameter.

E. Laying and Installing Pipe.

- 1. Concrete Pipe. The Contractor shall provide the necessary mason's lines and supports to insure installation of the pipe to line and grade. The Contractor's facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.
 - a. The Engineer shall inspect all pipe before it is laid and reject any section that is damaged by handling or is defective to a degree which will materially affect the function and service of the pipe.
 - b. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bell shall be laid upgrade.
 - c. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. The pipe shall be protected from water during placing and until the mortar in the joints has thoroughly set.
 - d. When bell and spigot pipes are used, spaces for the pipe bells shall be dug in the pipe subgrade to accommodate the bells. The spaces shall be deep enough to ensure that the bells do not bear the load of the pipe; they shall not be excessively wide in relation to the longitudinal direction of the trench. When the pipes are laid, the barrel of each section of pipe shall be in contact with the quadrant-shaped bedding throughout its full length, exclusive of the bell, to support the entire load of the pipe.

- e. Pipe shall not be laid on frozen ground.
 - f. When placing concrete pipe constructed with elliptical reinforcing, the pipe shall be oriented in accordance with the manufacturer's markings of top or bottom.
 - g. The upgrade end of pipelines not terminating in a structure shall be plugged or capped as approved by the Engineer.
 - h. Pipe which is not true in alignment, or which shows any settlement after laying, shall be taken up and re-laid without extra compensation.
 - i. The Contractor shall provide, as may be necessary, for the temporary diversion of stream flow to permit the installation of the pipe under dry conditions.
 - j. The Contractor shall lay tee sections to set the tee risers at the location shown on the plans, using spacer length of pipe as required. A tolerance of 1.0' will be required in the plan location of the riser tee branch, measured along the pipe centerline, within areas to be paved.
 - k. The proposed storm sewer pipe alignments will pass under existing storm sewer lines, and other utilities as shown on the plans. The Contractor shall support in place those existing utilities, which must remain in service during the construction process. At the Contractor's option, existing storm sewers may be removed and replaced by the Contractor in lieu of supporting these facilities in place. The Contractor is advised that existing watermains will be required to always remain under pressure.
 - l. The Contractor shall replace in kind with new materials any pipe or other existing facility damaged because of his work or furnish any new fittings required to make the system whole.
2. Corrugated Metal Pipe. Corrugated steel pipe shall be laid with separate gasket sections jointed firmly together with 3/8 inch thick by 7-inch-wide Neoprene gasket and coupling bands conforming to Fed. Spec. WW-P-405, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides.
- a. Proper facilities shall be provided for lowering the pipe when it is to be placed in a trench. The pipe shall be laid carefully and true to lines and grades on a bed that is uniformly firm throughout its length. Any pipe which is not in true alignment, or which shows any undue settlement after being laid or is damaged, shall be taken up and re-laid without extra compensation.
 - b. The pipe shall be placed so that the element of the cylindrical pipe constituting the centerline of the paved section shall coincide with the flow line of the culvert or sewer. Sections of paved pipe shall be laid so that the flow line is smooth and continuous across joints.
 - c. All pipes shall be handled so as to prevent bruising, or breaking on the spelter coating or the bituminous coating. All spots on the pipe where the spelter or bituminous coating has been damaged or destroyed shall be painted with two coats of asphaltic paint or otherwise repaired in a satisfactory manner.

F. Joining Pipe.

- 1. Concrete Pipe. Concrete pipe may be either bell and spigot or tongue and groove. The method of joining pipe sections shall be such that the ends are fully entered, and the inner surfaces are reasonably flush and even.

Joints shall be made with rubber gaskets or plastic gaskets.

a. Rubber Gasket Joints

The gasket shall be installed in accordance with the manufacturer`s instructions.

b. Composition Gasket Joints

The gasket shall be installed in accordance with the manufacturer`s instructions.

- i. Bell and Spigot Pipe. The first pipe shall be bedded to the established grade line, placing the bell end upstream. The interior surface of the bell shall be carefully cleaned with a wet brush, and the lower portion of the bell filled with mortar to such a depth as to bring the inner surfaces of the abutting pipe flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into the bell so that the sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar and a bead shall be formed around the joint with enough additional mortar. The cement mortar shall be protected from rapid drying from exposure to sun or wind by suitable covering such as damp burlap kept moist for at least 24 hours. If the mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint should be wrapped or bandaged with cheesecloth to hold the mortar in place.
- ii. Tongue and Groove Pipe. The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the second pipe. The grooved end of the first pipe shall be carefully cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned carefully with a wet brush and while in a horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall then be inserted in the grooved end of the first pipe until mortar is squeezed out on the interior and exterior surfaces. Sufficient mortar shall be used to completely fill the joint and to form a bead on the outside. The cement mortar shall be protected from rapid drying from exposure to sun or wind by suitable covering such as damp burlap kept moist for at least 24 hours. If the mortar is not sufficiently stiff to prevent appreciable slump before setting, an acceptable method shall be provided to hold the mortar in place.

2. Metal Pipe. Metal pipe shall be firmly joined by form fitting bands conforming to the requirements of ASTM A 760 for steel pipe and AASHTO M 196 for aluminum pipe.

3. PVC and Polyethylene Pipe. Fittings for PVC pipe shall conform to the requirements of ASTM D3034. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M252.

G. Backfilling. All trenches and excavations shall be backfilled within a reasonable time after the pipes are installed, unless other protection of the pipe is directed. Pipes shall be inspected before any backfill is placed, and any found to be out of alignment, unduly settled, or damaged, shall be removed, re-laid or replaced at the Contractor`s expense.

Materials for backfill shall be fine, readily compactible soil or granular material selected from the excavation or an approved source. It shall not contain frozen lumps, stones that would be retained on a 2" sieve, chunks of highly plastic clay, or other objectionable material. Granular backfill material shall have not less than 95% passing a 1/2" sieve and not less than 95% retained on a No. 4 sieve.

When the top of the pipe is even with or below the top of the trench, backfill shall be compacted in layers, not exceeding 6" on both sides of the pipe and to an elevation of one foot above the top of the pipe or to natural ground level whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the pipe. Backfilling shall be done in a manner to avoid injurious top or side pressure on the pipe. Material shall be brought up evenly on both sides of the pipe. When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 6" and shall be brought up evenly on both sides of the pipe to an elevation one foot above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the diameter of the pipe or 12 feet whichever is less.

For PVC and polyethylene pipe the backfill shall be placed in two stages; one to the top of the pipe and the other at least 12" over the top of the pipe. The backfill material shall meet the requirements as specified above.

All backfill shall be compacted to a density of not less than 90% of the maximum dry density as determined for the material by AASHTO Designation T-180. Density tests shall be taken, by the Owner's representative, at the frequency of one (1) per every other lift per 100 L.F. of trench or fraction thereof. The movement of construction machinery over a culvert shall be at the Contractor's risk. Any pipe damaged thereby shall be replaced at the expense of the Contractor.

- H. Connections. Where the plans call for connections to existing or proposed structures, these connections shall be watertight and made so that a smooth uniform flow line will be obtained throughout the drainage system.
- I. Cleaning and Restoration of Site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. Except for paved areas of the Airport, the Contractor shall restore all disturbed areas to their original condition.
 - 1. After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clean and in good condition.
 - 2. Performance of the work described in this section is not payable directly but shall be considered as subsidiary obligation of the Contractor covered under the contract unit price for the pipe.
 - 3. The Contractor shall note that there is an existing drainage system constructed in this project. The proposed drainage system will be connected to this existing system. The Contractor and the Engineer will inspect the existing drainage system prior to the start of work and record its condition and again at the completion of the work to assure that the system is clean and operable. The Contractor will be required to always maintain the existing drainage system during construction, and clean and/or rehabilitate to its prior condition at no additional cost to the contract.
- J. Inspection. Prior to final approval of the drainage system, the Engineer, accompanied by the Contractor's representative, shall make a thorough inspection, by an appropriate method, of the entire installation. Any indication of defects in material or workmanship or obstruction to flow in the pipe system shall be further investigated and corrected. Defects due to the Contractor's negligence shall be corrected by the Contractor without additional compensation and as directed by the Engineer.

4.0 METHOD OF MEASUREMENT

- A. The length of pipe to be paid for shall be the number of linear feet of pipe in place, completed and approved. It shall be measured along the centerline of the pipe, from end to inside face of structure to the end or inside face of structure, whichever is applicable. The several types and sizes shall be measured under the appropriate item without distinction as to pipe strength class. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured. Pipe bends and flared end sections were called for on the plans or as directed by the city, will be counted for separate payment. Tees, wyes and eccentric pipe reducers will not be measured separately for payment and shall be included in the measurement in linear feet of the line of pipe in which they are installed.
- B. The length of Class B or C Pipe Bedding to be paid for shall be the number of linear feet of pipe bedding, without regard to the pipe diameter, shaped, compacted and backfilled in accordance with these specifications and approved by the Engineer.
- C. Trench and excavation protection will not be directly measured for payment.
- D. Flared end sections of the various sizes and materials will each be counted for payment.
- E. Grated outlet sections will each be counted for payment.

5.0 BASIS OF PAYMENT

- A. Payment for storm sewer pipe, complete and installed as planned and/or directed, will be made at the contract unit price per linear foot for pipe, without distinction as to pipe strength class. If the contractor elects to utilize his own designs for concrete pipe, and or different beddings than those shown on the plans, those other designs will be paid for under the unit price items listed below for the various pipe diameters and bedding types. These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.
 - 1. No separate payment will be made for demolishing portions of walls of existing structures to make connection with new pipe.
 - 2. Hauling and placement of excess material removed in the pipe trench excavation process and not used, as backfill will not be measured for payment under this item. Payment for this work will be made under the appropriate embankment item as specified.
 - 3. No separate payment will be made for common trench excavation, or trench backfill, including select backfill. The cost of this work will be considered incidental to the construction of the storm sewer pipe.
 - 4. No separate payment will be made for any sheeting, shoring, bracing, pumping and counter-floatation measures which are required during construction, whether or not such work is indicated on the plans.
 - 5. No separate payment will be made for the cost of removing and abandoning existing storm sewers, existing manholes, existing inlets and other drainage structures. The costs of this work will be considered incidental to the storm sewer construction.
 - 6. Separate payment will be made for constructing concrete pipe collars for the purpose of joining two pipes. This will be paid under the item for "Miscellaneous Concrete"
 - 7. No separate payment will be made for the removal and replacement or support of existing utilities necessary during the construction of storm sewers. The cost of this work will be considered incidental to the construction of the storm sewer pipe.

8. No separate payment will be made for exceptional costs incurred by the Contractor in conforming to construction schedules established in the plans or for duplicated work required by these schedules. The cost of this work will be considered incidental to the storm sewer item.
9. No separate payment will be made for the removal and disposal of trash, rubble and garbage removed from the pipe trench, or for replacement backfill. All costs, therefor, shall be included in the prices bid for the pipe item.
10. No separate payment will be made for tees, reducers, or other fittings, except that bends and flared end sections will each be counted for payment.
11. Payment for Pipe Bedding completed and accepted will be made at the contract unit price per linear foot, which price shall be full compensation for furnishing and placing all material and for all labor, equipment, tools and incidentals necessary to complete the item.
12. Payment will be made at the contract lump sum price for Trench and Excavation Protection. This price shall be full compensation for furnishing and placing all material and for all labor, equipment, tools and incidentals necessary to complete the item. Partial payments shall be made as follows:
 - a. Fifteen percent (15%) of the contract item will be paid when the complete excavation and protection plan is approved.
 - b. Seventy-five percent (75%) of the contract item will be pro-rated on each partial payment in respect to the percent complete of all work on the contract, less allowances.
 - c. The final ten percent (10%) will be paid when all work is complete, and all reports have been submitted.
 - d. (d) Payment will be made under:
 - Item D-701-1- Storm Sewer, RCP, 18" Diameter - Per Linear Foot.
 - Item D-701-2- Storm Sewer, RCP, 24" Diameter - Per Linear Foot.
 - Item D-701-3- Storm Sewer, RCP, 30" Diameter - Per Linear Foot.
 - Item D-701-4- Storm Sewer, RCP, 36" Diameter - Per Linear Foot.
 - Item D-701-5- Storm Sewer, RCP, 42" Diameter - Per Linear Foot.
 - Item D-701-6- Concrete Flared End Section, 18" Diameter - Per Each.
 - Item D-701-7- Concrete Flared End Section, 24" Diameter - Per Each.
 - Item D-701-8- Concrete Flared End Section, 30" Diameter - Per Each.
 - Item D-701-9- Concrete Flared End Section, 36" Diameter - Per Each.
 - Item D-701-10- Concrete Flared End Section, 42" Diameter - Per Each.
 - Item D-701-11-Grated Outlet Structure – Per Each
 - Item D-701-12- Pipe Bedding, Type C - Per Linear Foot.
 - Item D-701-13- Trench and Excavation Protection- Per Lump Sum.

TESTING AND MATERIAL REQUIREMENTS

<u>Test and Short Title</u>	<u>Material and Short Title</u>
ASTM A 760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A 849	Standard Specification for Post-Applied Coatings, Paving's, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM C 6	Hydrated Lime
AASHTO M 45	Sand
ASTM C 76	RC Pipe
ASTM C 443	Rubber Gasket
AASHTO M 85	Portland Cement
AASHTO M 157	Ready-Mix Concrete
AASHTO M 173	Joint Sealer
AASHTO M 198	Gaskets
AASHTO M 219	Aluminum Structural Plate
Fed. Std. 601	Gasket Swell
1/HH-G-156	Flexibility

Note: Others as required by referenced specifications.

1/ Federal Specifications

END OF SECTION

SECTION D-705 - PIPE FOR UNDERDRAINS

1.0 DESCRIPTION

- A. This item shall consist of pipe for underdrains of the type, classes, sizes, and dimensions required on the plans, furnished and installed at the places designated on the plans, or by the Engineer, in accordance with these specifications and with the lines and grades given.
- B. This item shall include the furnishing and installation of underdrain pipe in place, the cost of underdrain pipes, common excavation, pavement removal, furnishing and installing all trench bracings, all fittings required to complete the underdrains as shown on the plans, and the material for the making of all joints including all connections to existing drainage pipes and structures.
- C. The bid price per linear foot of pipe shall include all backfill made with earth excavated from the immediate trench. Granular backfill, conforming to the requirements of Section 806, Aggregate for Drainage, of the Georgia Department of Transportation (GDOT) Standard Specifications Construction of Transportation Systems, shall meet the following specifications.

2.0 MATERIALS

- A. Underdrain Backfill. Underdrain backfill shall meet the quality requirements of GDOT Standard Specifications Construction of Transportation Systems Section 800, Coarse Aggregate, with the gradation meeting the requirements of size 89.

The above material shall be used to replace material from the trench for perforated pipe and shall be paid for separately as specified herein. Gradations shall be obtained on samples of underdrain backfill prior to delivery to the job site. Additional gradations shall be obtained at the rate of one (1) per week for size No. 89 during the stockpiling and placement operations. The quality requirement tests described under section 800 shall be performed prior to the start of delivery to the job site.

- B. General. Materials shall meet the requirements shown on the plans and as specified below.
 - 1. Smooth-wall Perforated PVC Pipe, ASTM F758, Poly (vinyl chloride) Ribbed Drainpipe & Fittings, based on controlled inside diameter, ASTM F794, Poly (vinyl chloride) (PVC) corrugated sewer pipe with a smooth interior and fittings, ASTM F949, Poly (vinyl chloride) (PVC) Profile Drain Pipe and fittings based on controlled inside diameter AASHTO M30. All PVC pipe for under drains shall be Schedule 40
 - 2. Fittings are not required to be leak-proof but must be tight enough to prevent intrusion of fine material. Fittings may snap or screw on. All fittings shall be of the composition and have the same physical properties as the tubing and shall not restrict flow. Fittings as a continuous part of the line shall be capable of passing the stretch resistance test in accordance with ASTM F-405, latest revision.

Schedule 40 PVC pipe supplied as meeting this specification shall be marked with the manufacturer's identification symbol regularly at not more than 10 ft. intervals and in addition may be required to carry an approved symbol designating the manufacturer's assurance of compliance also at regular intervals along the pipe. Fittings shall bear the identification symbol of the manufacturer. Each bundle shall bear the date, month and year of manufacture.

- 3. All underdrain pipes backfill shall be AASHTO or ASTM No. 89 stone.

3.0 CONSTRUCTION METHODS

- A. Equipment. All equipment necessary and required for the proper construction of pipe underdrains shall be on the project, in first class working condition, and approved by the Engineer before construction is permitted to start. The equipment shall be able to be set up to maintain line and grade control accurately without damaging the existing soil cement base. A standard backhoe will not be approved for this work
1. The Contractor shall provide hand tampers and pneumatic tampers to obtain the required compaction of the pipe bed and backfill, as specified.
- B. Excavation. The Contractor shall do all necessary excavation to the depth shown on the plans.
1. Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the Engineer. The excavation shall not be carried below the required depth; when this is done, the trench shall be backfilled at the Contractor's expense with material approved by the Engineer and compacted to the density of the surrounding earth material as determined by the AASHTO Compaction Control Tests AASHTO T-180. The laboratory compaction and field density shall be determined by methods described in Section P-152, "Excavation and Embankment".
 2. In case the depth of cut is changed from that shown on the plans, the change shall not exceed 6" without a revision in the contract unit price per linear foot of pipe. However, if the depth of cut is changed more than 6", compensation or deduction of work involved, whether increased or decreased, shall be provided for in a supplemental agreement.
 3. The minimum width of the trench at the top of the pipe, when placed, shall be a width which will permit the proper construction of joints and compaction of backfill around the pipe.
 4. The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the backfill to at least 12" over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot for the pipe.
 5. The Contractor is cautioned to exercise extreme care, particularly in the areas immediately and adjacent to taxiway and runway edges, where lighting conduit runs continuously and under which the piping must pass. The Contractor is further cautioned to exercise care in the vicinity of FAA communication, power, and electronic circuits. Damages to these and any other underground utilities shall be repaired in accordance with "General Conditions, Section 22.11". All cost associated with these repairs shall be paid for by the Contractor.
- C. Laying and Installing Pipe.
1. The Contractor's facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.
 2. The Engineer shall inspect all pipe before it is laid, and reject any section that is damaged by handling or is defective to a degree which will materially affect the function and service of the pipe.

3. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Pipe shall not be laid on frozen ground or in a wet trench.
 4. PVC pipe shall be installed in accordance with the requirements of ASTM D2321 or AASHTO standard specifications for Highway Bridges Section 30. Perforations shall meet the requirements of AASHTO M252 or M294 class 2, unless otherwise indicated on the plans.
- D. Mortar. The mortar shall be of the desired consistency for making connections to other pipes or to structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted.
- E. Backfilling.
1. Earth. All trenches and excavations shall be backfilled within a reasonable time after the pipes are installed, unless other protection of the pipe is provided. Backfill material shall be approved by the Engineer. Special care shall be taken in placing the backfill. Great care shall be used to obtain thorough compaction under the haunches and along the sides to the top of the pipe.
 - a. The backfill shall be placed in loose layers not exceeding 6" in depth under and around the pipe and not exceeding 8" over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the Engineer, until the trench is filled and brought to the proper elevation. Backfilling shall be done in a manner to avoid injurious top or side pressures on the pipe.
 - b. In embankments and for other areas, the backfill shall be compacted to 90% of the maximum density as determined by AASHTO T-180. The laboratory compaction and field density shall be determined by methods described in SECTION P-152, EXCAVATION AND EMBANKMENT. Density tests shall be taken at a frequency of one (1) per every other lift per 100 linear feet of trench for earth backfill.
 2. Granular Material. When granular backfill is required, its placement in the trench and about the pipe shall be as shown on the plans. Special care shall be taken in placing the backfill. The granular backfill shall not contain a damaging amount of foreign matter, nor shall earth from the sides of the trench or from the windrow be allowed to filter into the backfill. The backfill shall be placed in loose layers not exceeding 6" in depth and compacted by hand and vibratory tampers to the requirements as given above. Backfilling shall be done in a manner to avoid injurious top or side pressure on the pipe. The granular backfill shall be made to the elevation of the trench, as shown on the plans.
 - a. When perforated pipe is specified, granular backfill material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the plans.
 - b. Whenever a granular subbase blanket course is to be used under pavements or which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be placed in the trench up to an elevation of 2" above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent subgrade where it can be incorporated into the granular subbase blanket course. Any unsuitable material which remains over the underdrain trench shall be removed and replaced.

The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench. The backfill shall be compacted in accordance with the applicable portions of Section D-701 Pipe for Storm Drains.

- F. Connections. When the plans call for connections to existing or proposed structures, these connections shall be watertight and made so that a smooth uniform flow line will be obtained throughout the drainage system.
- G. Flushing and/or Rodding. The flushing and/or rodding of underdrain pipe shall be accomplished in such a manner to reasonably assure that the underdrain longitudinal pipes and outlet pipes are not obstructed or blocked or discontinuous.

Sufficient water is to be injected into the system, overcoming the amount absorbed into the backfill aggregate, to reasonably indicate free flow. This can be observed by monitoring the time it takes to reach a monitoring point and the magnitude of flow. The reverse also will be monitored, i.e. the time it takes for the flow to abate.

If the lines appear to be blocked, obstructed, or discontinuous, based on the above monitoring, the Contractor is to rod the lines to determine the point of the problem.

An exploratory pit would then be dug at the perceived problem point and corrections made to the underdrains.

- H. Cleaning and Restoration of Site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. Except for paved areas of the Airport, the Contractor shall restore all disturbed areas to their original condition.
 - 1. After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.
 - 2. Performance of the work described in this section is not payable directly but shall be considered as a subsidiary obligation of the Contractor, covered under the contract unit price for the underdrain.

4.0 METHODS OF MEASUREMENT

- A. The length of pipe to be paid for shall be the number of linear feet of underdrain pipes in place, completed, and approved to be measured along the centerline of the pipe from end of pipe or inside face of structure to the end or inside face of structure, whichever is applicable. All fittings and appurtenances shall be included in the length as typical pipe sections in the pipe being measured.
- B. The amount of low slump, low strength concrete as specified in P-501 shall not be measured separately as it is incidental to the work.
- C. Underdrain cleanouts constructed and finished in-place will each be counted for payment.
- D. Trench Rock Excavation will be measured per specification P-152.

5.0 BASIS OF PAYMENT

- A. Payment will be made at the contract unit price per linear foot for each kind of pipe, type and size designated. These prices shall be full compensation for furnishing all materials and for all labor, equipment, tools and incidentals necessary to complete these items, including the excavation and removal of existing underdrain pipes, connections to existing drainage pipes and structures and drainage stone. The cost of underdrain outfall pipe, concrete encasement, concrete collars at manholes or inlets, shall also be included in the linear foot price bid for the non-perforated underdrain outlet pipe.
- B. No separate payment shall be made for the 6-inch concrete caps of low slump, low strength concrete.
- C. Payment for underdrain cleanouts shall be made for each cleanout installed and accepted in-place. These prices shall be full compensation for furnishing all materials and for all labor, equipment, tools and incidentals necessary to complete these items.
- D. Payment for the underdrain pipe aggregate backfill shall be made per cubic yard placed and accepted.
- E. Payment for Trench Rock Excavation, if required, will be per item P-152-3.

Payment will be made under:

- Item D-705-1 8" Perforated Underdrain Pipe – Per Linear Foot
- Item D-705-2 8" Non-Perforated Underdrain Outlet Pipe, Concrete Encased – Per Linear Foot
- Item D-705-3 6" Perforated PVC Pipe – Per Linear Foot
- Item D-705-4 Underdrain Cleanout – Per Each
- Item D-705-5 Coarse Aggregate Backfill, #89 Stone– Per Cubic Yard

TESTING AND MATERIAL REQUIREMENTS

Test and short title	Material and short title
AASHTO T-180 -- Density	AASHTO M-85--Portland Cement
AASHTO T-27 – Gradation	AASHTO M-45--Sand
	ASTM C-6--Hydrated Lime ASTM D-1248—Joints
	ASTM D-3034--PVC Pipe & Fittings ASTM F-758--PVC Pipe
	ASTM F-949--PVC Pipe

END OF SECTION D-705

a. SECTION D-750 - SANITARY SEWERS

1.0 DESCRIPTION

- A. This work shall include the construction of sanitary sewer pipes of the types, classes and sizes required on the contract documents, furnished and installed as designated on the contract documents, or as directed by the Engineer.

2.0 SUBMITTALS

- A. Shop Drawings: For the following:
 - 1. Manholes: include plan, elevations, sections, details, frames and covers.
 - 2. Sewer Pipe: include manufacturer's cut sheet and certification.
- B. Coordination Drawings: Show pipe size, locations, and elevations. Show other piping in same trench and clearance from sewage system piping. Indicate interface and spatial relationship between manholes, piping and proximate structures.
- C. Field-Quality Control test reports. Infiltration test results.

3.0 MATERIALS

- A. Ductile iron pipe shall meet the requirements of AWWA C-151. The pipe shall be cement-enamel lined in accordance with AWWA C-104 and coated outside in accordance with Section 51-8.1 of AWWA C-151. Push-on type rubber gaskets shall be used for gravity pipe and restrained joints will be used for force mains. All pipes shall be strength Class 51 pipe, unless otherwise noted on the Contract Drawings.
- B. Reinforced concrete pipe shall be furnished in eight-foot maximum laying sections' and shall have the strength or Class as indicated on the plans. The pipe shall be lined with two coats of epoxy coating. Dry fill coating thickness will be seven to eight mils per coat. Two coats will be required: preferably one red and the second in gray. No additional payment will be made for epoxy coating; all cost thereof will be considered incidental to the type of pipe.
- C. All pipe and pipe joints on reinforced concrete pipe 48" diameter and smaller shall be certified as having been tested in accordance with ASTM Designation C-76 and C-443, respectively, for absorption and joint leakage. At least 1% of the pipe lengths and joints of each diameter from a given pipe run by a given manufacturer and not less than two pipe lengths or two joints of each diameter and run shall be so tested and certified. No runs of pipe failing to meet the absorption and leakage test requirements will be accepted. Lift holes will be permitted on all concrete pipe. Lift holes shall be sealed with 5 Star Non-Shrink Grout conforming to ASTM C-827 for shrinkage; have reached its initial set time within 45 minutes of mixing and initial set conforming to ASTM C-191; and with minimum compressive strength of 2,000 psi in one day and 7,000 psi at 28 days conforming to ASTM C-109.
- D. PVC pipe furnished for force main and pressure gravity sewer shall be smooth- wall solid pipe, ASTM F758 Schedule 40.
- E. Gaskets for both ductile iron pipe and reinforced concrete pipe shall be "O" ring type and approved, fuel resistant Neoprene "N". All gaskets proposed as fuel resistant equals shall conform to the requirements of ASTM C-443 and shall be tested for swelling in the presence of petroleum products in accordance with Federal Standard 601, Method 6001 and 6211. When the latter method is used No. 3 oil for 70 hours at 212°F, the swelling shall not exceed 100% by

volume.

- F. Manholes shall be as specified in Section D-751, "Manholes, Catch Basins and Inlets."
- G. Concrete for concrete encasement of sanitary sewers shall meet the requirements in Section "P-610 Structural Portland Cement Concrete". Concrete shall have a minimum compressive strength of 3,000 PSI at 28 days.

4.0 CONSTRUCTION

- A. Sanitary sewer pipe shall be constructed in accordance with Section D-701, "Pipe for Storm Sewers and Culverts", of these specifications. Sanitary facilities shall be tested:
 - 1. For infiltration in accordance with Section 660.3.06 "Quality Acceptance" of the Georgia Department of Transportation (DOT) Standard Specifications Construction of Transportation Systems.
 - 2. For water tightness with low-pressure air test. The Contractor shall furnish all necessary equipment and materials for testing including but not limited to pressure gauges, plugs, pumps, bulkheads, miscellaneous piping, etc.
 - a. The Contractor shall isolate the test section with required plugs, bulkheads, etc.
 - b. The Contractor shall pressurize the test section to 3.5 psi greater than the average backpressure of groundwater around the sewer (add 0.43 psi to test pressure for each vertical foot that the groundwater is about the groundwater is above the top of the pipe).
 - c. Allow 3 minutes for the pressure to stabilize.
 - d. The pressure shall not decrease more than 0.5 psi during the periods shown below:

<u>Pipe Diameter (inches)</u>	<u>Time/100ft of Pipe</u>
8	1 min – 12 sec.
10	1 min – 30 sec.
12	1 min – 48 sec.
14	2 min – 48 sec.
15	2 min – 0 sec.
16	2 min – 6 sec.
18	2 min - 12 sec.
20	2 min – 48 sec

- B. The Contractor will be required to maintain flow in existing sanitary sewers during construction. Blockage of any line or discharge of any line into adjacent drainage facilities will not be permitted. There will be no additional compensation for the maintenance of flow and all costs thereof will be considered incidental to the pipe.
- C. Where noted on the plans, the Contractor shall plug existing sanitary sewer pipe with concrete. Concrete plugs shall extend into the pipe a distance equal to the pipe diameter.
- D. All trench excavation through rock shall be extended at least one foot below the outside of the pipe in all directions and then backfilled with approved granular material to form the pipe bedding.
- E. Where noted on the contract plans, the Contractor shall remove or abandon existing manholes by demolishing or removing the top of the structure to five feet below finished grade and backfilling with approved material, once the floor of the structure has been made pervious by

drilled holes, as directed by the Engineer. No additional compensation will be made for this work, and all costs will be considered incidental to the pipe.

- F. Concrete encasement shall be placed in the trench around sanitary sewer pipe where indicated in the plans. The concrete encasement shall be in accordance with the detail in the plans

5.0 METHOD OF MEASUREMENT

- A. The length of pipe to be paid for shall be the number of linear feet of pipe in place completed and approved. It shall be measured along the centerline of the pipe from end to inside face of structure to the end or inside face of structure, whichever is applicable. The several types and sizes shall be measured under the appropriate item without distinction as to pipe strength class. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.
- B. The length of Type "B" and "C" Pipe Bedding and Concrete Encasement to be paid for shall be the number of linear feet of pipe bedding or concrete encasement, without regard to the pipe diameter, shaped, compacted and backfilled in accordance with these specifications and approved by the City.
- C. Trench and Excavation Protection shall be included in the contract lump sum price bid for contract Item Trench and Excavation Protection in "Pipe for Storm Drains," Section D-701. Trench Rock Excavation, if required, will be included in "Excavation and Embankment," Section P-152.
- D. Each manhole complete, in place and accepted will be counted for payment.

6.0 BASIS OF PAYMENT

- A. Payment for sanitary sewer pipe, complete and installed as planned and/or directed, will be made at the contract unit price per linear foot for pipe, without distinction as to pipe strength class. These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.
 - 1. No separate payment will be made for connection of new pipe as indicated on the drawings to existing sanitary sewer system (pipe, manhole, etc.). This work shall be considered incidental to the sanitary sewer construction.
 - 2. Hauling and placement of excess material removed in the pipe trench excavation process and not used as backfill will not be measured for payment under this item. Payment for this work will be made under the appropriate embankment item as specified in "Excavation and Embankment," Section P-152.
 - 3. No separate payment will be made for common trench excavation, or trench backfill, including select backfill. The cost of this work will be considered incidental to the construction of the sanitary sewer pipe.
 - 4. No separate payment will be made for any sheeting, shoring, bracing, pumping and counter-floatation measures which are required during construction, whether or not such work is indicated on the plans, other than as specified under the term "Trench and Excavation Protection" in "Pipe for Storm Drains," Section D-701.
 - 5. Payment will be made for the cost of removing and abandoning existing sanitary sewers, existing manholes, as specified by Section P-150, "Removal of Pavements and Miscellaneous Items".
 - 6. Separate payment will be made for constructing concrete pipe collars for the purpose of joining two pipes. This will be paid under the item for "Miscellaneous Concrete" in

“Manholes, Cath Basins, and Inlets,” Section D-751.

7. No separate payment will be made for the removal and replacement or support of existing utilities necessary during the construction of sanitary sewers. The cost of this work will be considered incidental to the construction of the sanitary sewer pipe.
 8. No separate payment will be made for exceptional costs incurred by the Contractor in conforming to construction schedules established in the plans or for duplicated work required by these schedules. The cost of this work will be considered incidental to the sanitary sewer item.
 9. No separate payment will be made for the removal and disposal of trash, rubble and garbage removed from the pipe trench, or for replacement backfill. All costs therefor, shall be included in the prices bid for the pipe item.
 10. No separate payment will be made for tees, reducers, or other fittings.
- B. Payment for Pipe Bedding completed and accepted will be made at the contract unit price per linear foot, which price shall be full compensation for furnishing and placing all material and for all labor, equipment, tools and incidentals necessary to complete the item.
- C. Each manhole of the various types, complete, in-place, and accepted shall be paid for at the contract price bid per each. Such prices and payments shall be full compensation for furnishing all materials, fittings, and other appurtenances called for on the plans for all preparation, excavation, and placing of materials, and for all labor, equipment, tools and incidentals necessary to complete the structures.

Payment will be made under:

Item D-750-1–Sanitary Sewer, 42” RCP, Gravity -Per Linear Foot

Item D-750-2-Sanitary Sewer 6” Diameter DIP, Gravity – Per Linear Foot

Item D-750-3-Sanitary Sewer, 12” Diameter DIP-Per Linear Foot

Item D-750-4-Sanitary Sewer, 8” Diameter DIP, CL 56-Per Linear Foot

Item D-750-5–Type “C” Bedding for Sanitary Sewers-Per Linear Foot

Item D-750-6-Type “B” Bedding for Sanitary Sewers-Per Linear Foot

Item D-750-7- Concrete Encasement for Sanitary Sewers-Per Linear Foot

Item D-750-8- 6’ Diameter Sanitary Sewer Manhole-Per Each.

Item D-750-9- Adjust Existing Sanitary Manhole to Grade-Per Each.

Item D-750-10-4’ Diameter Sanitary Sewer Manhole Over Existing Sanitary Sewer-Per Each

Item D-750-11-Sanitary Sewer Cleanout – Per Each

TESTING AND MATERIAL REQUIREMENTS

Test and Short Title	Material and Short
Title ASTM C 6	Hydrated Lime
AASHTO M 45	Sand
ASTM C 76	RC Pipe
ASTM C 443	Rubber Gasket
AASHTO M 85	Portland Cement
AASHTO M 157	Reddy-Mix Concrete
AASHTO M 173	Joint Sealer
AASHTO M 198	Gaskets
AASHTO M 219	Aluminum Structural Plate
1/HH-P-117	Oakum
Fed. Std. 601	Gasket Swell
1/HH-G-156	Flexibility

Note: Others as required by referenced specifications.

1/ Federal Specifications

END OF SECTION D-750

SECTION D-751 MANHOLES, CATCH BASINS AND INLETS

1.0 DESCRIPTION

- A. This work shall include construction of new manholes, inlets, headwalls, trench drains, miscellaneous drainage structures, adjusting inlets to grade, and other incidental concrete structures constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the Engineer.
- B. This section shall also include the repair of trench drains at locations shown in the plans.
- C. This section shall include plain or reinforced concrete for miscellaneous structures, constructed in accordance with the specification at the specified locations and conforming to the lines, grades and dimensions shown on the plans or required by the Engineer.
- D. All reinforced concrete structures partly or wholly precast, covered by these specifications shall be constructed in accordance with the shop drawings, approved by the Engineer, in advance of the work. Shop drawings shall indicate the location of all joints and the size, shape and orientation of all the pipe openings. Bar schedule for all reinforcing steel shall be submitted with the shop drawings. Shop drawings shall be submitted with all parts of the structure and hardware indicated – multiple submittals for the appurtenant parts of a single structure will be cause for rejection of the entire submittal.

2.0 MATERIALS

- A. Mortar. The mortar for brick masonry and similar work shall be composed of one part of Portland cement and two parts of mortar sand, by volume. The Portland cement shall conform to the requirements of AASHTO M-85. The sand shall conform to the requirements of AASHTO M-45. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C-6. The water shall be clean and free of deleterious amounts of acids, alkali's, and organic material. If the work is of questionable quality, it shall be tested in accordance with AASHTO T-26.
- B. Concrete. Joints between storm sewer pipes and manholes shall be made with formed and poured collars.

The top and bottom slabs and other portions of the various drainage structures to be constructed of reinforced concrete shall conform to the applicable requirements of Section 500, Section 833, and Section 441 of the Georgia Department of Transportation Standard Specifications. Unless otherwise noted on the contract documents, these elements may be cast in place or precast, at the Contractor's option. All concrete shall be Class A unless otherwise specified on the plans.

Reinforcing steel shall conform to ASTM A-615, Grade 60, and shall conform to the applicable requirements of Section 511 of the Georgia Department of Georgia Standard Specifications.

- C. Manholes.
 - 1. Precast concrete manhole risers shall conform to the requirements of ASTM C-478, unless noted otherwise on the plans.
 - 2. Precast circular wall sections of manholes shall conform to the requirements of ASTM C-

- 478, unless noted otherwise on the plans.
3. All manhole covers shall be furnished with four cover hold-down bolts, rubber gaskets, and a single pick hole on the cover periphery which does not extend beyond the seating flange of the frame. Frames shall be furnished with anchor bolts, as shown on the contract documents. All frames and covers shall be cast iron, as shown on the contract drawings.
 4. Rubber Gasket Joints shall conform to the requirements of C-433.
 - a. Gasket shall be "O"- ring or profile type, Neoprene, fuel resistant.
 - b. All gaskets proposed as fuel resistant equals shall be tested for swelling in the presence of petroleum products in accordance with Federal Standard 601, Method 6001 and 6211. When the latter method is used with No. 3 oil for 70 hours at 212° F., the swelling shall not exceed 100% by volume.
 5. All castings shall be thoroughly cleaned and given two coats of approved bituminous paint. After fabrication, structural steel units shall be galvanized to meet the requirements of AASHTO M-111.
 6. The steps or ladder bars shall be gray or malleable cast iron.
 7. Bedding for precast base sections shall conform to the requirements for coarse aggregate No. 89, Georgia DOT Standard Specifications.

3.0 CONSTRUCTION METHODS

A. Unclassified Excavation.

1. The Contractor shall do all excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.
2. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When poured concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.
3. All precast base sections must be founded on a compacted layer of Georgia DOT No. 89 coarse aggregate at least 18" thick.
4. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

5. Unless otherwise provided, the Contractor shall remove bracing, sheathing, or shoring involved in the construction of this item after the completion of the structure. Removal shall be affected in a manner, which will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.
6. After each excavation is completed, the Contractor shall notify the Engineer to that effect; and concrete or reinforcing steel shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.

- B. Concrete Structures. Concrete structures shall be built on prepared foundations, conforming to the dimensions and form indicated on the plans. The construction shall conform to the requirements of section 500, Class A Concrete, of the Georgia DOT Standard Specifications.

All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped downward toward the outlet.

Adjusting existing manholes and inlets shall consist of removing and replacing the casting, removing portions of the existing walls, and/or constructing new structure walls as necessary to lower an existing structure to grade. Also included under this item is the raising of an existing structure to grade.

- C. Precast Concrete Structures. Precast concrete structures shall be constructed on prepared aggregate bases and shall conform to the dimensions and locations shown on the contract documents. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily and all joining and connections shall be cemented with mortar. The top of the upper precast concrete pipe member shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required.

Provisions shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow.

- D. Inlet and Outlet Pipes. Inlet and outlet pipes shall extend through the walls of the structures for a sufficient distance beyond the outside to allow for connections but shall be cut off flush with the wall on the inside surface, unless otherwise directed. For concrete or brick structures, the mortar shall be placed around these pipes so as to form a tight, neat connection. For precast structures, joints between storm sewer pipes and structure walls shall be formed concrete collars, placed exterior of the structure, which completely fill and seal the annular void between the pipe and the structure wall.

- E. Placement and Treatment of Castings, Frames, and Fittings. All castings, frames, and fittings shall be placed in the positions indicated on the plans, or as directed by the Engineer, and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are to be placed upon previously constructed masonry, the bearing surface or masonry shall be brought true to line and grade and shall present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans, or as directed and approved by the Engineer. All units shall be set firm and secure.

After the frames and fittings have been set in final position and the concrete or mortar has been allowed to harden for seven days, then the grates or covers shall be placed and fastened down.

- F. Installation of Steps. The steps shall be installed as indicated on the plans, or as directed by the Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is poured. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven days. After this period has elapsed, the steps shall be cleaned and painted, unless they have been galvanized. When steps are required with precast concrete pipe structures, they shall be cast into the sides of the pipe at the time the pipe sections are manufactured, or set in place after the structure is erected, by drilling holes in the concrete and cementing the steps in place.

In lieu of steps, prefabricated ladders may be installed. In the case of brick or concrete structures, the ladder shall be held in place by grouting and supports in drilled holes. In the case of metal structures, the ladder shall be secured by welding the top support and grouting the bottom support into drilled holes in the foundation, or as directed.

G. Backfilling.

1. After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed 8" in loose depth and compacted to a density of not less than 90% of the maximum dry-density for the material as determined by AASHTO T-180. Density tests shall be taken at the frequency of one per every other lift per manhole, inlet, junction chamber, or drainage structure, as appropriate. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans, or as directed by the Engineer.
2. Backfilling shall not be placed against any structure until the Engineer gives permission. In the case of concrete, such permission shall not be given until the concrete has been in place seven days, or until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.
3. Backfill placed around concrete culverts shall be deposited on both sides at the same time and to approximately the same elevation. Care shall be taken to prevent any wedging action against the structure and all slopes bounding or within the area to be backfilled shall be stepped or serrated to prevent wedge action.
4. Backfill shall not be measured for direct payment. Performance of this work shall be considered as a subsidiary obligation of the Contractor covered under the contract unit price for the structure involved.

- H. Cleaning and Restoration of Site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition. After all work is complete, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

4.0 METHOD OF MEASUREMENT

- A. Each manhole, junction chamber and inlet complete, in place and accepted will be counted for payment.
- B. Each manhole and inlet adjustment complete, in place and accepted will be counted for payment.
- C. Miscellaneous concrete for collars, aprons, pipe plugs and other purposes will be measured by the cubic yard, complete, in place and accepted.
- D. No measurement or allowance shall be made for forms, falsework, cofferdams, pumping, bracing, expansion joints or material, water stops or utility sleeves.

5.0 BASIS OF PAYMENT

- A. Each manhole, inlet, manhole adjustment, and inlet adjustment of the various types, complete, in-place, and accepted shall be paid for at the contract price bid per each. Such prices and payments shall be full compensation for furnishing all materials, fittings, and other appurtenances called for on the plans for all preparation, excavation, and placing of materials, and for all labor, equipment, tools and incidentals necessary to complete the structures.
- B. No separate payment will be made for breaking and connecting into manholes for storm sewers. This work shall be considered incidental to the storm sewer construction.
- C. No additional payment will be made for sheeting, shoring, bracing, pumping, dewatering, and any counter-floatation measures, which may be required during construction.
- D. Payment will be made at the contract unit price per cubic yard for concrete for miscellaneous concrete. These prices shall be full compensation for furnishing all materials, for all preparation, excavation, and placing of materials, and for all labor, equipment, tools, and incidentals necessary to complete the structure. No separate payment will be made for reinforcing steel.
- E. Payment will be made under:
 - Item D-751-1 – 4’ Dia. Manhole – Per Each.
 - Item D-751-2 - Adjust Existing Manhole to Grade – Per Each.

END OF SECTION D-751

SECTION P-150 - REMOVAL OF PAVEMENTS AND MISCELLANEOUS ITEMS

1.0 DESCRIPTION

- A. This section consists of the breaking up and removal of pavements of all types, guardrail, and fencing in the areas indicated on the plans or as directed by the Engineer. The actual limits of pavement and fence removal shall be approved by the Engineer prior to the start of removal operations.
- B. The contractor shall accomplish the demolition and disposal in accordance with all local, state, and federal regulations and laws in regard to hazardous or toxic materials and shall obtain any permits required to accomplish the work.

2.0 CONSTRUCTION

- A. Pavement removal shall consist of saw cutting, breaking up and removal, if required, of all bituminous and concrete pavements, curbs, guardrail, and base courses as indicated on the plans. The horizontal limits of these removals shall be surveyed and saw cut prior to removal, unless otherwise agreed to by the Engineer.
- B. Temporary chain link fences shall be erected before existing chain link fences and gates with or without barbed wire are removed.

3.0 METHOD OF MEASUREMENT

- A. The area of pavement removal including curb and gutter (if required) to be measured for payment will be actual square yardage required to be removed for purposes so directed by the Engineer. Pavement removed outside these limits will not be measured for payment.
- B. Removal of existing chain link fence and gates with or without barbed wire regardless of height will be the actual linear footage of fence removed and disposed of as directed by the Engineer.

4.0 BASIS OF PAYMENT

- A. Payment shall be made at the contract unit price for pavement removal of all sections and types. This price shall be full compensation for breaking up of all designated pavements and for all broken materials removed and hauled to a designated area, or off airport, and for all labor, equipment and incidentals necessary to complete the item.
- B. Payment shall be made at the contract unit price for removal of existing fence. The price shall be full compensation for removal, disposal off airport property, and for all labor, equipment and incidentals necessary to complete the item.

- C. Payment will be made under:

Item P-150-1-Removal of Pavements– Per Square Yard. Item P-150-2-Demolition of Existing Fence – Per Linear Foot.

END OF SECTION

SECTION P-152 EXCAVATION AND EMBANKMENT

1.0 DESCRIPTION

- A. This section consists of furnishing borrow, excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct embankments and other facilities in accordance with these specifications and in conformity with the lines and grades established by the Engineer as shown on the plans.
- B. All suitable materials taken from excavation of any contract item shall be used in the formation of the embankment, subgrade, and for backfilling as indicated on the plans, or as directed by the Engineer.
1. When on-site material is not sufficient to construct the embankment, the Contractor shall furnish material from his own off-Airport borrow site(s). In general, the borrow material supplied shall be of such soil type and gradation that the material has the capacity of being tested in accordance with AASHTO T-180 and meets the stability requirements as specified under Section P-152, 02), g), 11).
- C. Classifications:
1. All material that is excavated and used for embankment shall be classified as "In-Place Embankment", "Borrow Excavation", "On Site Excavation", "Backfill", "Rock Excavation or as "Trench Rock Excavation".
 2. In-Place Embankment shall include onsite excavation and offsite borrow excavation, hauling, manipulation, placement, grading, and compaction of all materials necessary to construct embankments as set forth on the plans and in these specifications.
 3. Borrow Excavation shall consist of material approved by the Engineer and furnished by the Contractor from the Contractor's off Airport borrow site(s).
 4. Backfill shall include the excavation of unsuitable material, obtaining suitable replacement, hauling, placing and compaction of suitable material required to replace any unsuitable material which has been removed and disposed of. Unsuitable material may be placed on the finished slopes of the embankment when approved by the Engineer and deemed able to support vegetation. Deleterious materials such as wood, rubber, metal, paper, drywall, plastic, trash and other similar materials shall be disposed of off Airport property in a legal manner at no additional cost to the City.
 5. Unsuitable material shall include stripping and other materials that will not meet the compaction requirements for In-Place Embankment. Organic composition will generally be considered the basis for designating a material unsuitable. Excess moisture content will not be considered a basis for designating a material unsuitable. If there is any dispute over the suitability of materials, the Engineer's opinion shall be final. Removal of unsuitable material will be as specified per Section P-152, 01), (c), 4).
 6. The existing ground line shall be that surface which is defined by cross sections taken after all stripping and clearing and grubbing, and removal of pavement operations have been completed.
 7. Trench Rock Excavation shall include rock in the various pipe and utility trenches. The Contractor shall expose and determine the extent of rock in trenches. The rock removal shall be accomplished at such time to not damage or disturb completed work.

8. Rock Excavation shall include all solid rock embedded in deposits, in unstratified mass, and conglomerate deposits which are so firmly cemented they present all characteristics of solid rock, and which cannot be moved without drilling or blasting. This classification includes rock removed for the construction of underground structures such as manholes and vaults.
9. Excess Embankment shall include materials remaining after embankments are complete and excavation has been completed to the grades shown on the plans.
10. Selective Grading shall include the excavation, hauling, placement, and compaction including subgrade preparation, of all materials required to construct the areas as directed by the Engineer to final grades.

2.0 CONSTRUCTION METHODS

- A. General. The rough excavation shall be carried to the necessary depth to obtain the specified depth of subgrade densification. Should the Contractor, through negligence or other fault, excavate below the designated lines and grades, the excavation shall be replaced with approved materials, in an approved manner and condition, at the Contractor's expense. The Engineer shall have complete control over the excavation, moving, placing, and disposition of all material and shall determine the suitability of material to be placed in embankments. All material determined unsuitable shall be disposed of off airport property or as directed by the Engineer. Topsoil shall be utilized as directed in Section P-152, 02), (f) contained hereinafter.
1. Before beginning excavation, grading, and embankment operations in any area, the area shall have all sediment control devices in place, be completely cleared and grubbed or stripped of all vegetation and approved by the Engineer to proceed.
 2. The Contractor shall inform and satisfy himself as to the character, quantity, and distribution of all material to be excavated. No payment will be made for any excavated material which is used for purposes other than those designated
 3. Those areas outside of the pavement areas in which the top layer of soil material becomes compacted, due to hauling or to any other activity of the Contractor, shall be scarified and disced to a depth of 4 inches, as directed, to loosen and pulverize the soil. All materials that would be deleterious to the establishment of grass shall not be incorporated into the top 4 to 6 inches of areas to be grassed. The Contractor shall remove any such material prior to commencement of the grassing operation.
 4. If it is necessary to interrupt existing surface drainage, sewers or underdrainage, conduits, utilities, or similar underground structures, or parts thereof, the Contractor shall be responsible for and shall take all necessary precautions to protect and preserve or provide temporary services. When such facilities are encountered, the Contractor shall notify the utility owner as provided for elsewhere in these specifications, who shall arrange for their removal, if necessary. The Contractor shall, at its own expense, satisfactorily repair all damage to such facilities or structures which may result from any of his operations during the period of the contract.
- B. Excavation.

Excavation shall be performed as indicated on the contract plans to the lines, grades, and elevation shown, or as directed by the Engineer, and shall be made so that the requirements for formation of embankments can be followed. All unsuitable material encountered within the limits indicated shall be removed and disposed of as directed by the Engineer. During the process of excavation, the grade shall be maintained so that it will always be well drained. When

directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the work.

1. If, at the time of excavation, it is not possible to place any material in its proper section of the permanent construction, it shall be stockpiled in approved areas for later use. Any stockpiling or re-hauling of material will be done at no additional cost to the city.
2. After all indicated areas have been excavated to the line, grades, and elevations shown, the Contractor shall follow the requirements of Section P-152, 02), (j) as contained hereinafter.
3. The Contractor shall excavate to the limits as indicated and/or implied on the plans. Widening or narrowing of the section and raising or lowering of the grade to avoid haul will not be permitted. The City reserves the right to make minor adjustments or revisions in lines or grades, if found necessary, as the work progresses due to discrepancies in the plans or to obtain satisfactory construction.
4. The disposition of existing structures and utilities shall be as indicated on the drawings, and as specified in other sections of these specifications.
5. In cut areas, the existing ground shall be compacted to a minimum depth of six (6) inches and to a density of not less than 90% of the maximum density, at optimum moisture, as determined by AASHTO T-180 except as modified in Section P-152, 02), (j). Any unsuitable materials encountered shall be removed and paid for as specified herein.
6. No payment or measurement for payment will be made for suitable materials removed, manipulated, and replaced to obtain density. Any removal, manipulation, aeration, replacement, and re-compaction of suitable materials necessary to obtain the required density shall be considered incidental to the excavation and embankment operations and shall be performed by the Contractor at no additional cost to the project.
7. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in the top 6 inches of a pavement subgrade
8. In cuts, all loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the plans or as directed by the Engineer.
9. Blasting, when necessary, will be permitted only when proper precautions are taken for the protection and safety of all persons, the work, and the property. All damage done to the work or property shall be repaired at the Contractor's expense. All operations of the Contractor in connection with transportation, storage, and use of explosives shall be approved by the Engineer. Any approval given will not relieve the Contractor of his responsibility in blasting operations. If any portion of the Work is over excavated by blasting, that portion will be restored to the plan elevations by filling with suitable material by the Contractor at no additional cost to the City.
10. Blasting for trench rock excavation shall be controlled by limiting particle velocity to 1" - 2" per second at nearby structures. The use of a recording seismograph will be required for all detonations. The use of electrical detonation will not be allowed.
11. No measurement of trench rock excavation will be made until the Contractor demonstrates to the satisfaction of the Engineer that the material encountered must be drilled and blasted. Contractor must demonstrate that a crawler tractor having a minimum Flywheel Horsepower rating of 440 at 2100 RPM, or approved equal, and equipped with a single

tooth ripper compatible with this type and size equipment will not penetrate the material. The specifications of the equipment used by the Contractor for this purpose shall be submitted to the Engineer for approval.

C. Borrow Excavation

Borrow excavation shall consist of the excavation, loading and hauling of material from the Contractor's off Airport borrow area(s). The Contractor shall be totally responsible for paying for and obtaining all permits and meeting all requirements of all Local, State, and Federal Authorities for excavating borrow and hauling the material to the construction site. All cost associated with obtaining and supplying the borrow material shall be included in the cubic yard unit cost of "In-Place Embankment".

1. The borrow excavation shall be handled and placed as specified in these specifications for excavation and embankment.
2. In general, the borrow material supplied shall be of such soil type and gradation that the material has the capability of being tested in accordance with AASHTO T-180 and meets the stability requirements as specified under Section P-152, (02), (g), (11).
3. To maintain the construction schedule, an appropriate portion of the Contractor's borrow material shall consist of a granular type of material that can be placed and compacted during wet conditions.

D. Ditch Excavation.

1. Ditch excavation shall consist of excavating the drainage ditches to the templates, lines, and grades shown on the plans or as directed by the Engineer. The work shall be performed in proper sequence with the other construction. The location of all ditches shall be established on the ground. All satisfactory materials shall be placed in the taxiway or roadway embankments; all unsatisfactory materials shall be disposed of off Airport Property. The Engineer shall decide whether material from a given location is satisfactory. All necessary handwork shall be performed to secure a finish true to line, elevation, and cross-section, as designated.
2. Ditches constructed on the project shall be maintained to the required cross-section and shall be kept free of silt, debris, or obstructions until the project is accepted. Seeding and mulching of the slopes shall be done as soon as practical after the completion of the excavation. All work shall be in accordance with the Georgia Soil and Water Conservation Commission's *Manual for Erosion and Sediment Control in Georgia*.
3. No separate payment shall be made for ditch excavation. Payment for all excavated material shall be made at the contract unit price for "In-Place Embankment", "Backfill", or "Rock Excavation", whichever the case may be.

E. Embankment areas shall be stripped or cleared and grubbed and existing pavement broken up and removed before existing cross sections are taken. Existing ground cross sections shall be taken before construction of the embankment will be permitted to start.

1. Immediately prior to the placing of the fill materials, the entire area upon which the embankment is to be placed, except where limited by rock, shall be scarified and broken by means of a disc harrow or plow, or other approved equipment, to a depth of 6 inches. Scarifying shall be done approximately parallel to the axis of the fill. All roots, debris, large stones, or objectionable material that would cause interference with the compaction of the foundation or fill shall be removed from the area and disposed of as directed by the

- Engineer. A thin layer (approximately 3 inches) of the fill material shall be spread over the scarified foundation and the whole area compacted as required in the specifications.
2. Where embankments are to be placed on existing slopes steeper than 3-to-1, horizontal benches shall be constructed. The benches shall be of a width sufficient to allow the placement of a maximum of three lifts of compacted embankment material between successive benches.
 3. No direct payment shall be made for the ditch excavation performed under this section. The necessary clearing and grubbing, removal of pavement and the yardage removed will be paid for under the respective items of work as provided for elsewhere within the contract documents.
- F. Stripping shall include the removal of all vegetation and organic matter from areas not cleared and grubbed. Grass shall be removed to a depth of approximately 3 inches. No stripping will be required in areas that have been cleared and grubbed. All material excavated during the stripping operation shall be stockpiled at the work site and is to be distributed over the finished grading of the side slopes and infields. The Contractor is to take this into account during the excavation and embankment operations. Payment for stripping operations is included in the pay item for "In-Place Embankment".
- G. Formation of Embankments. Embankments shall be formed of satisfactory materials placed in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross section.
1. The grading operations shall be conducted, and the various soil strata shall be placed, to produce a soil structure as shown on the typical cross section or as directed. All materials entering the embankment shall be reasonably free of organic matter such as leaves, grass, roots, and other objectionable material. Soil, granular material, shale, and any other material permitted for use in embankment shall be spread in successive layers as specified.
 2. Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing weather, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.
 3. The material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform-moisture content of within ± 3 points of optimum moisture throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Sprinkling shall be done with approved equipment that will sufficiently distribute the water. Sufficient equipment to furnish the required water shall always be available. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.
 4. Rolling operations shall be continued until the embankments for the roadways are compacted to not less than 90 % of the maximum density, at moisture content within ± 3 points of optimum, as determined by AASHTO T-180 except as modified in Section P-152, 02), (j). Any areas inaccessible to a roller shall be consolidated and compacted by mechanical tampers.
 5. During construction of the embankment, the Contractor shall always route his equipment,

- both when loaded and when empty, over the layers as they are placed and shall distribute the travel evenly over the entire width of the embankment. The equipment shall be operated in such a manner that hardpan, cemented gravel, clay, or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.
6. In the construction of embankments, starting layers shall be placed in the deepest portion of the fill and the outer areas of the fill to form a surface parallel to the finished grade lines. This surface shall drain away from the terminal/concourse building site and the MSE walls towards the location of the proposed apron drainage systems. The layers shall be constructed approximately parallel to the finished grade line and the drainage systems constructed as the embankment placement progresses.
 7. Stone or fragmentary rock larger than 2 inches in their greatest dimension will not be allowed in the top 4 feet of the embankment. All fill material placed in the top 4 feet of the embankment shall be capable of being tested in accordance with AASHTO T-180. If the Contractor proposes to use fill material below 4 feet of the top of the embankment that cannot be tested in accordance with AASHTO T-180 due to the size and amount of rock, the Contractor shall obtain approval from the Engineer prior to the placement of the material. To obtain the approval from the Engineer, the Contractor shall submit a plan for approval that describes the soil/rock mix fill material proposed to be used, including the type and gradation of the material, and how this material shall be brought up in layers to fill voids with the finer materials to form a dense, compacted mass of low compressibility. If the plan is approved, the Contractor shall then be required to demonstrate to the satisfaction of the Engineer in a test section the ability to consolidate and compact the embankment with a suitable mix of rock and finer material before proceeding with the use of this material. Rock or boulders from the project site shall not be disposed of outside of the excavation or embankment areas, except at places and in the manner designated by the Engineer. Rock may be incorporated into the embankment provided that the larger sections are well separated, and soil is worked and blended with the rock. No rock or broken pavement materials larger than 6 inches shall be placed in the embankments within ten feet (10') of the toe of slope or the slope face.
 8. Material available in this stockpile on site is mixed dirt and rock, with a particle size of 4 inches and less. This material may not be used above an elevation 4' below finished subgrade, unless the contractor can successfully segregate the larger particles to produce a mix that will meet the requirements of paragraph 7 above.
 9. When rock, from on the Airport project site, is of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment in layers as approved by the Engineer. The Contractor shall demonstrate to the Engineer in a test section the ability to consolidate and compact this material to the satisfaction of the Engineer before proceeding with use of this material. These lifts shall not be constructed above an elevation 4 feet below the finished subgrade.
 10. Frozen material shall not be placed in the embankment, nor shall embankment be placed upon frozen material.
 11. The Contractor shall be responsible for the stability of all embankments made under this contract and shall conduct all testing required at each borrow source and at the embankment to determine the angle of internal friction and the cohesion soil strength based on the ninety percent (90%) modified density within ± 3 points of optimum moisture content as determined by AASHTO T-180 specification. Higher densities may be required on some soils to increase the soil strength in order to meet the stability requirements for

the embankments. Borrow source material shall conform to the safe zone combination illustrated in the chart shown in Appendix 1 (P-152).

12. Following site demolition, prior to placement of embankment, the exposed ground surface shall be densified by rolling with a large, vibratory roller (CAT-CB564D or similar) making at least 2 complete passes in two perpendicular directions. Following densification, the site shall be proof rolled under the observation of the geotechnical engineer. Proof rolling shall be conducted with a fully loaded, tandem axle dump truck or similar pneumatic tired vehicle of about 30 tons gross weight. The purpose of proof rolling will be to detect weak or soft surficial zones that may require additional treatment prior to placement of embankment.

No embankment shall be placed until the required stripping, pavement removal, or unsuitable material removal, whichever the case may be, has been completed and the Contractor has taken cross-sections as directed by the Engineer.

- H. Selective Grading Selective grading shall consist of fine grading of areas where the existing ground is generally within +/- two feet of the grades shown in the plans or as directed by the Engineer. Cut areas shall meet the requirements specified under Section P-152, 02), (b) Excavation. Embankment areas shall meet the requirements specified under Section P-152, 02), (g) Formation of Embankments. The exact limits of selective grading shall be established by the Engineer with the Contractor in the field prior to any operations by the Contractor in the areas designated.
- I. Equipment. The Contractor, unless otherwise specified, may use any type of earth-moving, compaction, and watering equipment he may desire or has at his disposal, provided the equipment is in a satisfactory condition and is of such capacity that the construction schedule can be maintained as planned by the Contractor and as approved by the Engineer in accordance with the total calendar days or working days bid for the construction. The Contractor shall furnish, operate, and maintain such equipment as is necessary to control uniform density, layers, section, and smoothness of grade.
- J. Preparation and Protection of the Top of the Subgrade.
 1. When completed, the subgrade shall be true to the lines, grades, and cross-sections shown on the plans or as directed by the Engineer. After all drains, structures, ducts, and other underground appurtenances, except transverse and longitudinal underdrains along the edges or under the pavement have been completed, the subgrade shall be compacted to the depths and densities specified herein.

Preparation of subgrade for all areas where pavement is to be placed under this contract shall be scarified and compacted for a depth of 24 inches below soil cement level, to a density of not less than 95% of the maximum density, at optimum moisture, as determined by AASHTO T-180. Payment for this work is to be included in the contract unit price for "Preparation of Subgrade".
 2. After grading operations are complete, all loose stones larger than two (2) inches in their greatest dimension shall be removed from the surface of all proposed graded paving areas and disposed of as directed by the Engineer.
 3. When all manipulation and shaping is complete, the subgrade is to be proof rolled by completely covering it twice (two passes) with a pneumatic tired roller weighing at least fifty (50) tons with four (4) tires of equal bearing pressure and 90 pounds per square inch of tire pressure. Any irregularities or depressions that develop under proof rolling shall be corrected by loosening the material at these places and adding, removing, or replacing

material until the surface is smooth and uniform. Any portion of the area that is inaccessible to a roller shall be compacted with mechanical tampers. The material shall be sprinkled with water during compaction operations as directed by the Engineer.

Earthwork constructed under this contract and scheduled for paving under future contracts shall be proof rolled as specified above. There shall be no specific payment for this work and the cost thereof included in the unit price bid for "In-place Embankment".

Payment for proof rolling and correcting irregularities shall be included in the contract unit price for "Preparation of Subgrade", for earthwork constructed under this or previous contracts, and scheduled for paving under this contract.

4. At all times, the top of the subgrade shall be kept in such condition that it will drain readily and effectively. The Contractor shall take all precautions necessary to protect the subgrade from damage. This includes limiting of hauling over the finished subgrade to that which is essential for construction purposes. All ruts or rough places that develop in a completed subgrade shall be smoothed and recompacted. No subbase, base, surface course, or pavement shall be placed on the subgrade until the subgrade has been approved by the Engineer.
- K. Haul. No payment will be made separately or directly for haul on any part of the work. All hauling will be considered a necessary and incidental part of the work, and its cost shall be considered by the Contractor and included in the contract unit price for the pay items of work involved.
- L. Tolerances. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 16 foot straightedge applied parallel and at right angles to the center-line, it shall not show any deviation in excess of 1/2 inch, or shall not be more than 0.04 foot from true grade as established by grade hubs or pins. Any deviation more than these amounts shall be corrected by loosening, adding, or removing materials, reshaping, and recompacting.

On all other areas outside the pavement, base or subbase limits, the surface shall be of such smoothness that it will not vary more than 0.10 of a foot from true grade as established by grade hubs. Any deviation more than this amount shall be corrected by loosening, adding or removing materials, and reshaping.
- M. Testing. Compaction tests will be made for each 500 s.y. on each layer of each area of embankment or backfill and each 200 s.y. of each area on finished subgrade. Sufficient soil classification tests shall be made each 200 s.y. to accurately determine the classification of the top two feet of finished subgrade. Elevations of finished grades of the subgrade under the pavement area shall be checked to ensure proper thickness and grades of base and surface to be placed thereon.
- N. Testing Procedures. The maximum density shall be determined by the appropriate method shown below:
 1. Where all of the material passes a No. 4 sieve, use AASHTO T-180, Method A (or B).
 2. Where the material contains particles larger than a No. 4 sieve, use AASHTO T-180, Method C (or D).
 3. Where the material contains particles larger than 3/4 inch, follow the replacement procedure given in the note under Method C of AASHTO T-180.

The field density shall be determined in accordance with AASHTO T-191, ASTM D-1556, ASTM D-2937 or ASTM D-2922. ASTM D-2922 may be used if a minimum of every tenth test is run in accordance with AASHTO T-191, ASTM D-1556 or ASTM D-2937, for calibration. AASHTO T-224 shall determine the correction for coarse particles in the soil compaction tests.

The field moisture content shall be determined in accordance with AASHTO T-217, or ASTM D-2216.

3.0 METHOD OF MEASUREMENT

- A. The quantity of "In-Place Embankment" to be paid for shall be the number of cubic yards measured in their final position. Fill settlement, if any, will not be measured for payment. Quantities for monthly estimates may be computed with equipment of Contractor's choosing. The final quantity shall be computed by the average end area method using existing ground cross-sections taken after the area has been prepared for placement of embankment and final cross-sections taken by the Contractor after the material has been placed and compacted.
- B. No specific measurement for payment will be made for Excavation, other than the rock items listed below.
- C. The quantity of "Backfill" to be paid for shall be the number of cubic yards measured in their final position. The quantity shall be computed by the average end area method using cross-sections taken by the Contractor after any unsuitable material has been removed and final cross-sections taken by the Contractor upon completion of backfill operations.
- D. The quantity of "Preparation of Subgrade" to be paid for shall be the number of square yards measured in its final position as shown on the typical section on the plans.
- E. No specific measurement for payment will be made for "Borrow Excavation".
- F. The quantity of Rock or Trench Rock Excavation authorized and accepted by the Engineer to be paid for shall be the number of cubic yards measured. The quantity shall be computed by the average end area method using cross-sections taken before excavation of rock starts and after it is finished. The area used for calculations shall not exceed the neat line pay limits shown on the plans, where applicable. The measurement will include over-breakage unless caused by the negligence of the Contractor. Measurement will be made as "Trench Rock Excavation" for rock removed from pipe or utility trenches and as "Rock Excavation" for various structures such as manholes or vaults.
- G. The quality of excess embankment to be authorized for payment shall be based on documented truck counts, after the Engineer and Contractor have agreed upon a volume of cubic yards per truck.

4.0 BASIS OF PAYMENT

- A. Payment shall be made at the contract unit price per cubic yard for "In-Place Embankment". This price shall be full compensation for all borrow material supplied, on site excavation, loading and hauling to various site locations and the formation and compaction of embankments, preparations and completions of ditches and dikes, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the item.
- B. No payment shall be made for "On Site Excavation". The cost of this work shall be included in the unit price for "In-Place Embankment".

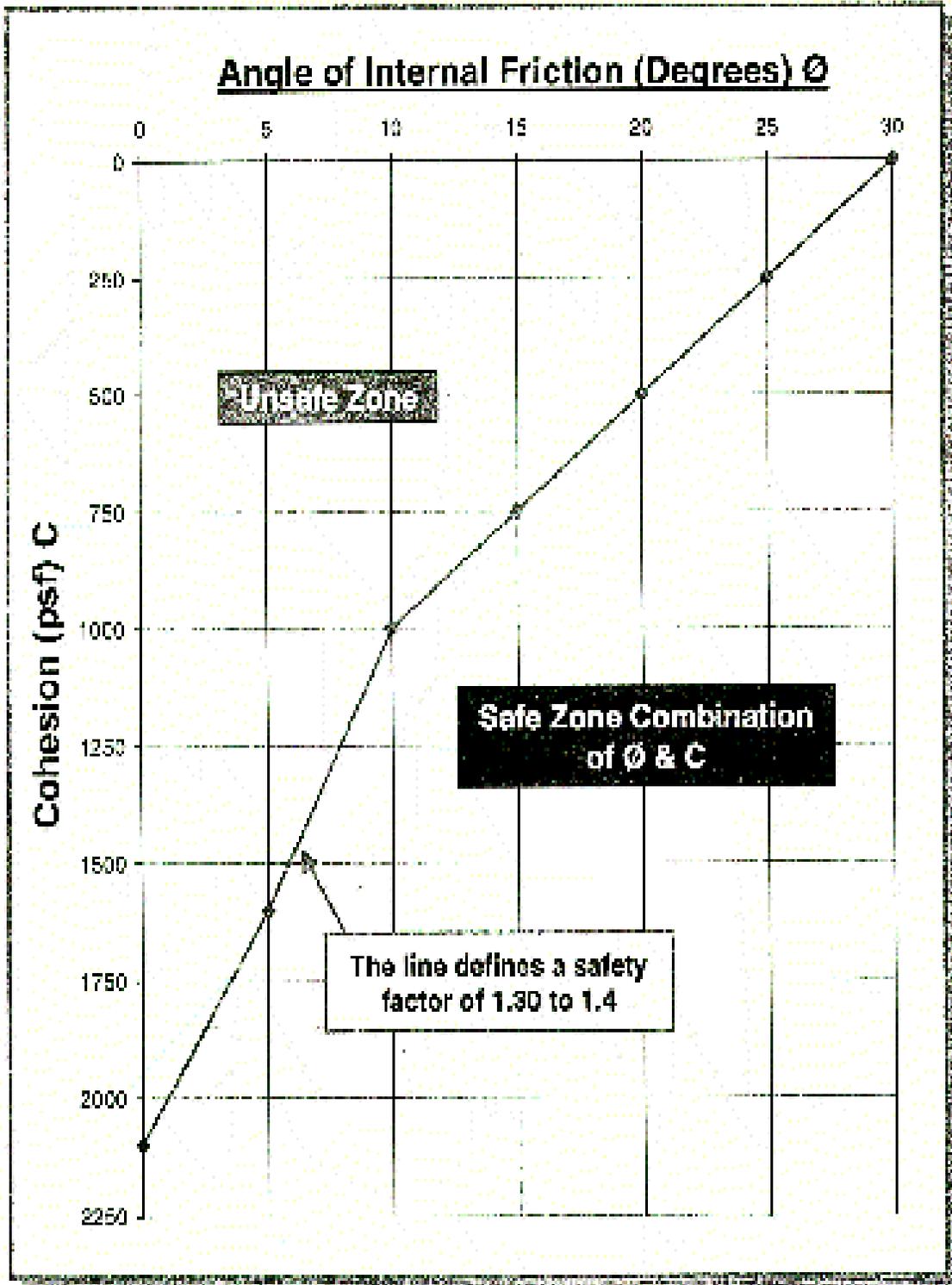
- C. Payment shall be made at the contract unit price per cubic yard for "Backfill". This price shall be full compensation for excavation of unsuitable material, obtaining suitable material, hauling, and placing of backfill and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.
- D. Payment shall be made at the contract unit price per square yard for "Preparation of Subgrade". This price shall be full compensation for compacting, shaping, and proof rolling the subgrade, removing unsuitable material, and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.
- E. Payment shall be made at the contract unit price per cubic yard for "Trench Rock Excavation". This price shall be full compensation for blasting, excavation, loading and hauling to the final location and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.
- F. Payments shall be made at the contract unit price per cubic yard for "Rock Excavation". This price shall be full compensation for blasting, excavation, loading and hauling to the final location and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.
- G. Payment shall be made at the contract unit price per cubic yard for excess embankment. This price shall be full compensation for loading, hauling and delivery to the recycled materials jobsite.
- H. Payment will be made under:
 - Item P-152-1 In-Place Embankment - Per Cubic Yard.
 - Item P-152-2 Backfill - Per Cubic Yard.
 - Item P-152-3 Preparation of Subgrade - Per Square Yard.
 - Item P-152-4 Trench Rock Excavation - Per Cubic Yard.
 - Item P-152-5 Rock Excavation - Per Cubic Yard.
 - Item P-152-6 Excess Embankment - Per Cubic Yard

TESTING AND MATERIAL REQUIREMENTS

<u>Testing and short title</u>	<u>Material and short title</u>
AASHTO T-180	Moisture Density Relation
None	None
AASHTO T-191, ASTM D-1556, D-2937 or D-2922, AASHTO T-224	Field Density
AASHTO T-217 or ASTM D-2216	Moisture Content

END OF SECTION P-152

Appendix 1



SECTION P-209 - CRUSHED AGGREGATE BASE COURSE

1.0 DESCRIPTION

- A. This item consists of a base course composed of crushed aggregates or recycled concrete base constructed on a prepared surface in accordance with these specifications and in conformity to the dimensions and typical cross sections shown on the plans.
- B. This item includes constructing a surface course composed of crushed aggregate base material on a prepared surface in accordance with these specifications and in conformity to the dimensions and typical cross sections shown on the plans.

2.0 MATERIALS

- A. Aggregates shall consist of clean, sound, durable particles of crushed stone or crushed gravel and shall be free from coatings of clay, silt, vegetable matter, and other objectionable materials and shall contain no clay balls. Fine aggregate passing the No. 4 sieve shall consist of fines from the operation of crushing the coarse aggregate. If necessary, fine aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone or gravel that meet the requirements for wear and soundness specified for coarse aggregate.

The crushed aggregate portion which is retained on the No. 4 sieve shall contain not more than 15 percent, by weight, of flat and/or elongated pieces exceeding a ratio of 5:1 between maximum and minimum dimensions as tested in accordance with ASTM D 4791, and shall have at least 90 percent by weight of particles with at least two fractured faces and 100 percent with at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

The percentage of wear shall not be greater than 45 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed 12 percent, after 5 cycles, when tested in accordance with ASTM C 88.

The fraction passing the No. 40 sieve shall have a liquid limit no greater than 25 and a plasticity index of not more than 4 when tested in accordance with ASTM D 4318. The fine aggregate shall have a minimum sand equivalent value of 35 when tested in accordance with ASTM D 2419.

1. Aggregates for preliminary testing shall be furnished by the Contractor prior to the start of production. Except as otherwise specified, all tests for initial aggregate submittals necessary to determine compliance with the specification requirements will be made by the Engineer at no expense to the Contractor.

Samples of aggregates shall be furnished by the Contractor at the start of production and at intervals during production. The sampling points and intervals will be designated by the Engineer. The samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this section.

In lieu of testing, the Engineer may accept certified state test results indicating that the aggregate meets specification requirements.

Samples of aggregates to check gradation shall be taken by the Engineer at least once daily. Sampling shall be in accordance with ASTM D 75, and testing shall be in accordance with ASTM C 136 and C 117.

2. The gradation (job mix) of the final mixture shall fall within the design range indicated in Table 1, when tested in accordance with ASTM C 117 and C 136. The final gradation shall be continuously well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on an adjacent sieve or vice versa.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE

Sieve Size	Design Range Percentage by Weight Passing Sieves	Job Mix Tolerances Percent
2 in (50.0 mm)	100	0
1-1/2 (37.0 mm)	95-100	+/- 5
1 in (25.0 mm)	70-95	+/- 8
3/4 in (19.0 mm)	55-85	+/- 8
No. 4 (4.75 mm)	30-60	+/- 8
No. 30 (0.60 mm)	12-30	+/- 5
No. 200 (0.075 mm)	0-8	+/- 3

The job mix tolerances in Table 1 shall be applied to the job mix gradation to establish a job control grading band. The full tolerance still will apply if application of the tolerances results in a job control grading band outside the design range.

The fraction of the final mixture that passes the No. 200 sieve shall not exceed 60 percent of the fraction passing the No. 30 sieve.

- B. If used to construct the base course, Recycled Concrete Base materials shall meet the requirements of Section 815.2.03 Recycled Concrete Base, of the Georgia Department of Transportation Special Provision 815 – Graded Aggregate and all other sections referenced therein.

3.0 CONSTRUCTION METHODS

- A. The underlying surface shall be checked and accepted by the Engineer before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling, or any other cause shall be corrected at the Contractor's expense before the base course is placed thereon. Material shall not be placed on frozen surfaces.
 1. Weather Limitations. Do not construct base course when atmospheric temperature is below 35 degrees F or when rainfall or other weather conditions detrimentally affect the quality of the finished course.
- B. The aggregate shall be uniformly blended during crushing operations or mixed in a plant. The plant shall blend and mix the materials to meet the specifications and to secure the proper moisture content for compaction. Delivery, storage, placement, and rolling procedures shall not cause damage, segregation, or contamination to the blended and mixed materials.

- C. The crushed aggregate base material or crushed aggregate surface course material shall be placed on the moistened underlying surface in layers of uniform thickness with a mechanical spreader.

The maximum depth of a compacted layer shall be 8 inches. If the total depth of the compacted material is more than 8 inches, it shall be constructed in two or more layers. In multi-layer construction, the base course shall be placed in approximately equal-depth layers.

The previously constructed layer shall be cleaned of loose and foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered with the next layer.

- D. Immediately upon completion of the spreading operations, the crushed aggregate shall be compacted full depth to not less than 100 percent maximum density as determined by ASTM D 1557. The number, type, and weight of rollers shall be sufficient to compact the material to the required density.

The moisture content of the material during placing operations shall not be below, nor more than 1-1/2 percentage points above, the optimum moisture content as determined by the ASTM method specified for determining maximum density.

- E. The surface of the aggregate base course shall be finished by blading or with automated equipment especially designed for this purpose.

In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is 1/2 inch or more below grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be blended and recompact to bring it to grade. If the finished surface is above plan grade, it shall be cut back to grade and rerolled.

- F. The finished surface shall not vary more than 3/8 inch when tested with a 16-foot straightedge applied parallel with and, when practical, at right angles to the centerline. Any deviation more than this amount shall be corrected by the Contractor at the Contractor's expense.
- G. The base course or surface course shall be maintained in a condition that will meet all specification requirements until the work is accepted. Equipment used in the construction of an adjoining section may be routed over completed portions of the base course, provided no damage results and provided that the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

4.0 METHOD OF MEASUREMENT

- A. The quantity of crushed aggregate base course, composed of crushed aggregate or recycled concrete base course, to be paid for will be determined by measurement of the number of cubic yards of material constructed and accepted by the Engineer as complying with the plans and specifications.
- B. The quantity of crushed aggregate surface course to be paid for will be determined by measurement of the number of cubic yards of material constructed and accepted by the Engineer as complying with the plans and specifications.

5.0 BASIS OF PAYMENT

- A. Payment shall be made at the contract unit price per cubic yard for either crushed aggregate base course or recycled concrete base, under Item P-209-1. Crushed aggregate surface course will be paid for at the contract unit price per cubic yard under Item P-209-2. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.
- B. Payment will be made under:
 - Item P-209-1 Crushed Aggregate Base Course - Per Cubic Yard
 - Item P-209-2 Crushed Aggregate Surface Course - Per Cubic Yard

TESTING REQUIREMENTS

- ASTM C 88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- ASTM C 117 Materials Finer than 75-micron (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- ASTM C 136 Sieve Analysis of Fine and Coarse Aggregate
- ASTM D 75 Sampling Aggregates
- ASTM D 422 Particle-Size Analysis of Soils
- ASTM D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 k N-m/m³)
- ASTM D 1556 Density and Unit Weight of Soil in Place by the Sand - Cone Method
- ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft- lbf/ft³ (2,700 kN-m/m³))
- ASTM D 1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils
- ASTM D 2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- ASTM D 2419 Sand Equivalent Value of Soils and Fine Aggregate
- ASTM D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3665 Random Sampling of Construction Materials
- ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D 4791 Flat Particles, Elongated Particles, or Flat and Elongated Particles In Coarse Aggregate

END OF SECTION

SECTION P-501 PORTLAND CEMENT CONCRETE PAVEMENT

1.0 DESCRIPTION

- A. This work shall consist of pavements composed of Portland Cement Concrete, with or without reinforcements as specified, constructed on a prepared subgrade or subbase course in accordance with these specifications and shall conform to the thickness and typical cross sections shown on the plans and with lines and grades established by the Contractor.
- B. This section shall also include the replacement of damaged and/or deficient soil cement stabilized base course, and capping of underdrain trenches with low slump, low strength concrete. Mix design and placement methods shall be in general accordance with the requirements of this section.

2.0 MATERIALS

All aggregates shall be sourced from producers on the most recent Georgia Department of Transportation Office of Materials and Research Qualified Products List. Gradation will be performed at the frequency of one per day for each material for each day of the stockpiling or production.

All aggregates, including sand and stone, for use in concrete shall be tested for alkali-aggregate reaction in accordance with either ASTM C1260 or ASTM C1293. Expansions less than 0.08% at 14 days in the caustic soak solution in ASTM C1260 or less than 0.04% at one year in ASTM C1293 shall indicate that the aggregate is considered non-deleteriously reactive. Aggregates at or above these limits shall be considered potentially deleteriously reactive.

Use of aggregates at or above these limits (i.e., aggregates that are potentially deleteriously reactive) shall require testing of the proposed concrete mix design to demonstrate control of deleterious expansion from ASR. The tests to demonstrate control of the mix shall be either a modified version of ASTM C1260 or ASTM C1293. The modification is that any mineral admixtures in the mix design shall be included in the cementitious portion of the batch of materials to be tested, and at the same weight percentages as designed for use in the concrete mixture being evaluated. Expansions less than 0.08% at 28 days in the caustic soak solution in the modified ASTM C1260 or less than 0.04% at two years in the modified ASTM C1293 shall be indicative of control of deleterious expansions from ASR (Alkali-Silica Reaction).

Aggregates shall also be tested for alkali-carbonate reaction in accordance with the criteria stated in ASTM C33. Aggregates shown to be alkali-carbonate reactive shall not be used.

- A. Fine Aggregate. Fine aggregate for concrete shall be natural sand and shall conform to the requirements of ASTM C33 and AASHTO M-6 and shall meet the gradation requirements of Table I.

TABLE I

Gradation For Fine Aggregate

Sieve Designation (Square Openings)	Percentage by Weight Passing Sieve
3/8 Inch	100
No. 4	95-100
No. 16	45-80
No. 30	25-55
No. 50	10-30
No. 100	2-10

- B. Coarse Aggregate. Coarse aggregate for concrete shall conform to the requirements of ASTM C33 and AASHTO M80. Coarse aggregate shall be furnished in the two separate sizes as shown in Table II. The coarse aggregate shall show no more than 47% wear when tested in accordance with ASTM C131 and/or ASTM C535.

TABLE II

Gradations From 1-1/2 Inch to No. 4

Sieve Designation (Square Openings)	Percentage by Weight Passing Sieves (AASHTO T-27)						
	2"	1-1/2"	1"	3/4"	3/8"	No. 4	No. 8
1-1/2" to 3/4"	100	90-100	20-55	0-15	0-5	-	-
3/4" to No. 4	-	-	100	90-100	10-55	0-10	0-5

- C. Cement. The cement used shall be Portland cement conforming to one of the following specifications:

Portland Cement ASTM C150, Type I or Type II

Cement supplied for use in concrete shall be of the low alkali type, the total alkali content to be less than 0.40%.

If for any reason cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

A minimum of five and one-half (5½) bags of Portland cement, at 94#/bag, per cubic yard of concrete shall be used in the mix.

- D. Pre-molded Joint Filler. Pre-molded joint filler for expansion joints shall conform to the requirements of AASHTO M 213 and shall be punched to admit the dowels were called for on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Engineer. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Engineer.
- E. Joint Sealer. The joint sealer for the joints in the concrete pavement shall be as specified in

Section P-605 Joint Sealing Filler.

- F. Dowel and Tie Bars. Dowel and tie bars shall conform to the requirements of AASHTO M 31 or AASHTO M 42, except that rail steel shall not be used for tie bars that are to be bent or re-straightened during construction. Tie bars shall be deformed bars. Dowel bars shall be plain round bars of the size specified and shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the construction site, one-half of the length of each dowel bar shall be painted with one coat of paint.
- G. Water. Water used in mixing or curing shall be as clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product as possible. Water will be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without testing. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials.
- H. Cover Materials For Curing. Curing materials shall be liquid membrane-forming compounds for curing concrete and shall conform to ASTM C 309, Type 2, Class B. Apply at the rate of no more than 125 square feet per 1 gallon.
- I. Admixtures. The use of any material added to the concrete mix shall be approved by the Engineer. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below for the admixtures for which approvals are desired. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests will be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

Pozzolanic admixtures shall be fly ash meeting the requirements of ASTM C-350 or raw or calcined natural pozzolans meeting the requirements of ASTM C-402.

Air-entraining admixtures shall meet the requirements of AASHTO M 154 or ASTM C-260. Concrete to be tested for approval shall be made with the cement and aggregate to be used in the work and shall contain an air content of 4% to 6% by volume of the concrete mixture, as determined by ASTM C-231.

Water-reducing, set-controlling mixture shall meet the requirements of ASTM C-494, Type A, water-reducing or Type D, water-reducing and retarding and shall be added to all mixes. Type A shall be added when temperatures are below 65°F., and Type D when temperatures are above 65°F. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions. The water-reducing, set-controlling and retarding admixtures shall not contain calcium chloride or chloride containing compounds as a functional ingredient.

- J. Fly Ash. Fly ash shall be used as an additive in concrete to promote workability and plasticity. Fly ash shall be used as a partial replacement for portland cement in concrete in accordance with the following:
 - 1. The quantity of fly ash in the mix shall be 25% of the weight of total cementitious material (i.e., Portland cement plus fly ash).
 - 2. The fly ash shall conform to ASTM C-618, Type F, except that the loss on ignition shall not exceed 3%. The fly ash should have a maximum of 1.5% available alkali and a maximum 6% CaO.

3. Separate facilities must be provided for the fly ash such that it will be stored in the same fashion as cement and batched and weighed to the same degree of accuracy as required for cement. The same scales may be used for weighing both cement and fly ash provided they are handled as a separate operation.
 4. The Contractor shall assume full responsibility for obtaining concrete having the minimum strength requirements set forth in the specifications.
- K. Steel Reinforcement. Deformed welded wire fabric conforming to the requirements of AASHTO M-55 or M-221 shall be used where specified on the plans.

3.0 CONSTRUCTION METHODS

- A. Equipment. Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the job site sufficiently before the start of construction operation for examination and approval.
1. Batching Plant and Equipment.
 - a. General. The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If bulk cement is used, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation.
 - b. Bins and Hoppers. Bins with adequate separate compartments for fine aggregate and for each required size of coarse aggregate shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that, as the quantity desired in the weighing hopper is approached, the material may be added slowly and shut off with precision. A port or other opening for removing an overload of any one of the several materials from the hopper shall be provided. Weighing hoppers shall be constructed to eliminate accumulations of tare materials and to discharge fully.
 - c. An automatic recording device capable of recording all of the individual ingredients of the mix shall be installed at the point of manufacture of the concrete.
 - d. Scales. The scales for weighing aggregates and cement shall be of either the or the spring less dial type. They shall be accurate within 0.5% throughout their range of use. When beam-type scales are used, provision, such as "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached.

A device on the weighing beams shall clearly indicate critical position. Poises shall be designed to be locked in any position and to prevent unauthorized change. The weight beam and "tell-tale" device shall be in full view of the operator while charging the hopper, and they shall have convenient access to all controls.

Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten 50-pound weights for frequent testing of all scales.

2. Mixers

- a. General. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

A device, accurate within 3% and satisfactory to the Engineer, shall be provided at the mixer for determining the amount of air-entraining agent that is added to each batch requiring such admixture.

Mixers shall be examined daily for the accumulation of hard concrete or mortar and the wear of blades.

- b. Mixers at construction sites. Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing that each batch is mixed 90 seconds. The mixers shall be cleaned at suitable intervals. The pickup and throwover blades in the drum(s) shall be repaired or replaced when they are worn down 3/4 inch or more. The Contractor shall have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or provide permanent marks on blades to show points of 3/4 inch wear from new conditions. Drilled holes of 1/4 inch diameter near each end and at the midpoint of each blade are recommended.
- c. Central plant mixers. Mixers for central plant mixing (plant mixer, revolving drum type mixer, single opening revolving truncated drum mixer, and a revolving drum charging at one end and discharging at the other end) shall have attached thereto, in a prominent place by the manufacturer, a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the normal capacity (in cubic feet) of the drum or container in terms of the volume of mixed concrete, and the speed of rotation of the mixing drum or blades. Central plant mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed. The water system for a central mixer shall be either a calibrated measuring tank or a meter and shall not necessarily be an integral part of the mixer.

The mixers shall be cleaned at suitable intervals. They shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or to wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch or more. The Contractor shall provide the Engineer with a copy of the manufacturer's design showing dimensions and arrangement of blades in reference to original height and depth.

- d. Truck Mixers and Truck Agitators. Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central mixed concrete, shall conform to the requirements of AASHTO M 157.

- e. Non-agitator Trucks. Non-agitating hauling equipment shall conform to the requirements of AASHTO M 157.
3. Finishing Equipment.
- a. Finishing machine. The finishing machine shall be self-propelled and equipped with at least two oscillating type transverse screeds.
 - b. Vibrators. Vibrators, for full width vibration of concrete paving slabs, may be either the surface pan type or the internal type with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or they may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. The frequency of the surface vibrators shall be not less than 3,500 impulses per minute and the frequency of the internal type shall be not less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

When spud internal vibrators are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

4. Concrete Saw. When sawing of joints is elected or specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be always maintained at the site of the work during sawing operations.

The Contractor shall provide adequate artificial lighting facilities for night sawing. All this equipment shall always be on the job both before and during concrete placement. Immediately after the initial sawing, the Contractor shall flush out the slurry in the joint with water and install a backer rod slightly larger in diameter than the width of the saw cut, at the bottom of the saw cut. The length of the backer rod shall be extended approximately 6" beyond the slab edge for future overlap of the adjacent slab.

5. Forms. Straight side forms shall be made of metal having a thickness of not less than 7/32" and shall be furnished in sections of not less than 10 feet in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to the depth of the forms. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than two-thirds the height of the form. Forms with battered top surfaces, and bent, twisted, or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting.

- B. Form Setting. Forms shall be set sufficiently in advance of the concrete placement. After the forms have been set to correct grade, the grade shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than 3 pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch at any point.

Excessive settlement or springing of forms under the finishing machine will not be tolerated. Forms shall be cleaned and oiled prior to the placing of concrete.

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

- C. Conditioning of Underlying Course. Ruts or depressions caused by hauling or usage of other equipment shall be filled, as they develop, with suitable material to the satisfaction of the Engineer. A multiple-pin template weighing not less than 1,000 pounds (per 20-foot machine) or other approved template shall be provided and operated on the forms immediately in advance of the placing of the concrete. If the mixer is operated upon the grade, the template shall be operated between the mixer and the spreader; in any case, it shall be propelled only by hand and plates shall be adjustable so that they may be set and maintained at the correct contour of the underlying course. The adjustment and operation of the template shall be such as will provide an accurate retest of the grade before placing the concrete thereon. All excess material shall be removed. If the grade is found to be below the true elevation, the depressions shall be filled with approved material and thoroughly compacted to the proper cross section by rolling or tamping with a hand tamp.
1. The template shall be maintained in accurate adjustment, always by the Contractor, and should be checked daily.
 2. The work described under the foregoing paragraphs does not contemplate a regular sub-grading operation, but rather a final accurate check of the underlying course.
- D. Handling, Measuring and Batching Materials. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be built up in layers of not more than 3 feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to "cone" down over the next lower layer. Aggregates from different sources and of different gradings shall not be stockpiled together.
1. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner to secure the specified grading of the material. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or nonuniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the Engineer.
 2. The fine aggregate and each size of coarse aggregate shall be separately weighed into hoppers in the respective amounts set by the job mix. Cement shall be measured by the sack or by weight. Separate scales and hoppers, with a device to indicate positively the complete discharge of the batch of cement into the batch box or container, shall be used for weighing the cement. Ninety-four pounds of bulk cement shall be considered one sack. Batches involving fractional sacks shall not be allowed, except when bulk cement is used.
 3. When mixing is at the site of the work, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or while being dumped. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper or transporting container or into the

batch itself for transportation to the mixer, such as a chute, boot, or other approved device, to prevent loss of cement. The device shall be arranged to provide positive assurance of the actual presence in each batch of the entire cement content specified.

4. Bulk cement shall be transported to the mixer in tight compartments capable of carrying the full amount of cement required for the batch, or if permitted, between the fine and coarse aggregate. When cement is placed in contact with the aggregates, batches may be rejected unless mixed 1-1/2 hours of such contact. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of sacks required by the job mix.
5. Batches shall be delivered to the mixer separately and intact. Each batch shall be dumped into the mixer without loss of cement, and when more than one batch is carried on the truck, it shall be dumped without spilling of material from one batch compartment into another. Batching shall be conducted so that the results in the weights of each material required will be within a tolerance of 1% for cement and 2% for aggregates.
6. Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within $\pm 1\%$ of required amounts. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide checking of the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

Methods and equipment for adding air-entraining agent or other admixtures to the batch, when required, shall be approved by the Engineer. All admixtures shall be measured into the mixer with an accuracy of $\pm 3\%$.

E. Proportions.

1. At least thirty (30) days prior to the start of concrete paving operations and after approval of all material to be used in the concrete, the Contractor shall submit the proportions of the material to produce the specified flexural strength of 650 psi at 28 days and 735 psi at 90 days. During the mix design process, additional beams shall be made to determine the strength at 24 hours, 36 hours and 48 hours. The Contractor shall submit for approval the job mix formula, at his expense, to the Engineer at least thirty (30) days prior to construction. The proportioning shall be approved in writing by the Engineer to the Contractor. Should a change in sources of materials be made, or if different sources of materials are to be used, proportions for these materials shall also be approved in writing by the Engineer before said materials are incorporated into the mix. The approved mix shall be a workable concrete designed for a two and a half (2-1/2) inches slump, with two (2) inches as the minimum and three (3) inches as the maximum allowable in any specimen and an air content of 4% to 6%.
2. The mix design for the low slump, low strength concrete shall follow the general requirements of this section. The concrete shall be designed for a 1" to 2" slump, 5% to 7% air content and a 7-day compressive strength of 2000 psi. The low slump concrete shall also be used for capping the underdrain trenches, duct banks, and conduit trenches in the base materials.

The mix design procedure shall include testing for gradation, specific gravity, fineness modulus, dry rodded unit weight, abrasion, compressive and tensile strengths of cement, slump, air, yield, strength, time of set, shrinkage, and statistical analysis. Sufficient beams shall be cast during the mix design process to adequately determine the strengths at 3 days,

7 days, 14 days, 28 days, and 90 days to ensure compliance with the requirements of the contract documents.

During construction, the Contractor shall make at least seven (7) beams for each 200 cubic yards, or fraction thereof, placed. Each individual three (3), seven (7) twenty-eight (28) day flexural strength test, consisting of the average of two (2) beam breaks, shall represent that amount of concrete each side of the test location midway to the adjacent test locations or to end of lane, whichever is applicable. The quantity of concrete represented by each test shall be as near as practical to the specified frequency. Beams shall be tested at three (3) and seven (7) twenty-eight (28) and ninety (90) days. The flexural strength average of any four (4) consecutive strength tests, tested at the end of twenty-eight (28) days, shall have an average flexural strength equal to or greater than the specified flexural strength. When an individual 28-day test falls below 650 psi, the Contractor will be required to core the test location and have tests conducted in accordance to ASTM C496, at no additional cost to the City. The Contractor shall be responsible for establishing the relationship between flexural strength and the splitting tensile strength to the satisfaction of the Engineer. When the test specimens fail to conform to the requirements for strength, the Engineer shall have the right to order changes in the concrete sufficient to increase the strength to meet these requirements.

In order to monitor quality control the Contractor shall make test beams and the Contractor shall provide the concrete and adequate facilities for sampling, making, (including the beam molds), storing, curing, and breaking the beams in accordance with the ASTM specifications, at facilities set up by the Contractor at the worksite. Complete records shall be maintained on a daily basis, showing the location, age, test results, standard deviation, consecutive four (4) average, remarks and other data necessary to monitor quality control.

Should any portion of the concrete pavement fail to meet the requirement of the average four (4) consecutive twenty-eight (28) day flexural strength tests, the following shall apply:

a. Twenty-eight (28) day strengths shall be adjusted for any variation from design strengths in proportion to the square of the thickness as follows:

b.
$$fs_{\text{adjusted}} = \frac{t_{\text{actual}}^2}{t_{\text{design}}^2} \times fs_{\text{actual}}$$

Where: t_{actual} = actual pavement thickness

t_{design} = design thickness

fs_{actual} = actual 28-day flexural strength

fs_{adjusted} = adjusted 28-day flexural strength

c. If the concrete pavements fail to meet the strength tests after adjustment for thickness, the unit price shall be adjusted for that quantity of concrete as defined by the 200 cubic yards, or 500 cubic yards represented by the beam specimens.

TABLE III

<u>Adjusted Deficiency in Flexure Strength-PSI</u>		<u>Proportional Part of Contract Price Allowed</u>	
4.0	650 psi and above	5.0	100%
6.0	649 psi to 645 psi	7.0	90%
8.0	644 psi to 640 psi	9.0	80%
10.0	639 psi to 635 psi	11.0	70%
12.0	634 psi to 630 psi	13.0	60%
14.0	629 psi to 625 psi	15.0	50%

Any adjusted deficiency below 625 psi shall be removed or, if approved by the Engineer, may be left in place without payment.

- F. Mixing Concrete. The concrete may be mixed at the work site in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are emptied into the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of AASHTO M-157.
1. When mixed at work site or in a central mixing plant, the mixing time shall be not less than 50 seconds nor more than 90 seconds. Four seconds shall be added to the specified mixing time if timing starts the instant the skip reaches its maximum raised position. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.
 2. The mixer shall be operated at the drum speed as shown on the manufacturer's nameplate on the approved mixer. Any concrete mixed less than the specified time shall be discarded by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the standard rating plate on the mixer, except that an overload up to 10% above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.
 3. The batch shall be charged into the drum so that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform, and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.
 4. Mixed concrete from the central-mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks having special bodies. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the work site shall not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 60 minutes when the concrete is hauled in truck mixers or truck agitators.
 5. Retempering concrete by adding water will not be permitted. Concrete that is not within the specified slump limits at the time of placement shall not be used. Admixtures for increasing the workability or for accelerating the set will be permitted only when specifically specified for in the contract.
- G. Limitations of Mixing. No concrete shall be mixed, placed or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.
1. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat

reaches 40°F., and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

2. When concreting is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50°F., and not more than 80°F., at the time of placement in the forms.
3. If the air temperature is 35°F., or less at the time of placing concrete, the Engineer may require the water and/or the aggregates to be heated to not less than 70°F., nor more than 150°F. Concrete shall not be placed on frozen subgrade nor shall frozen aggregates be used in the concrete.
4. Sufficient cold weather protection shall be provided to cover and protect the freshly placed concrete for a period of a minimum of five (5) days.
5. Placement of concrete during hot weather shall be controlled by various means to maintain the concrete temperature at the time of placement in the forms to 85°F.

The temperature of the various materials and the final concrete may require the use of several simultaneous cooling methods including covering the aggregate stockpiles, sprinkling the aggregates, chilled water, substituting crushed ice for a portion of the mixing water, and/or any other method to maintain the temperature of the concrete at the time of placement to a maximum of 85° F.

H. Placing Concrete. The concrete shall be deposited on the thoroughly moistened grade in such a manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such a manner as to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

1. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than 15 seconds in any one location.
2. Concrete shall be deposited as near to expansion and contraction joints as possible, without disturbing them but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.
3. When concrete is placed on low-slump low-strength concrete subbase, a bond breaker, approved by the Engineer, shall be used.
4. Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by approved methods.

- I. Strike-Off of Concrete and Placement of Reinforcement. Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement, or it may be placed in plastic concrete by mechanical or vibratory means after spreading.
 1. Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond.
 2. Reinforcing steel with rust, mill scale, or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable AASHTO specification requirement.
 3. The Contractor shall, at his option, either place pavement reinforcing manually in the plane shown on the plans and then place the final lift or they may set the reinforcing into place using mechanical equipment to be approved by the Engineer prior to its use, after the placement of the concrete.
 4. Mechanical equipment to place the pavement reinforcing after the placement of concrete shall be capable of positioning the pavement reinforcing at the required depth in the wet concrete without damaging the edges and finished surface of the concrete pavement. The Contractor shall use a finishing machine, equipped with side forms, to correct and refinish the surface of the concrete pavement to provide a smooth riding surface in accordance with the requirements of the specifications.

- J. Joints.
 1. General. Longitudinal and transverse joints shall be constructed as indicated on the plans and in accordance with these requirements. All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement. Joints shall not vary more than 1/4 inch from true line or from their designated position. The vertical surface of the pavements adjacent to all expansion joints shall be finished to a true plane and edged to a radius of 1/4 inch, or as shown on the plans. The surface across the joints shall be tested with a 10-foot straightedge as the joints are finished and any irregularities in excess of 1/8 inch shall be corrected before the concrete has hardened. Transverse joints shall be at right angles to the centerline of the pavement and shall extend the full width of the slab. The transverse joints in succeeding lanes shall be placed in the line with similar joints in the first lane. In the case of widening existing pavements, transverse joints shall be placed in line with similar joints in the existing pavement. All transverse contraction joints shall be saw cut to the depths and widths shown in the plans.
 - a. Deformed Dowel Bars. Deformed dowel bars of the dimensions and spacings as shown on the plans shall be installed principally in longitudinal construction joints as shown on the plans. The dowel bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals of 12 inches, unless otherwise specified. They shall be held in position parallel to the pavement surface and midway between the

surfaces of the slab.

When deformed dowel bars extend into an unpaved lane, they shall be drilled and epoxy grouted into the poured lane as hereinafter specified, unless threaded bolt or other assembled deformed dowel bars are specified. These bars shall not be painted, greased, or enclosed in sleeves.

- b. Smooth Dowel Bars. Smooth dowel bars or other load-transfer units of an approved type shall be placed across transverse, longitudinal, or other joints in the manner as specified on the plans. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by an approved assembly device to be left permanently in place. When the dowels for longitudinal construction joints extend into an unpaved lane, they shall be drilled and epoxy grouted into the poured lane as hereinafter specified. The dowel or load-transfer and joint devices shall be rigid enough to permit complete assembly as a unit ready to be lifted and placed into position. The portion of each dowel painted with rust preventative paint, as required under Paragraph 02(f) hereinbefore, shall be thoroughly coated with Asphalt MC-70, or an approved lubricant, to prevent the concrete from binding to that portion of the dowel. In lieu of using dowel assemblies at contraction joints, dowel bars may be placed in the full thickness of pavement by a mechanical device approved by the Engineers.
2. Installation. If the paving mixer is operated from an adjacent lane, any joint materials required shall be set immediately after the final testing of the grade. If the paving mixer is operated from the lane being poured, the materials shall be set immediately after the mixer moves forward to permit as much time as possible for proper installation. All joint materials required shall be put in place on the completed and accepted grade. The materials and joint position shall be either at right angles or parallel to the centerline of the pavement, except for fillets or irregular sections. The top of an assembled joint device shall be set at the proper distance below the pavement surface and the elevation shall be checked. Such devices shall be set to the required position and line and shall be securely held in place by stakes or other means during the pouring and finishing of the concrete. The pre-molded joint material shall be placed and held in a vertical position; if constructed in sections there shall be no offsets between adjacent units. Dowel bars shall be checked for exact position and alignment as soon as the joint device is staked in place, and the device shall be tested to determine whether it is firmly supported. Any joint installation not firmly and securely supported shall be reset.
 - a. When joints in concrete pavements are sawed, the joints shall be cut at the time and in the manner approved by the Engineer. The equipment used shall be as described in paragraph 03(a) 4).
 - b. The circular cutter shall be capable of cutting a groove in a straight line; the circular cutter shall produce a slot at least 1/8 inch wide. When shown on the plans or required by the specifications, the top portion of the slot or groove shall be widened by means of a second shallower cut or by suitable and approved beveling to provide adequate space joint sealers. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing. Sawing shall be carried on both during the day and night as required. The joints shall be sawed at the required spacing consecutively in sequence of the concrete placement, unless otherwise approved by the Engineer.
3. Longitudinal Joints.
 - a. Construction. Longitudinal construction joints necessary for lane construction shall be formed against suitable forms made of steel. Wooden forms may be used under special

conditions, when approved by the Engineer. The construction joints shall be a butt-type joint with smooth dowel bars or deformed tie-bars, as indicated on the plans. The dowels for this type of joint shall be painted and greased. The edges of the joint shall be finished with a grooving tool or edging tool and a space or slot shall be formed along the joint of the dimensions, as indicated, to receive the joint sealing material. Provisions shall be made for the installation of tie bars as noted on the plans.

- b. Contraction or Weakened-plane Type. The longitudinal groove formed or sawed in the top of the slab shall be installed where indicated on the drawings. The groove shall be formed in the plastic concrete with suitable tools or material to obtain the width and depth specified, or it shall be sawed with approved equipment in the hardened concrete to the dimensions required. When the groove is formed in plastic concrete, it shall be true to line with not more than 1/4-inch variation in 10 feet; it shall be uniform in width and depth; and the sides of the groove shall be finished evenly and smoothly with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The sawed groove shall be straight and of uniform width and depth. In either case, the groove shall be clean cut so that spalling will be avoided at intersections with transverse joints. Tie bars shall be installed across those joints, as shown on the plans.
- c. Expansion. Longitudinal expansion joints shall be installed where designated on the plans. These shall be of a butt type without load-transfer devices and shall include a pre-molded expansion material. The thickness of the concrete at these joints shall be increased by at least 25% of the normal pavement thickness to the nearest inch but not less than 2 inches. This increase shall slope to normal thickness in not less than 10 feet from the joint unless otherwise indicated on the plans or to the nearest joint such as a groove joint. The pre-molded filler, of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. The filler shall be securely staked or fastened into position perpendicular to the proposed finished surface.

A metal or wooden cap shall be provided to protect the top edge of the filler and to permit the concrete to be placed and finished. After the concrete has been placed and struck off, the cap shall be carefully withdrawn leaving the space over the pre-molded filler. The edges of the joint shall be finished and tooled while the concrete is still plastic. The width of the joint shall be corrected for temperature, nominal width shown on the plans to be at 68°F.

4. Transverse Joints.

- a. Expansion. Transverse expansion joints shall be installed at the locations and spacing as shown on the plans. The joints shall be installed at right angles to the centerline and perpendicular to the surface of the pavement. The joints shall be so installed and finished to insure complete separation of the slabs.

Expansion joints shall be of a pre-molded type conforming to these specifications and with the plans and shall be the full width of the pavement strip.

All concrete shall be cleaned from the top of the joint material. Before the pavement is opened to traffic this space shall be swept clean and filled with approved joint sealing material.

The filler shall be placed on the side of the installing plate nearest the mixer. The top edge of the filler shall be protected by a metal channel cap of at least 10-gauge material. The installing device may be designed with this cap self-contained.

All devices used for the installation of expansion joints shall be approved by the Engineer. They shall be easily removable without disturbing the concrete and held in proper transverse and vertical alignment. Immediately after forms are removed, any concrete bridging the joint space at the ends shall be removed for the full width and depth of the joint.

When specified, expansion joints shall be equipped with dowels of the dimensions and at the spacing and location indicated on the plans. The dowels shall be firmly supported in place and accurately aligned parallel to the subgrade and the centerline of the pavement by means of a dowel assembly which will remain in the pavement and will ensure that the dowels are not displaced during construction.

Other types of load-transfer devices may be used, when approved by the Engineer. The width of the joint shall be corrected for temperature, nominal width shown on the plans to be at 68°F.

- b. Contraction. Transverse contraction joints, weakened-plane joints, or both, shall be installed at the locations and spacing as shown on the plans. These joints will be installed by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened in the same manner as specified in paragraph 03)(j)3)ii).

Dowel bar assembly shall be installed when required, as shown on the plans.

- c. Construction. Transverse construction joints shall be installed in accordance with the details on the plans and ordinarily are only needed when it is necessary to suspend the work for more than 30 minutes. The construction joint shall be located at a planned contraction or expansion joint. The fresh concrete shall be removed back to the previously spaced regular joint.
- d. Construction of Connection Between New and Existing Pavement. The Contractor shall hand excavate, using extreme care, to the dimensions shown in the plans, adjacent to the edges of all existing pavements to prevent any damage to the existing pavement.

The connection between the new and existing pavements shall be constructed as shown on the plans.

Any damage to the existing pavement caused by the Contractor's operations shall be repaired by him, to the satisfaction of the Engineer at no cost to the Owner.

K. Final Strike-Off, Consolidation and Finishing.

- 1. Sequence. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight edging, and final surface finish. The addition of superficial water to the surface of the concrete to assist in finishing operations generally will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.
- 2. Finishing at Joints.
 - a. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material; it shall be firmly placed without voids or segregation under and around all load-transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in paragraph 03)(h).

- b. After the concrete has been placed and vibrated adjacent to the joints as required in paragraph 03(h), the finishing machine shall be operated in a manner to avoid damage or misalignment of joints. If uninterrupted operations of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed from the front of and off the joint; the front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine shall be resumed.

When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

3. Machine Finishing.

- a. A belt finish or burlap drag will be acceptable on the taxiway and roadway pavements. The final elevations of all pavements shall not vary more than one fourth (1/4) inch from the finished grade elevations.
- b. Vibratory Method. When vibration is specified, vibrators for full-width vibration of concrete paving slabs shall meet the requirement specified in paragraph 03)(a)3) ii). If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and methods which will produce pavement conforming to the specifications.

When in operation, the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, always moving in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking-off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

4. Hand Finishing. Unless otherwise specified, hand finishing methods will not be permitted, except under the following conditions:

- a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade.
- b. Narrow widths or areas or irregular dimensions where operation of the mechanical equipment is impractical may be finished by hand methods.
- c. Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete when reinforcement is used.
- d. The screed for the surface shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal or of other suitable material, shod with metal.
- e. Consolidation shall be attained using a suitable vibrator or other approved equipment.

5. Floating. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, using one of the following methods, as specified or permitted:
 - a. Hand Method. The hand-operated longitudinal float shall be not less than 12 feet in length and 6 inches in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion, while held in a floating position parallel to the road centerline and passing gradually from one side of the pavement to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the side forms on each pass.
 - b. Mechanical Method. The mechanical longitudinal float shall be approved by the Engineer, and it shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the Engineer on each transverse trip. The float shall pass over each pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.
 - c. Alternative Mechanical Method. As an alternative to paragraph 03(k)5)ii., Contractor may use a machine composed of a cutting and smoothing float(s) suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with, the side forms.

If necessary, following one of the preceding methods of floating, long handled floats having blades not less than 5 feet in length and 6 inches in width may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike-off and consolidation are done by hand, and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped one-half the length of the blade.

6. Straight-Edge Testing and Surface Correction. After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 16-foot straightedge. For this purpose, the Contractor shall furnish and use an accurate 16-foot straightedge swung from handles 3 feet longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one half the length of the straightedge. Any depressions shall be immediately filled with freshly mixed concrete, struck-off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface correction shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross section.

7. Final Finish. Taxiways, roadways and other pavements may be finished with either a belt finish, or a burlap drag finish.
 - a. Belt Finish. If the surface texture is to be a belt finish, when straight edging is completed and water sheen has practically disappeared and just before the concrete becomes non-plastic, the surface shall be belted with a 2-ply canvas belt not less than 8 inches wide and at least 3 feet longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the centerline and with a rapid advance parallel to the centerline.
 - b. Drag Finish. If the surface texture is to be a drag finish, a drag shall be used; it shall consist of a seamless strip of damp burlap and it shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap at least 3 feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than two layers of burlap with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such a condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags substituted.

8. Edging at Forms and Joints. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to the radius required by the plans. A well-defined and continuous radius shall be produced and a smooth, dense, mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the edge shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straightedge before the concrete has set, and correction shall be made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

- L. Surface Test. The Contractor shall also have a 16' rolling straightedge on the work to check the completed pavement. Surface deviations more than 1/4 inch in 16 feet in any direction will require correction by planning. Deviations exceeding 1/2" shall be cause for removal and replacement.

Any area or section so removed shall not be less than 10 feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced.

- M. Curing. Immediately after the finishing operations have been completed and marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with one of the following methods. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour between stages of curing or during the curing period.

1. Impervious Membrane Method. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall.

Curing compound shall be applied by mechanical sprayers under pressure at the rate of 1 gallon to not more than 125 square feet. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by effective mechanical means. Hand spraying of off widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed.

The curing shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface.

2. Curing in Cold Weather. When the average daily temperature is below 40°F., curing shall consist of covering the newly laid pavement with a protective curing authorized by the Engineer, which shall be retained in place as determined by the Engineer. Admixture for curing or temperature control may be used only when authorized by the Engineer.

When concrete is being placed and the air temperature may be expected to drop below 30°F., a sufficient supply of suitable blanketing material shall be provided along the work. Any time the temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to prevent freezing of the concrete. The period such protection shall be maintained shall be determined by the Engineer. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

- N. Removing Forms. Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except where auxiliary forms are used temporarily in widened areas. Forms shall be removed carefully to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated in paragraph (m) above. Major honeycombed areas shall be considered as defective work and shall be removed and replaced. Any area or section so removed shall be not less than 10 feet in length, nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced.
- O. Sealing Joints. The joints in the pavement shall be sealed in accordance with Section P-605 of these specifications.
- P. Protection of Pavement. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc.

The plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

- Q. Loading on new concrete. The pavement shall attain a strength of 450 psi for dowel drilling equipment on the new concrete, 500 psi for paving equipment on the new pavement and 650 psi for opening to air traffic. The strength shall be determined based on the actual strength adjusted for the ratio of the design thickness compared to the actual thickness based on the pavement design.
- R. Opening to Traffic. The Engineer shall decide when the pavement shall be opened to traffic, based on flexural strength testing. The pavement shall not be opened to traffic for at least 3 days after the concrete has been placed. Prior to opening, the pavement shall be cleaned.
- S. Surface Tolerances. Extreme care must be exercised in all phases of the operation to assure that the pavement will pass the specified tolerances. The following tolerances are applicable:
 - 1. Lateral deviation from established alignment of the pavement edge shall not exceed plus or minus 0.10 foot in any lane.
 - 2. Vertical deviation from established grade shall not exceed plus or minus 0.04 foot at any point.
 - 3. Surface smoothness deviations shall not exceed 1/4" from a 16-foot straightedge placed in any direction, including placement along and spanning any pavement joint or edge, and in addition shall not exceed the requirements as stated in 03)(L).
 - 4. To stay within the above tolerances, the Contractor must control the tolerances on all phases of construction preceding the placement of pavement and is cautioned that additive deviations may result in the removal and replacement of out of tolerance construction and/or price adjustments for deficient construction in accordance with the specifications as stated herein.
- T. Tolerance of Pavement Thickness. The thickness of the pavement shall be determined by average caliper measurement of cores taken and tested in accordance with AASHTO T-148 and by edge measurements taken prior to placement of adjacent lanes. Cores shall be taken by the Contractor at the frequency of one per 250 feet per lane per section to verify pavement thickness and concrete consolidation. The Contractor shall patch the core holes in a manner approved by the Engineer.

Should any portion of the concrete pavement fail to meet the requirements of the thickness, the following shall apply:

- 1. The twenty-eight (28) day strengths for the area of thickness deficiency shall be adjusted in proportion to the square of the thickness.

$$f_{s\text{adjusted}} = \frac{t^2_{\text{actual}}}{t^2_{\text{design}}} \times f_{s\text{actual}}$$

Where: t_{actual} = actual pavement thickness
 t_{design} = pavement design thickness shown on plans
 $f_{s\text{actual}}$ = actual 28-day flexural strength
 $f_{s\text{adjusted}}$ = adjusted 28-day flexural strength

- 2. If $f_{s\text{adjusted}}$ is less than 650 psi, the unit price shall be adjusted in accordance with Table III in Article 03(e), Item ii.

4.0 METHOD OF MEASUREMENT

- A. The yardage to be paid for shall be the total area of each depth of pavement, measured in square yards, in-place, completed and accepted less any deductions hereinbefore required for deficient strength or thickness. Thickened slabs will be measured separately.
- B. The quantity of low-slump low-strength concrete, to be paid for shall be the total volume measured in cubic yards, in-place, completed and accepted less any deductions hereinbefore required for deficient strength or thickness. Measurements will be made at all locations where the low-slump, low-strength concrete is used to cap underdrain and utility trenches in existing stabilized base course and shoulders, as a new base course for pavement widening and base course reconstruction, and for any replacement of untreated subgrade soil. Measurement will not be made for the use of the low-slump low-strength concrete used by the contractor to repair damage to existing base course and subgrade.

5.0 BASIS OF PAYMENT

- A. General. The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard, after any adjustments required for deficient strength or thickness, which price and payment shall be full compensation for all mix designs, for furnishing and placing all materials, including any dowels and steel reinforcement.
- B. No additional payment over the unit contract bid price shall be made for any pavement which has an average thickness in excess of that shown on the plans or for strengths in excess of that specified.

Adjustments in the payment will be made for smoothness, in accordance with sections 03)(I) and ii).

- C. Payment for low-slump, low-strength concrete for base or base replacement shall be paid at the contract unit price per cubic yard which price and payment shall be full compensation for mix design, for furnishing and placing all materials and incidentals.
- D. Payment for low-slump, low-strength concrete placed in underdrain or duct banks shall be included in the unit price bid for those items.

Payment will be made under:

Item P-501-1	Non- Reinforced Portland Cement Concrete Airfield Pavement, 16" Thick - Per Square Yard.
Item P-501-2	Reinforced Portland Cement Concrete Airfield Pavement, 16" Thick - Per Square Yard.
Item P-501-3	Non-Reinforced Thickened Edge Portland Cement Concrete Airfield Pavement, 16" – 20" Thick – Per Square Yard
Item P-501-4	Reinforced Thickened Edge Portland Cement Concrete Airfield Pavement, 16" – 20" Thick – Per Square Yard
Item P-501-5	Low-Slump Low-Strength Concrete – Per Cubic Yard

TESTING AND MATERIAL REQUIREMENTS

<u>Test and short title</u>	<u>Material and short title</u>
AASHTO T-26 -- Water	AASHTO M 6 -- Fine Aggregate
AASHTO T-23 -- Test Specimens	AASHTO M 80 -- Coarse Aggregate
AASHTO T-97 -- Flexural Strength	AASHTO M 85 -- Portland Cement Concrete
AASHTO T-119 -- Slump	AASHTO M 154 -- Air-entrained PC
AASHTO T-152 -- Air (Aggregate)	AASHTO M 151 -- Slag PC
AASHTO T-121 -- Yield	ASHTO M 90 -- Joint Filler
AASHTO T-84 and T-85 Absorption and Specific Gravity	AASHTO M 153 -- Joint Filler
AASHTO T-148 -- Cores	AASHTO M 213 -- Joint Filler
ASTM T-173 -- Air (Slag)	AASHTO M 55 -- Wire
ASTM C1260 -- ASR	AASHTO M 137 -- Bars
ASTM C1293 -- ASR	AASHTO M 54 -- Bars
ASTM C-496 Splitting Tensile Strength	AASHTO M 31 -- Bars
	AASHTO M 42 -- Bars
	AASHTO M 73 -- Mats
	AASHTO M 139 -- Paper
	ASHTO M 171 -- Polyethylene
	AASHTO M 182 -- Burlap
	AASHTO M 148 -- Membrane
	ASTM C 618 -- Fly Ash
	ASTM C 402 -- Pozzolans
	ASTM C 260 -- Air-entraining
	STM C 494 -- Water Reducing
	ASHTO M 157 -- Ready Mix
	Fed. Spec. TT-C-800 -- Membrane

Note: Others as required by referenced specifications.

END OF SECTION P-501

SECTION P-504- HIGH EARLY STRENGTH CEMENT CONCRETE PAVEMENT

1.0 DESCRIPTION

1. This work shall consist of pavement composed of a quick setting high early strength concrete, with or without reinforcement, constructed on re-compacted base course, after removal of the existing pavement. The work shall comply with applicable sections of the 501 Specifications referenced herein, and shall conform to the lines, grades, thickness and typical cross sections shown on the drawings.

2.0 QUALITY CONTROL

Quality Control shall be as specified in Special Conditions Section SC-15 and in Section P-501- Portland Cement Concrete Pavement, with the addition of the following:

If the concrete is produced at the paving site with a mobile batching-mixing plant, the equipment shall be capable of producing the specified concrete mix to the standards of quality and uniformity that would be required for production by a permanent or portable batch plant. Specifically, the equipment shall be capable of consistent production to the concrete uniformity requirements of Table A1.1 in ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing. Compliance with these requirements shall be demonstrated by quality control testing of the mix produced by each equipment unit proposed for use on the project. A qualified independent laboratory, at the Contractor's expense shall perform the testing. The test results and a certification by the laboratory that the equipment meets the above stated requirements shall be submitted and approved by the Engineer before the start of full pavement production will be authorized. If the equipment compliance documentation is not previously submitted and approved, the required testing shall be accomplished during the Mix Design Development and Test Section process.

3.0 MATERIALS

A. Fine Aggregate

Fine Aggregate for concrete shall conform to the requirements of ASTM C33 and shall meet the requirements of Table 1, as specified in Section P-501 - Portland Cement Concrete Pavement.

B. Coarse Aggregate

As specified in Section P-501 - Portland Cement Concrete Pavement.

C. Cement

Cement shall be one of the following:

1. Portland Cement conforming to the requirements of ASTM C150, Type I, Type II, or Type III.
2. "Rapid Set C-150 Cement" as manufactured by the CTS Cement Manufacturing Company, or an approved equal.
3. A combination of the above.

All cement of a particular type shall be the product of one manufacturer. If, for any reason, cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

The cement listed above shall be capable of producing a quick setting high early strength concrete with the following properties:

- a. Development of flexural strength in excess of 500 psi not later than 4 hours from the time water is added to the mix.
- b. The mix setting shall accommodate a placing and finishing time of 45 minutes, plus or minus 15 minutes.

If the Contractor proposes to use a cement other than Rapid-Set C-150 cement, information relating to the proposed cement shall be submitted indicating the use of the material under (5) separate contracts for the previous (5) years.

A. Admixtures

As specified in Section P-501 - Portland Cement Concrete Pavement.

B. Water

As specified in Section P-501 - Portland Cement Concrete Pavement.

C. Steel Reinforcement and Tie Bars

Steel reinforcement shall meet the requirements of Section P-501 - Portland Cement Concrete Pavement.

D. Pre-molded Joint Filler

As specified in Section P-501 - Portland Cement Concrete Pavement.

E. Joint Sealer

The sealer for joints in the concrete pavement shall meet the requirements of Section P-605 - Joint Sealing Filler.

F. Cover Material for Curing

Curing materials and methods shall conform to the recommendations of the curing material manufacturer and the cement manufacturer, and Section P-501 - Portland Cement Concrete Pavement.

4.0 MIX DESIGN

A. General

As specified in Section P-501 - Portland Cement Concrete Pavement, with the exception of the following:

1. A mix design shall be developed to allow for the construction of 12.5 to 50 x 25-foot slabs per nightly work shift specified in the phasing plans. The mix design shall meet the criteria specified in 4) Mix Design (b) Strength and Proportions.
2. Several quick setting high early strength concrete mix designs, utilizing RAPID-SET Cement as manufactured by CTS Cement Company, were developed, that met the above criteria, and were used on airfield pavement projects at Hartsfield Atlanta International Airport in 1997, 2001 and 2004. Information on the concrete mix designs used is available from the CTS Cement Company; telephone # 1-800-929-3030.

3. The previous project experience with quick setting concrete mix designs showed variability in the set time of the concrete mix and the cement material used. The Contractor shall develop a mix design and quality control program to allow adjustment in the procedures so the concrete mix that is used consistently meets the criteria specified at no cost to the Owner.

B. Strength and Proportions

As specified in Section P-501 - Portland Cement Concrete Pavement, except for the following:

1. A mix design shall be developed by the Contractor to meet the following properties:
 - a. The concrete mix shall achieve a minimum flexural strength of 500 psi within 4 hours of the time water is added to the mix and shall achieve a minimum flexural of 750 psi in 28 days.
 - b. The concrete placed each night must attain the 500-psi flexural strength each morning when the pavement is opened to traffic.
 - c. The concrete mix shall have a set time of a minimum of 30 minutes beyond the time established by the Contractor's procedure to batch, transport, and place the mix takes a set and no further surface finishing can be accomplished.

The proportions of the concrete mix shall be as developed by the Contractor to meet the specified criteria. There is no specified minimum cement content, slump, water/cement ratio or restriction on admixtures. The entrained air content shall be 4.5% plus or minus 1.0 percent.

- d. The mix shall have a minimum durability factor of 95 when tested in accordance with ASTM C666.

C. Cementitious Materials

Fly ash and silica fume may be used in the mix. Ground blast-furnace slag shall not be used.

D. Admixtures

As specified in Section P-501 - Portland Cement Concrete Pavement, with the exception of the following:

Air Entraining: The average air content shall be 4.5 percent, plus or minus 1.0 percent, and the mix shall have a durability factor of 95 or more when tested in accordance with ASTM C-666. The durability factor shall be determined by a test of the actual concrete mix to be used on the project.

E. Mix Design Development

The Contractor shall develop a mix design that meets the criteria specified in section 4) Mix Design. The process shall include the development of a minimum of three trial batches with decreasing water/cement ratios.

The batches shall use the intended raw materials to be used for the project, including cement, fine and coarse aggregates as well as chemical and mineral admixtures. The trial batch mixtures shall maintain the same fine aggregate/coarse aggregate ratios as well as the same proportions of intended admixtures, only the water/cement ratio shall be varied. The testing of the trial batches shall, at a minimum, include flexural strength, temperature development, air content and slump. Flexural beam tests and temperature development specimens shall be prepared in

accordance with ASTM C31, except that specimens shall be surrounded with insulative blankets for minimum of 5 hours following addition of water to the mix. The mix design to be submitted for use on the project shall be required only on the trial batches. Freeze-thaw durability testing shall be required only on the specific mix design intended for use on the project.

F. Flexural Strength Testing

The average of a minimum of two flexural strength test results shall be completed at 4 hours, 5 hours, 6 hours, 8 hours, 24 hours, 7 days and 28 days for each of the three trial batches. The results shall be plotted on a flexural strength versus water/cement ratio.

G. Temperature Development

The trial batches shall be monitored for development of temperature from the time the water is added to the mix until an age of 5 hours at 15 minutes intervals. The temperature of the water and other materials and the ambient temperature at the time of batching shall be recorded. The time at which the mix takes a set shall be recorded along with the corresponding temperature of the mix. The temperature shall be taken with a thermometer accurate to within 0.5 °F. The thermometer shall remain inserted in the curing sample throughout the period of testing. The temperature data shall be plotted for each trial batch, with temperature on the vertical scale and time on the horizontal. The set time of the mix shall be identified for each batch.

H. Freeze-Thaw Durability

The mix intended for use on the project shall be tested for durability in accordance with ASTM C666.

I. Mix Design Submittal

The mix design submittal shall include the following minimum information:

1. Type(s) of cement.
2. Water/cement ratio.
3. Slump.
4. Air Entrainment percentage.
5. Flexural strength test results at 4, 5, 6, 8 and 24 hours, 7 days and 28 days.
6. Results of durability test in accordance with ASTM C666.
7. Temperature development of mix and set time.
8. Plant/lab mix certification of proportion of materials.
9. Fine and coarse aggregate supplier, pit location, graduation, fineness modulus, tested wear, specific gravity, absorption capacity and moisture content.
10. Manufacturer's name, catalog information for the cement(s) and admixtures used, including ASTM certification information.
11. Certification of Testing Laboratory designing the mix.

J. Tentative Mix Design Approval

- a. When a mix design meeting all the specified criteria and documentation requirements have been met and approved by the Engineer, the mix design may be given tentative approval. Tentative approval may be granted prior to the receipt of the 28-day strength

tests, if 750-psi flexural strength has been demonstrated at an earlier test period.

K. Full Mix Design Approval

Full approval of the mix design will be granted when the following requirement has been met:

1. Acceptable results from the 28-day strength.

5.0 CONSTRUCTION METHODS

A. Equipment

As specified in Section P-501 - Portland Cement Concrete Pavement, with the following exceptions and additions:

1. Backup Equipment: For pavement removal and replacement under night working conditions, the Contractor shall provide backup units for each item of equipment that is essential to the timely completion of each night's work. The backup equipment shall be itemized and submitted for review and approval prior to the placement of any pavements.
2. If the concrete is produced at the paving site with a mobile batching-mixing plant, the equipment shall meet the requirements specified in Section 2 Quality Control. Inspection of each equipment unit for calibration and effective operation shall occur at least once during every night of production and for every 40 cubic yards of concrete produced.

B. Form Setting

The concrete shall be placed and formed in accordance with the following:

1. Against the sides of previously placed concrete slabs, or against other existing slabs or structures which will remain: Unless the slabs are separated by expansion joint material, the sides of the adjacent concrete shall be sprayed with a debonding agent, approved by the Engineer, that will prevent bonding at the face of the joint. The prevention of bonding is critical to the prevention of cracking in the newly placed concrete.

C. Conditioning of Underlying Surface, for Side-Form and Fill-In Slab Construction.

The base shall be well moistened with water, without saturating, immediately ahead of concrete placement to prevent loss of moisture from the concrete. The elevations of the finished base course shall be properly recorded at sufficient locations (grid pattern not exceeding five feet spacing) in each slab in order to establish the depth of the new concrete slab.

D. Handling, Measuring and Batching Material

As specified in Section P-501 - Portland Cement Concrete Pavement.

E. Mixing Concrete

As specified in Section P-501 - Portland Cement Concrete Pavement.

F. Limitations of Mixing and Placing

As specified in Section P-501 - Portland Cement Concrete Pavement, with the following exceptions and additions:

1. Portable Lighting Units sufficient for control and observation of the work shall be in position at the concrete placement site prior to mixing concrete each night. In addition, adequate lighting shall be provided at the batch plant to facilitate quality control and safe operations.

2. Concrete shall be mixed only in quantities, which are required for immediate use and can be placed and finished prior to final setting of the concrete.
3. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature reaches 40°F and shall not be resumed until an ascending air temperature reaches 35°F.
4. To compensate for cool temperatures and to enhance early concrete curing and strength gain, the Engineer may require the water and/or aggregates to be heated to not less than 70°F nor more than 150°F.

G. Placing Concrete

As specified in Section P-501 - Portland Cement Concrete Pavement, with the following exceptions and additions:

1. Slip forming is not an appropriate method for placement of the concrete covered by these specifications.
2. The Contractor shall use all means necessary to protect concrete materials before, during and after installation and to protect the installed work and materials of all other trades such that final conditions will be as specified. In the event of damage, immediately make all repairs and replacements necessary to the satisfaction and approval of the Engineer and at no additional cost to the Owner.
3. The concrete shall be deposited on the moistened base in a manner, which requires as little rehandling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment is equipped with means for discharge of concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread to prevent segregation of the materials. Necessary hand spreading shall be done with shovels - not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots coated with foreign substances.
4. Concrete shall be thoroughly consolidated against and along the faces of all adjacent slabs and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the base or adjacent slabs. In no case shall a vibrator be operated longer than 15 seconds in any one location, nor shall they be used to move concrete. The contractor shall demonstrate that the method of vibration he chooses to use will properly consolidate the concrete and shall not build up excessive slurry on the surface.

H. Strike-Off of Concrete and Placement of Reinforcement

As specified in Section P-501 - Portland Cement Concrete Pavement.

I. Joints

As specified in Section P-501 - Portland Cement Concrete Pavement, excluding provisions for slip-form construction, which is not applicable. Prior to placing the new concrete, the existing concrete faces shall be sprayed with an approved debonding agent to prevent bond of new concrete to the existing concrete.

J. Final Strike-Off, Consolidating and Finishing

As specified in Section P-501 - Portland Cement Concrete Pavement.

K. Surface Texture

As specified in Section P-501 - Portland Cement Concrete Pavement.

L. Surface Testing

As specified in Section P-501 - Portland Cement Concrete Pavement.

M. Curing

The initial method of curing, to begin immediately after the finishing and set of the pavement surface, shall be water curing. The entire surface shall be inundated for at least 2 hours, or until the concrete cools.

After the minimum water-curing period and before opening the pavement to traffic, an impervious curing membrane shall be applied as specified in Section P-501 - Portland Cement Concrete Pavement.

N. Sealing Joints

As specified in Section P-605 - Joint Sealing Filler.

O. Protection of Pavement

P. As specified in Section P-501 - Portland Cement Concrete Pavement.

Opening to Traffic

The Engineer shall decide when the pavement will be opened to traffic. The flexural strength of the permanent concrete required for opening the pavement to normal airport traffic (vehicles and aircraft) is 500 psi, based on testing in accordance with ASTM C78.

In addition to the above requirements, all equipment, materials and debris shall be removed and the pavement in the immediate work area shall be cleaned by the Contractor to the satisfaction of the Engineer prior to each pavement opening.

6.0 MATERIAL ACCEPTANCE

A. Acceptance Sampling and Testing

Concrete samples shall be furnished by the Contractor and shall be taken in the field to determine the consistency, air content and strength of the concrete. Flexural test beams shall be made each night that the concrete is placed. The specimens shall be made in accordance with ASTM C31. Each group of test beams shall be molded from the same batch of concrete and shall consist of a sufficient number of specimens to provide at least two flexural strength tests at each of the test ages specified below. However, at the start of paving operations and when the aggregate source, aggregate characteristics, or mix design is changed, additional groups of test beams may be required and testing of beams at various hourly ages may be required, until the Engineer is satisfied that the concrete mixture being used complies with the strength requirements of these specifications, for the actual nightly placement schedule.

1. The time scheduled for opening the pavement to normal airport traffic (aircraft and vehicles) each morning is 0800 hours. For purposes of the following discussion "batching" means the time that water is added as the final ingredient to the concrete mix. The test reports for all beams shall record the age of the concrete, from the batching to the time of testing.

2. Test ages for the nightly concrete placement shall be the following:
 - a. If concrete batching ends later than 4 hours prior to scheduled pavement opening, beams made from concrete that is placed in the last slab constructed each night shall be tested at or slightly before the scheduled time for pavement opening, to insure that the required strength has been attained. Tests made at that time shall be the OPENING TIME tests used in the computation of pay factors.
 - b. If concrete batching ends earlier than 4 hours prior to scheduled pavement opening, one set of beams shall be tested at an age of 4 hours from batching. These tests shall be continued only to the extent determined necessary by the Engineer to evaluate the performance of the specified 4-hour mix design requirement. They shall be used as the OPENING TIME tests only if the 4-hour age coincides with the scheduled opening time.
 - c. If concrete batching ends earlier than 4 hours prior to scheduled pavement opening, beams made from concrete that is placed in the last slab constructed each night shall be tested at or slightly before the scheduled time for pavement opening, to insure that the required strength has been attained. Tests made at that time shall be the OPENING TIME tests used in the computation of pay factors.
 - d. Initially, beams shall be tested at ages of 4 hours, 8 hours and 24 hours. When the consistency of the Contractor's paving operations, placement completion time and concrete strength gain has been demonstrated to the satisfaction of the Engineer, some or all of the testing at these ages may be terminated.
 - e. Beams from each night of work shall be tested at an age of 28 days, for the duration of the project. These tests shall be the 28-DAY tests used in the computation of pay factors.
3. The flexural strength of the concrete shall meet the following requirements:
 - a. For each night of placement, the average strength of the concrete tested shall not be less than 500 psi at the time the pavement is scheduled for opening to normal airport traffic.
 - b. For each night of placement, the average strength of the concrete tested at an age of 28 days shall not be less than 750 psi.
4. Specimens, which are obviously defective, shall not be considered in the determination of strength. The specimens with the least imperfections shall be used for the earlier tests.
5. When the satisfactory relationship between the 24 hour and 28 day strengths has been established and approved, the 24-hour results may be used as an indication of the 28-day strengths, for purposes of interim acceptance and progress payments. However, final acceptance and payment will be based only on the OPENING TIME and 28 DAY strengths, with the following exception: If the OPENING TIME strength of any lot of concrete is 650 psi or more, the pay factor from that lot shall be 1.0, regardless of the 28 DAY strength.
6. Final acceptance and payment, each night's production, regardless of quantity, shall be considered as one lot. Except as provided above, the pay factor for each lot shall be established on the basis of both the OPENING TIME and the 28 DAY-strength test results, according to the following formulas and tables:

$$\text{PAY FACTOR} = (0.3 \times \text{OPENING TIME FACTOR}) +$$

(0.7 X 28 DAY FACTOR)

TABLE 1: OPENING TIME FACTOR

TABLE 2: 28 DAY FACTOR

Flexural Strength	Factor	Flexural Strength	Factor
500 psi min.	1.00	750 psi min.	1.00
490 to 499 psi	.90	740 to 749 psi	.90
480 to 489 psi	.80	720 to 739 psi	.70
470 to 479 psi	.70	700 to 719 psi	.50
460 to 469 psi	.60	650 to 699 psi	.30
450 to 459 psi	.50	Below 650 psi	.00
Below 450 psi	.00		

- a. If the average OPENING TIME strength for any lot is below 500 psi, concrete placement shall be suspended until the deficiency is investigated and corrections acceptable to the Engineer are made. The corrections which the Engineer shall have the right to require include additional test strips using the current mix, changes to the mix, and establishing an earlier nightly time deadline for final batching and placement of concrete.
- b. Closure of the pavement beyond the scheduled opening time of 0800 hours due to concrete strength deficiencies or other concrete deficiencies, will subject the Contractor to liquidated damages as specified in the Contract.
- c. If the average OPENING TIME strength for any lot is less than 400 psi, the Contractor shall remove and replace the concrete at his own expense.
- d. If the average 28-DAY strength for any lot is less than 650 psi, regardless of the OPENING TIME strength, the Contractor shall remove and replace the concrete at his own expense.

B. Acceptance Criteria

1. Flexural Strength

Acceptance based on flexural strength shall be as specified in Section 6) Material Acceptance (a) Acceptance Sampling and Testing.

2. Thickness

Cores shall be made to determine thickness and consolidation. No deductions will be made for deficient thickness unless the pavement elevations, as determined by survey, are not within the specification requirements.

7.0 METHOD OF MEASUREMENT

- A. The quantity for “High Early Strength Cement Concrete Pavement” to be measured for payment shall be the number of square yards of pavement in place, completed and accepted, including mix design development and pavement constructed as part of test sections.

8.0 BASIS OF PAYMENT

- A. The accepted quantity of “High Early Strength Cement Concrete Pavement (including mix design development and test sections) will be paid for at the contract unit price per square yard, which price and payment shall be full compensation for furnishing required lighting and other equipment, placing all materials, steel reinforcement, joint sawing, curing and surface texturing, provided, however, that for any pavement found deficient in flexural strength, price adjustment shall be made as specified in Section 6) Material Acceptance. Payment adjustments based on pavement thickness shall be made from tolerance pavements as per Section 6) Material Acceptance.
- B. No additional payment over the unit contract bid price shall be made for pavement which has an average thickness more than that shown on the plans or for strengths in excess of that specified.
- C. Price Adjustment

The pay factor for each lot shall be determined as specified in Section 6) Material Acceptance (a) Acceptance Sampling and Testing. If the pay factor for a lot of concrete is less than 1.0, payment for the material in that lot shall be made at a reduced price, arrived at by multiplying the contract price per square yard by the appropriate pay factor.

- D. Payment will be made under:

Item P-504-1 High Early Strength Cement Concrete Pavement, 16” Thick Per Square Yard

TEST REQUIREMENTS

As specified in Section P-501 - Portland Cement Concrete Pavement.

MATERIAL REQUIREMENTS

As specified in Section P-501 - Portland Cement Concrete Pavement.

END OF SECTION P-504

SECTION P-605 JOINT SEALING FILLER

1.0 DESCRIPTION

- A. This section shall consist of providing and installing resilient and adhesive joint sealing filler capable of effectively sealing joints and cracks in pavements and structures and around the various electrical items embedded in the pavement.
- B. This section includes routing and sealing pavement cracks as directed by the Engineer.
- C. It is the intent of this specification to provide a superior sealed joint, considerably in excess of normal industry standards.

2.0 MATERIALS

- A. The joint sealing material for concrete pavement joints shall conform to the requirements of Table I.
 - 1. Cold Applied Sealant for Joints.

(a) **TABLE 1 - SILICONE SEALANT REQUIREMENT**

<u>Test Method</u>	<u>Test</u>	<u>Material Requirement</u>
<u>As Supplied</u>		
ASTM D 2202	Flow, maximum.....	0.2
ASTM D-1475	Specific Gravity	1.450 - 1.515
ASTM C 1183	Extrusion Rate,	
(Type S)	mL/minute, minimum.....	50
ASTM C 679	Tack-Free Time, minutes	35 – 75
<u>Upon Complete Cure</u>		
ASTM D 2240	Durometer ¹ , Shore A, points.....	15 - 25
ASTM D 412,	Modulus, at 150% Elongation ¹ ,	
Die C	psi (k Pa), maximum 45 (310)	
ASTM D 412,		
Die C	Elongation ¹ , minimum.....	1200
ASTM D 5329 ²	Adhesion to Concrete,	
(Section 9,	minimum % elongation.....	500
(Modified)		

Performance

ASTM C 719 Movement, 10 cycles at
 100/-50 % No failure

ASTM C 793 Accelerated Weathering,
 @ 5,000 hoursNo cracks, blisters or bond loss

1-Sample cured 7 days at 77 ± 2 F (25 ± 1 C) and $50 \pm 5\%$ relative humidity. Proper joint design and proper joint preparation are necessary for maximum performance.

2-Tested on random samples at least on a Quarterly basis. The Engineer shall have additional tests performed in accordance with ASTM C-719 on random samples taken from material supplied to the work. Material not passing the testing shall be removed and replaced at the contractor’s cost.

- B. The joint sealing material for the concrete and asphalt joint interfaces shall conform to the requirements of Table II. This material may also be used to seal around light base cans in Portland cement concrete pavements.

TABLE 2 - SL SELF- LEVELING SILICONE SEALANT REQUIREMENT

<u>Test Method</u>	<u>Test</u>	<u>Material Requirement</u>
<u>As Supplied</u>		
ASTM D 1475	Specific Gravity.....	1.26 – 1.34
ASTM C 1183	Extrusion Rate,	
(Type S)	mL/minute, minimum	50
CTM 0098	Skin Over Time,	
	minutes, maximum.....	60
CTM 0208	Non-Volatile Content, minimum.....	96
<u>Upon Complete Cure</u>		
ASTM D 412,	Elongation ¹ , % minimum	1400
Die C, Modified		
ASTM D 5329	Joint Modulus at 50% elongation ¹ ,	

(Section 9 psi (kPa), maximum.....7 (49)
Modified)

Joint Modulus at 100% Elongation¹ ,
psi (kPa), maximum8 (56)

Joint Modulus at 150% Elongation ¹ ,
psi (kPa), maximum9 (62)

ASTM D-5329 Adhesion to Asphalt/Concrete ¹ ,
(Section 9, elongation600 min
modified)

Performance

ASTM C 719 Movement, 10 cycles
at + 100/-50 % No failure

ASTM C 793 Accelerated Weathering,
at 5,000 hoursNo cracks, blisters ,or bond loss

- 1 Sample cured 7 days at 77 ± 2 F (25 ± 1 C) and 50 ± 5% relative humidity. Proper joint design and proper joint preparation are necessary for maximum performance.
- 2 Tested on random samples at least on a Quarterly basis. The Engineer shall have additional tests performed in accordance with ASTM C-719 on random samples taken from material supplied to the work. Material not passing the testing shall be removed and replaced at the contractor's cost.

3.0 PREFORMED BACKUP RODS

Prefomed backup rods, as shown on the plans and as recommended and approved by the sealant manufacturer, shall be used with cold applied sealants to control the depth of the sealant, to achieve the desired shape factor, to support the sealant against indentation and sag, and shall be a non-moisture absorbing resilient material. Backup materials shall be compatible with the sealant, shall not adhere to the sealant, shall be compressible without extruding the sealant, and shall recover to maintain contact with the joint faces when the joint is open.

Samples of all materials which the Contractor proposes for use and copies of the sealant manufacturer's recommendations for mixing and installation shall be submitted to the Engineer for approval at least thirty (30) days prior to use.

An appropriate primer, compatible with the seal and either manufactured by or approved by the sealant manufacturer shall be used with the sealant.

Each lot or batch of sealing material shall be delivered to the job-site in the manufacturer's original sealed container. Each container shall be labeled to include the following:

1. Name of Material.
2. Manufacturer's Name.
3. Manufacturer's Lot Number.

4. Shelf Life.
5. Mixing Instructions.
6. Storage Instructions.

4.0 CONSTRUCTION METHODS

- A. Time of Application. The joints shall be sealed immediately following the curing period or as soon thereafter as weather conditions permit, and before the pavement is opened to traffic, including construction traffic. At the time of application of the sealing compound, the atmospheric and pavement temperature shall be above 50°F and the weather shall not be rainy or foggy. The temperature requirements may be waived only when so directed by the Engineer.

At a temperature of 75°F. (24°C) and 50% relative humidity, the sealant will cure to a tack-free surface in about one hour. At a temperature of 40°F. (4°C) the tack-free time will be about 2-3 hours.

- B. Equipment. All equipment necessary for the proper construction of this work shall be on the project in first class working condition. The equipment shall be as recommended by the manufacturer of the filler and approved by the Engineer before construction is permitted to start. Air compressors shall be equipped with suitable traps capable of removing all free water and oil from the compressed air and shall be capable of furnishing air with a pressure greater than 90 psi.
- C. Preparation of Joints. Immediately after final saw cutting and beveling is complete, the resulting cement slurry, laitance, curing compound and other foreign material shall be completely removed from the joint by water blasting. After cleaning is complete the joint shall be blown out with compressed air. When the surfaces are clean and dry, and just prior to placement of the backer rod and sealant, the joint shall be sand blasted with two passes, i.e., one pass on each bond face, then compressed air shall be used to blow out the joint and remove all residual dust.

Preparation for concrete pavement crack routing and sealing shall be by properly routing the crack to be slightly lower than the existing crack to ensure proper adhesion to the sidewalls. The cracks should be routed out to provide a minimum sealant reservoir 3/8" wide with a minimum depth of 3/8". The contractor shall use a specialized crack router that is designed to automatically follow the crack. Thickness and depth below the pavement surface shall be as specified for joint sealant. The cracks should be free of dirt, dust, and moisture and be frost-free.

- D. Installation of Sealants. Joints and cracks shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Engineer before sealing is allowed. Sealants shall be installed in accordance with the manufacturer's recommendations and the following requirements:
1. Cold Applied Sealants. A backer rod shall be installed as shown on the plans and the primer shall be applied in the correct sequence in accordance with the sealant manufacturer's instructions, prior to placement of the joint sealer. The sealant shall be applied in a continuous operation, with an approved mechanical device that will force the sealant to the bottom of the joint and completely fill the joint without spilling the material on the surface of the pavement and shall adhere to the concrete and be free of voids.

The sealant shall then be tooled, with an appropriate tool, to produce a slightly concave surface approximately 1/4" below the pavement surface for roadways, 3/8" below the surface for aprons and taxiways and 1/2" below the surface of runways. The sealant shall have a minimum thickness of 3/8". Tooling shall be accomplished before a skin forms on the surface, usually within 10 minutes of application.

The sealant shall be tooled in both directions to ensure a void-free installation. Sealant which does not bond to the concrete surface of the joint walls, contains voids, or fails to set to a tack-free condition will be rejected and replaced by the Contractor at no additional cost. Before sealing the joints, the Contractor shall demonstrate that the equipment and procedures for preparing, mixing, and placing the sealant will produce a satisfactory joint seal. This shall include the preparation of two small batches and the application of the resulting material.

2. A manufacturer's representative(s) is to conduct the demonstration(s), train the Contractor's personnel, and ensure the installation procedures are in accordance with the manufacturer's directions prior to the start of the sealing operations. The representative(s) shall visit the job-site at least four (4) times during the sealing operation for each type of sealant, and after the sealing is complete, is to conduct a general inspection of the work and perform more extensive inspections and/or testing on a random basis to reasonably assure that the construction is in accordance with the manufacturer's recommended construction methods and procedures. A report outlining the findings is to be submitted at the completion of the inspection.
3. To ensure that the superior workmanship is achieved throughout the contract, the Contractor shall be required to construct a test section per crew on a portion of the contract site prior to commencing the contract work in order to evaluate workmanship of each of the Contractor's crews. If the test sites are completed to the satisfaction of the Engineer, the Contractor shall then receive notice to proceed with the approved crews with the remainder of the Contract work.

However, to maintain an acceptable level of productivity, the Contractor shall be required to maintain the same crew members per crew who performed work in the test area together throughout the duration of the contract. If any personnel changes are anticipated by the Contractor, either reducing the work force or changing specific individuals, the Engineer is to be notified. If, at any point during the construction period after a personnel change has been made, the Engineer believes the workmanship has diminished, the crew shall be ordered to halt all construction operations. The Contractor shall then be required to reinstate the original work crew or set-up with the Engineer to perform in another test area to re-qualify the new crew.

A new test area will then be developed by the Engineer. Upon a successful evaluation of the new test area, the evaluated crew may proceed with the contract construction.

4. The Contractor shall be required to perform test cores on portions of the newly installed joint seals at intervals outlined below. The cores shall be analyzed by the Engineer to evaluate the Contractor's workmanship. If the cores indicate unacceptable workmanship, the Contractor will be required to replace the sealant to the last acceptable core.

If deemed necessary by the Engineer, additional test cores will be required to determine the limits of defective work. Any additional cores shall be taken by the Contractor at no additional cost to the Owner.

- a. At expansion joints, the Contractor will perform a test core every 100 feet per crew.
- b. At longitudinal and transverse joints, the Contractor will perform a test core every 100 feet per crew.

If the test results indicate satisfactory work is obtained by a crew on a continuous basis, the Engineer may reduce the number of cores required from the original amount of 100 feet for that crew. The specific intervals increasing or decreasing the number of cores, is at the Engineer's discretion.

5.0 TEST CORE

As stated above, the resealed joints are to be tested at specific intervals. The size of the test cores shall be as follows:

- A. Transverse and longitudinal joints in general shall require a 1-1/2 inch diameter core. The actual core size will be based on the minimum core required to include the portion of the joint between the top edges of the beveled edge to a depth of 1/2 inch below the backer rod (see detail on Plans).
- B. The expansion joint in general shall require a 2-1/2 inch to a 5 inch core drilled to a depth of at least 2 inches below the backer rod. The actual core size will be based on a minimum core size required to include the portion of joint between the top of the beveled edges (see detail on Plans).
- C. The cores for the completed joint seal shall not be taken until after the seal has cured for 14 to 28 days as recommended by the seal manufacturer.
- D. The Contractor shall patch the core holes by preparing the core hole in the same manner as for seal placement. A short section of backer rod shall be coiled in the hole prior to sealant placement. After sealant placement the material shall be tooled to ensure bonding to the entire surface.
- E. Warranty. The sealant shall be warranted for repair and/or replacement for all defects in materials and workmanship by both the Contractor and the Sealant Manufacturer for a period of five (5) years.

6.0 METHOD OF MEASUREMENT

- A. Joint sealing material for contraction, construction, longitudinal, and asphalt/concrete interface shall be measured by the linear foot of sealant in place, complete, and accepted.
- B. Crack routing and sealing shall be measured by the linear foot of sealant in place, complete, and accepted.
- C. Expansion joint replacement shall be measured by the linear foot of expansion joint in place, complete, and accepted. This shall include specially fabricated sections of expansion joint material as may be required.

7.0 BASIS OF PAYMENT

- A. Payment for joint sealing material shall be made at the contract unit price per linear foot. The price shall be full compensation for all joint preparation, furnishing all materials including backer rod, expansion filler, and sealant, delivery, placing of the material, for test coring, and for all labor, equipment, tools, and incidentals necessary to complete the item.
- B. Payment for crack routing and sealing shall be made at the contract unit price per linear foot. The price shall be full compensation for all crack preparation, furnishing all materials including backer rod and sealant, delivery, placing of the material, for test coring, and for all labor, equipment, tools, and incidentals necessary to complete the item.
- C. Payment for expansion joint replacement shall be made at the contract unit price per linear foot. The price shall be full compensation for all joint preparation, removal of existing expansion joint material, furnishing all materials, special fabrication as necessary, delivery, placing of the material, locating reinforcing steel, and for all labor, equipment, tools, and incidentals necessary to complete the item.

D. Payment will be made under:

- Item P-605-1 Cold Applied Sealant, Contraction, Construction and Longitudinal Joints - Per Linear Foot.
- Item P-605-2 Cold Applied Sealant, Expansion Joints - Per Linear Foot.
- Item P-605-3 Cold Applied Sealant, Asphalt – Concrete Joint Interface - Per Linear Foot. Item P-605-4 Crack Routing and Sealing - Per Linear Foot.

TESTING AND MATERIAL REQUIREMENTS

Test and Short Title

MIL-S-8802	Flow, Extrusion Rate, Tack-Free Time, Adhesion
ASTM D-1475	Specific Gravity
ASTM D-2240	Durometer
ASTM D-412,	Die C Modulus, Elongation
ASTM C-719	Movement
ASTM D-793	Accelerated Weathering
ASTM D-2202	Flow or Sag
AASHTO T-132	Bond to Concrete

END OF SECTION P-605

SECTION P-610 - STRUCTURAL PORTLAND CEMENT CONCRETE

The requirements of Section 500 of the State of Georgia, Standard Specifications shall apply with the following modifications and additions:

1.0 DESCRIPTION OF WORK

This section consists of the manufacture and utilization of Portland Cement Concrete in the construction of drainage structures and underdrain outlet pipes, electrical manholes and handholes, sign bases and light bases, and electrical duct banks.

2.0 CLASSES AND USE OF CONCRETE

Cast-in-place foundations and related structures shall have a minimum compressive strength of 4000 psi and shall be designated as Class 4000 Concrete.

3.0 QUALITY CONTROL OF CONCRETE:

- A. Proportioning: The Contractor shall be responsible for designing the proportions of Portland Cement, fine aggregates, coarse aggregate, water and admixture, which will produce a workable concrete mix meeting all of the following limiting criteria for the concrete specified:

Minimum Cement

Content Per

Minimum Compressive Strength

<u>Class</u>	<u>Cubic Yard</u>	<u>Slump</u>	<u>7 Days</u>	<u>28 Days</u>
4000	6.5 bags*	3" ± 1"	2800 psi	4000 psi

*94 lbs. cement per bag

- B. Since the cement content necessary for a given mix to produce certain strength requirements is also dependent on the type and gradation of the aggregates actually used. The Contractor shall use whatever amount of cement is required to comply with all the provisions specified herein, and all costs or such compliance and materials required shall be understood to be included in the price bid for the various concrete items in the proposal.
- C. The slump shall be determined in accordance with ASTM Test Method C143. The consistency of the concrete shall be such as to be easily workable and to permit proper finishing. The plastic concrete, when deposited, shall not flow but shall remain in a conical pile. There shall be a minimum of segregation and surplus water during the process of handling and finishing.
- D. Admixtures: Air-entraining agents conforming to the requirements of the Standard Specifications shall be added to each concrete batch in such amount as to secure between 4% and 6% air entrained in the plastic concrete. Consideration shall be given to the amount of any air entrainment that may be incidentally afforded whenever a water reducing retarder agent is used.
 - 1. The concrete producer shall insure compliance with the manufacturer's recommendations for the method of dispensing the admixtures, with particular attention to possible undesirable chemical reaction between products when mixed in concentrated form. The following listed admixtures shall be used in all concrete:
 - a. A water reducing agent (ASTM C494 Type A) shall be added to the concrete when the ambient temperature is below 65⁰F, and a water reducing retarder (ASTM C494 Type D) shall be added to the concrete at temperatures above 65⁰F., as directed by the Engineer.

The manufacturer of the mixture shall submit in writing to the Prime Contractor for submission to the Engineer, special recommendations for quantities of the mix to be used under various temperatures and job conditions to assure that the concrete can be maintained at a uniform consistency prior to and during placing. The mix is to have sufficient workability between lifts to prevent the occurrence of lift lines with the specified placement and consolidation techniques, and as approved by the Engineer.

- b. The addition of the superplasticizer, if deemed necessary, to the concrete mix shall be metered to assure proper dosage; the superplasticizer shall be added to the concrete only at the job site, and immediately prior to its placement in the forms.

The Contractor will be required to run trial batches prior to concrete construction to determine the proper dosage of the superplasticizer and/or the water-reducing-retarding admixture. A slump-loss curve acceptable to the Contractor as well as other test results must be submitted to the Engineer for approval. The Contractor shall advise the Engineer not less than 48 hours prior to any trial batches so that the Engineer may witness the trial batches. Changing the dosage of the superplasticizer at the job site will not be permitted without prior approval of the Engineer. This approval or rejection will be made at the job site on a case-by-case basis.

The maximum slump permitted for the superplasticizer concrete shall be eight (8) inches. Calcium chloride or other admixtures containing calcium chloride shall not be used.

- c. The water reducing retarder agent proposed for use shall have a proven performance record in large construction projects for at least five years, as evidenced by letters from owners of structures attesting to satisfactory quality and durability of the concrete structures cited, submitted to the Engineer when approval of the agent is requested.

The agent may be in liquid or powder form and may be either a) a calcium, sodium, potassium or ammonium salt of lignosulfonic acid, or b) a hydroxylated carboic acid or its salt.

Concrete containing this agent is hereinafter referred to as the "test concrete", and concrete with the same materials but without the agent is hereinafter referred to as the "referenced concrete". Both test and reference concretes shall be prepared at an ambient temperature of 70⁰F. The cement and aggregates for the test and reference concretes shall be the same as those to be used in the project.

Test concrete containing the agent in an amount sufficient to cause an increase of 50% and 60% in the initial setting time (ASTM Test Method C403) over the initial setting time of the reference concrete at an ambient temperature of 70⁰F, and having the same cement content and slump (AASHTO Test Method T119) as the reference concrete, shall exhibit the following properties when compared to such reference concrete.

- E. The water content in the test concrete shall be decreased by at least 5% from that of the reference concrete.
- F. The longitudinal linear measurement of the drying shrinkage (AASHTO Test Method T160) of the test concrete at the age of 28 days, after 14 days of initial moist curing, shall be decreased by at least 5% from that of the reference concrete.
- G. The compressive strength (AASHTO Test Method T22) of the test concrete shall be increased by at least 10% at the ages of 3, 7, and 28 days, from that of the reference concrete.

Concrete strengths shall be calculated on the average results of at least five 6 inch diameter by 12 inch high cylinders for compressive tests, at each age of test, prepared in accordance with

AASHTO Test Method T126. Drying shrinkage shall be calculated on the average results of at least 3" x 3" x 16" specimens prepared in accordance with AASHTO Test Method T160.

The Contractor shall submit to the Engineer actual test data from an approved laboratory evidencing that the above requirements have been met.

The Contractor shall submit to the Engineer a certificate written by the manufacturer of the proposed water reducing retarder agent stating that the agent to be furnished for the project is identical in composition with the agent that was used for the acceptance tests. The samples of the agent necessary for the acceptance tests shall be selected at random from stockpiled supplies.

H. Laboratory Mix Design:

Concrete mixes shall be designed by the Contractor on the basis of approved ingredients which the Contractor intends to use for this project and all trial batches shall be made using such materials. Trial mixes designed by the Contractor shall be tested for complete conformance to these Specifications by an approved laboratory engaged by the Contractor and at his own expense. All materials for the trial batches shall be furnished by the Contractor and the batches prepared either by him or by his laboratory, also at his own expense. After the Contractor has designed satisfactory mixes, and his laboratory has tested for compressive strength at least four concrete cylinders (for each mix) from each of three separate trial batches using that mix (2 cylinders for each age per batch), he shall furnish the Engineer the mix data, the results of the cylinder tests, the yield as determined by ASTM Test Method C138, and all necessary ingredients for producing approximately 5 cubic feet of concrete. In establishing the amount of each ingredient to be used in the design mixes, the cement and aggregate proportions shall be given by weight for measuring and batching purposes; water and admixture shall be given by weight or volume, as appropriate or convenient. The Engineer may then check the mixes for conformance to specifications and observe various other characteristics of the plastic concrete, such as workability, cohesiveness, finishing, setting time, etc. All such check testing will be done at the Owner's expense. If any of the requirements are not met, the mixes design will be rejected, and the Contractor shall furnish a new design and materials until satisfactory results are produced. Then each design mix shall be checked as prescribed above for a new mix whenever the source of cement, coarse aggregate, fine aggregate or any other ingredient changes.

Upon acceptance of a design mix found satisfactory to the Engineer, the mix proportions shall be used without change for all concrete structures under the class of concrete in this contract, unless necessary modifications are subsequently approved by the Engineer. Corrections necessitated by variations in the moisture content of the aggregates shall be made by the Contractor as required.

4.0 CONCRETE MANUFACTURING

An automatic recording device capable of recording all of the individual ingredients of the mixes shall be installed at the point of manufacture of the concrete.

5.0 PRODUCTION AND PLACEMENT CAPACITY REQUIREMENTS

The requirements of Section 500.06 of the GDOT Standard Specifications shall apply.

6.0 FORMS

- A. The requirements of this Article in the Standard Specifications shall apply except that the formwork shall also conform to the following:
1. Prepare and submit shop drawings to the Engineer for review.
 2. Forms shall be designed with adequate strength to withstand pumping pressures and to permit ramming of concrete to fill all possible voids. All hinges shall be drilled for the hinge pins to insure better alignment of the forms.
 3. Forms shall be provided with ample openings through which the concrete may be placed, worked and inspected as it moves into place.
 4. Forms shall be metal type forms or plywood forms constructed to fit exactly the shapes required. The material used shall be of such thickness that the forms will remain true to shape. All bolts and rivet heads shall be countersunk. Clamps, pins and other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Forms which do not present a smooth surface or do not line up properly shall not be used.
 5. Care shall be exercised to keep forms free from rust and grease and other foreign matter. Forms which, in the opinion of the Engineer are unsatisfactory, shall not be used.

7.0 REMOVAL OF FALSEWORK AND FORMS

Forms shall not be removed without approval of the Engineer, and all removal shall be accomplished in a manner which will prevent injury to the concrete. Forms shall be removed only after the concrete has attained sufficient strength to support itself without damage.

8.0 APPLICATION OF EXTERNAL LOADS TO CONCRETE

- A. Backfilling around underground structures shall not be performed until the compressive strength of the concrete has reached its design strength evidenced by concrete cylinders taken from the pour and tested in accordance with these specifications, unless authorized by the Engineer.
- B. In order that the Engineer can maintain a record of the strength gain of all concrete placed, and to enable the Contractor and the Engineer to determine the times for the removal of the forms and the application of external loads, the Engineer shall make 6" x 12" concrete test cylinders for determining strengths and other properties of the concrete, molds and equipment therefore, shall tag and identify the cylinders, shall cure the test specimens in the same manner as the concrete in the construction being sampled, and shall deliver them to his laboratory for testing. These cylinders shall be prepared in accordance with the requirements of ASTM Specification C31 and tested in accordance with AASHTO Test Method T22.
- C. In general, and unless otherwise required, six test cylinders shall be made from each continuous pour of concrete. Two cylinders of each set of six will be tested to determine when the concrete reaches the stresses for the removal of the forms, two at 7 days and two at 28 days. The cost of taking concrete samples, furnishing molds and equipment, preparing, curing and testing the cylinders shall be at the expense of the Contractor.
- D. If, during the course of construction, a 7-day concrete cylinder breaks at a compressive strength lower than that specified hereinbefore for that age, the Engineer reserves the right to order the Contractor to immediately core the portion of the concrete construction represented by that cylinder for testing purposes. The coring shall be made of the size and at the locations ordered by the Engineer. Coring and filling core holes with concrete and core testing shall be done at the Contractor's expense. If the results of the core tests indicate that, in the sole opinion of the

Engineer, the expected rate of strength gain is not sufficient to produce a satisfactory strength at 28 days, the portion of the concrete construction represented by the core, as delineated by the Engineer, shall be removed and disposed of, at the Contractor's expense, and that portion replaced with new construction. If the results of the core tests indicate that a satisfactory 28-day strength may yet be realized, possible rejection of the concrete in question will be deferred until the 28-day cylinders are tested. If a 28-day cylinder breaks at a strength below the required value, the Engineer reserves the right to immediately reject the concrete represented by the cylinder, ordering such construction removed and replaced within designated limits, or he may permit the Contractor to perform additional coring. If additional coring is permitted, the Engineer will either accept or reject the concrete represented on the basis of the 28-day core tests and all previous tests. The Engineer's decision in these cases shall be final and conclusive.

- E. In the event that, during the course of construction, and following satisfactory 7 day cylinder tests, a 28 day concrete cylinder breaks at a compressive strength lower than that specified hereinbefore for that age, the Engineer reserves the right to immediately reject the concrete represented by the cylinder, ordering such construction removed and replaced within designated limits, or he may permit the Contractor to perform coring wherever ordered. If coring is permitted, the Engineer will either accept or reject the concrete represented on the basis of the 28-day core tests and all previous tests. Coring and filling core holes with concrete and core testing shall be done at the Contractor's expense. The Engineer's decision in these cases shall be final and conclusive.

9.0 CONCRETE HANDLING AND PLACING

- A. Before placing concrete, care shall be taken to ensure that all required embedded items are firmly and securely fastened in place, as shown on the plans or approved by the Engineer. All embedded items shall be thoroughly cleaned and free from oil and other foreign matter such as loose coating of rust, paint, scale and the like. Concrete shall be placed continuously in the forms in layers of such thickness as may be directed by the Engineer. Each layer shall be placed and compacted before the preceding batch has taken initial set. Tapping or other external vibration of forms will not be permitted without specific permission of the Engineer. Each layer shall be so compacted as to avoid the formation of a construction joint with a preceding layer which has not taken initial set. When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. Where directed by the Engineer, such surfaces shall be cut with an air and water jet at the proper stage of surface hardening or shall be thoroughly cleaned with a stiff wire brush or other satisfactory tool and a stream of water or air, or both, under pressure, if necessary, to remove all laitance of undesirable surface accumulations. If surfaces are not cleaned at the proper time or in the proper manner, sandblasting may be required to produce the required surface. Work shall not be halted except at construction joints shown on the plans or the approved shop drawings. Immediately after the work of placing concrete is halted, all accumulations of mortar splashed upon the reinforcement and surfaces of the forms shall be removed before the concrete takes its initial set. Care shall be taken when leaning reinforcing steel to prevent damage to or breakage of the concrete steel bond. Concrete that has attained its initial set or has contained its mix-water for more than 60 minutes shall not be placed in the work. Placing will not be permitted when, in the opinion of the Engineer, limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. No concrete shall be placed by compressed air.
- B. Any concrete which is found to be defective, before the final completion and acceptance of the work, shall be removed, disposed of and the structure properly rebuilt, or if damaged during such time shall be properly repaired or replaced, as required to the satisfaction of the Engineer, at no cost to the Owner.

- C. Chutes and Troughs: Where steep slopes are required, chutes either shall be equipped with baffle boards or shall be in short lengths that reverse the direction or movement. Concrete shall not be allowed to drop freely more than 5 feet in unexposed work nor more than 3 feet in exposed work; where greater drops are required, a tremie or other approved methods shall be employed. The discharge of the tremies shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 12 inches thick, and the spacing of the tremies shall be such that segregation does not occur. Care shall be taken to fill each part of the form by depositing the concrete in as near the final position as possible. The coarse aggregate shall be worked back from the forms and around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred, and no strain shall be placed on the ends of projecting reinforcement.
- D. Pump Placement. Where the concrete is conveyed and placed by pumping, the plant and equipment used shall be subject to approval by the Engineer. Operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. The position of the discharge end of the line shall be as near the final position of the concrete as possible. The discharge lines shall be horizontal, inclined upwards or vertical from the machine. When placing is completed, concrete to be used which is remaining in the pipelines shall be ejected without contamination of concrete or separation of ingredients. After each operation, debris and flushing water shall be washed away from the structures.
- E. Pumps used to convey concrete shall be of a suitable kind and size to adequately handle the volumes of the concrete to be conveyed. The use of aluminum components that might come in contact, during pumping or conveying, with fresh concrete will not be permitted.
- F. Vibrating: Unless otherwise directed, concrete shall be compacted with suitable high speed mechanical vibrators. Vibrators shall not be used to push concrete into position.

The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to the point where segregation occurs. Vibrators shall not penetrate previously placed layers more than 2 inches to consolidate the layers and to prevent over vibration of the previously vibrated layer.
- G. Water stops shall be installed at the location shown on the plans.

10.0 CONCRETE SURFACE FINISHES

Finish shall be Type I, Type II, Type III, or Type IV as specified in the Standard Specifications.

11.0 COLD WEATHER CONCRETING

The requirements of Section 500.14 of the Standard Specifications shall apply.

12.0 HOT WEATHER CONCRETING

The requirements of Section 500.15 of the GDOT Standard Specifications shall apply.

13.0 TOLERANCES

Permissible construction tolerances shall conform to the requirements specified in the Standard Specification. The Contractor shall be responsible for setting and maintaining forms sufficiently within the tolerances specified. Concrete work that exceeds the tolerance limits specified shall be remedied or removed and replaced or corrected at the expense of the Contractor.

14.0 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- A. Measurement will not be made for structural Portland cement concrete used in the construction of drainage and electrical items.
- B. Payment will not be made for structural Portland cement concrete under this specification. Compensation for structural Portland cement concrete, when used for the construction of drainage and electrical items will be included as a part of the respective items.

TESTING AND MATERIAL REQUIREMENTS

<u>Testing and Short Title</u>	<u>Material and Short Title</u>	
AASHTO T-27-Gradation	AASHTO M-80	- Aggregate
AASHTO T-96-Abrasion	AASHTO M-6	- Aggregate
AASHTO T-26-Water	AASHTO M-85	- Portland Cement
AASHTO T-121-Yield	AASHTO M-134	- Air-Entrained Portland Cement
AASHTO T-84-Absorption		
AASHTO T-85-Absorption	ASTM C-350	- Fly Ash
AASHTO T-152-Air Content	ASTM C-402	- Pozzolans
AASHTO T-23-Cylinders	AASHTO M-154	- Air-Entrained
AASHTO T-22-Compressive Test		- Additives
	ASTM C-494	- Retarder
AASHTO T-119-Slump		
AASHTO M-33-Joint Material		
	ASHTO M-90	- Joint Material
ASTM C-31-Test Specimens	AASHTO M-153	- Joint Material
AASHTO M-213		-Joint Material
	AASHTO M-18	- Joint Material
	AASHTO M-73	- Cotton Mats
	AASHTO M-139	- Paper
	AASHTO M-171	- Polyethylene
	AASHTO M-182	- Burlap
	AASHTO M-148	- Membrane
	ASTM C-618	- Fly Ash

END OF SECTION P-610

SECTION P-615 SITE CONCRETE

1.0 DESCRIPTION

- A. This section shall consist of constructing concrete curb and gutter, sidewalks, paved ditches and miscellaneous site work concrete in accordance with the lines, grades and dimensions shown on the plans or as required by the Engineer.

2.0 MATERIALS

- A. Concrete and other required materials shall conform to the requirements of Article 441.2 of the Georgia Department of Transportation's Standard Specifications. Modify the concrete to use a minimum compressive strength of 3000 PSI at 28 days.

3.0 CONSTRUCTION METHODS

- A. These items shall be constructed in accordance with the requirements of the applicable portions of Article 441.3 of the Georgia Department of Transportation's Standard Specifications.
- B. The compaction and testing requirements for the subgrade materials under these items shall be the same as the requirements for subgrades under paved areas in Section P- 152, Excavation and Embankment.
- C. Parking bumper blocks shall be installed at the locations and in accordance with details shown on the plans.

4.0 METHOD OF MEASUREMENT

- A. Concrete curb and gutter will be measured per linear feet of curb and gutter, completed in- place and accepted.
- B. Excavation and backfill will not be measured for payment.
- C. Ditch paving will be measured by the cubic yard, complete, in place and accepted.
- D. Concrete traffic island and sidewalk paving will be measured by the square yard, complete, in place and accepted.
- E. Concrete bumper blocks will each be counted for payment, completed and accepted.

5.0 BASIS OF PAYMENT

- A. Payment will be made at the Contract unit price per linear foot for curb and gutter, complete in-place. These prices shall be full compensation for furnishing all materials, preparations and placing of the materials and for all labor, equipment, tools, and incidentals necessary to complete this item.
- B. Payment will be made at the Contract unit price per cubic yard of ditch and sidewalk paving, complete in-place. These prices shall be full compensation for furnishing all materials, preparations and placing of the materials and for all labor, equipment, tools, and incidentals necessary to complete this item. Steel reinforcing bars or mats will not be paid separately.
- C. Payment will be made at the contract unit price per square yard for traffic islands, complete in place, including steel where required.
- D. Payment will be made at the contract unit price for concrete bumper blocks, including rebar, installation, and for all labor, tools, equipment and incidentals necessary to complete the item.

E. Payment will be made under:

Item P-615-1 - Concrete Curb and Gutter - Per Linear Foot

Item P-615-2 - Concrete Ditch Paving - Per Cubic Yard

Item P-615-3 - Concrete Sidewalk - Per Square Yard

Item P-615-4 - Concrete Island Paving - Per Square Yard

Item P-615-5 - Concrete Bumper Blocks - Per Each

END OF SECTION P-615

SECTION P-621 - PAVEMENT MARKINGS AND MARKING REMOVAL

1.0 DESCRIPTION

This section shall consist of the preparation and painting of markings and stripes, and the removal of existing markings, on the surface of Runway, Taxiways, Aprons and Roadways applied in accordance with these specifications and at the locations shown on the plans, or as directed by the City.

2.0 MATERIALS

- A. Materials Acceptance. The Contractor shall furnish manufacturer's certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. The reports can be used for material acceptance, or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.
- B. Paint. Paint shall be Waterborne meeting the requirements of Federal Specification TT-P- 1952E, Type II, furnished in White – 37925, Yellow – 33538 or 33655, Red – 31136, and Black – 37038, in accordance with Federal Standard No. 595. Pink shall be made using one part Red – 31136 to two parts White – 37925.
- C. Reflective Media. This feature will be provided by the addition of glass spheres to the surface of the pigmented binder. Glass spheres shall meet the requirements of Federal Specification TT-B-1325D, Type III Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.
- D. Water. Water to be used by high-pressure water equipment for removing pavement markings shall be obtained by the Contractor from a potable source.
- E. Chemicals. The use of chemicals for removing pavement markings will not be permitted.

3.0 CONSTRUCTION METHODS

- A. Weather Limitations. The painting shall be performed only when the existing surface is dry and clean, when the atmospheric temperature is at least 45°F and rising, when the pavement surface temperature is at least 5°F above the dew point, and when the weather is not excessively windy, dusty, or foggy. The suitability of the weather will be determined by the city.

Do not perform work when the atmospheric temperature is below 40 degrees F or when the pavement is covered with snow or ice.

Markings shall not be applied when the wind speed exceeds 10 knots unless windscreens are used to shroud the material guns.

- B. Equipment. All equipment for the work shall be approved by the City and shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.
 - 1. The mechanical marker shall be an approved atomizing spray-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall be designed to apply markings of uniform cross sections and clear-cut edges without running or spattering and within the limits for straightness set forth herein. When needed, a dispenser shall be furnished which is properly designed for attachment to the mechanical marker and suitable for dispensing the required quantity of

- reflective media. The equipment shall be capable of applying markings from 6 to 36 inches in a single pass with uniform coverage and capable of applying two colors simultaneously without applying glass beads to the black markings.
2. Suitable adjustments shall be provided on the sprayer(s) of a single machine or by furnishing additional equipment for painting the width required.
- C. Removal Methods. Pavement markings shall be removed from indicated areas by methods acceptable to the Engineer, such as sandblasting, water blasting, or bead blasting, that cause negligible damage to existing pavements, surface texture, joint sealants, or other airfield appurtenances as determined by the City. The method for protecting existing joint sealants during marking removal shall be submitted to the Engineer for approval prior to beginning work on this item. The Contractor shall repair at his expense any damage to the pavement, surface texture, sealant, or appurtenances caused by the removal work. Methods to repair damages shall be acceptable to the City.
1. Contractor shall be aware that existing paint to be removed may contain lead. Safety precautions shall be taken for environmental concerns. Contractor shall test the area prior to submitting a bid for this condition.
 2. Any removal method that causes objectionable dust, contaminated water runoff, or other such hazard or nuisance shall be controlled by means approved by the City that eliminate such causes of objection, or its use will not be allowed.
- D. Preparation of Surfaces. Immediately before application of the paint, the existing surface shall be dry and entirely free from dirt, grease, oil, acids, laitance, existing paint, or other foreign matter which would reduce the bond between the coat of paint and the pavement. The surface shall be thoroughly cleaned by water blasting as required to remove all dirt, laitance and loose materials. After the cleaning operations, vacuuming or other City- approved cleaning methods shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.
1. During blasting, dust and debris will be controlled and contained by vacuums or other approved processes.
 2. Obliterating pavement markings by masking with paint, bituminous material, surface treatments or other cover material will not be an acceptable removal method.
 3. Paint shall not be applied to new Portland cement concrete pavement until the concrete in the areas to be painted is clean of curing material and/or removal of existing markings. Sandblasting or high-pressure water shall be used to remove curing material and laitance from the concrete surfaces.
- E. Layouts and Alignment. Suitable layouts and lines of proposed stripes shall be spotted in advance of the paint application. Control points shall be spaced at such intervals as will insure accurate location of all markings. All stripes shall be accurately surveyed, and layout accomplished well in advance of painting and shall be approved by the City prior to applying paint.
1. The Contractor shall provide an experienced technician to supervise the location, alignment, layout, dimensions and application of the paint.
- F. Application. Markings shall be applied at the locations and to the dimensions and spacing indicated on the plans or as specified. Paint shall not be applied until the layouts, indicated alignment and the condition of the existing surface have been approved by the City. Pavement shall be dry to the satisfaction of the City prior to application of paint.

1. The paint shall be mixed in accordance with the manufacturer's instructions before application. The paint shall be thoroughly mixed and applied to the surface of the pavement with the marking machine at its original consistency without the addition of thinner. The paint shall be applied uniformly by suitable equipment at the following rates:

<u>Pavement Type</u>	<u>Paint Application Rate</u>
Portland Cement Concrete	115 Square Feet per Gallon Freshly
Seal coated Asphalt Concrete	75 Square Feet per Gallon Other
Asphalt Concrete	115 Square Feet per Gallon

2. The reflective media shall be distributed to the surface of the pigmented binder immediately after application and imbedded at the rate and depth as required to provide adhesion and reflection. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Type III glass beads shall be applied at the rate of 10 pounds per gallon of paint for white and yellow markings. Type III glass beads shall not be used for red, pink, or black markings.

Red and pink markings shall utilize Type I, gradation A glass beads. Type I, gradation A glass beads shall be applied at the rate of 5 pounds per gallon of paint for red or pink markings.

3. All painting shall be performed to the satisfaction of the City by competent and experienced equipment operators, laborers, and artisans in a neat and workmanlike manner. The edges of the markings shall not deviate from a straight line more than ½ in 50 feet and marking dimensions and spacings shall be within the following tolerances

Dimension and Spacing	Tolerance
36 inches	+/- ½ inch
Greater than 36 inches to 6 feet	+/- 1 inch
Greater than 6 feet to 60 feet	+/- 2 inches
Greater than 60 feet	+/- 3 inches

4. A period of 7 days shall elapse between placement of a bituminous surface course or seal coat and application of the paint. Upon application to properly prepared surfaces after curing, the paint shall not bleed excessively, blister, peel, curl, or discolor.
5. New concrete pavement shall be allowed to cure for 7 days before removing curing compound and installing permanent markings.
6. The Contractor shall furnish certified test reports for the materials shipped to the project. These reports shall not be interpreted as a basis for final acceptance. The City shall be notified upon arrival of a shipment of paint to the job site for inspecting and sampling of the materials. The Contractor shall make an accurate accounting of the paint materials used in the accepted work. All emptied containers shall be returned to the storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

- G. Protection. After application of the paint, all markings shall be protected while the paint is drying. The fresh paint shall be protected from injury or damage of any kind. The Contractor shall be directly responsible and shall erect or place suitable warning signs, flags or barricades,

and protective screens or coverings as required. All surfaces shall be protected from disfiguration by spatter, splashes, spillage, drippings of paint or other materials. Contractor's failure to protect fresh paint shall result in repainting at contractor's expense.

- H. Cleanup. The Contractor shall remove from the site all debris, waste, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. Loose or unadhered reflective media shall be removed from the site to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.
- I. Defective Workmanship or Material. When any material not conforming to the requirements of the specifications or plans has been delivered to the project or incorporated in the work, or any work performed is of inferior quality, such material or work shall be considered defective and shall be corrected as directed by the City, at the expense of the Contractor. Any area of paint that chips or peels or wears excessively in respect to the overall work shall be repainted within the warranty period. Any areas that do not have a continuous uniform coverage of beads will need to be remarked at the Contractor's expense.

4.0 METHOD OF MEASUREMENT

- A. The payment for pavement striping and marking removal shall be the number of square feet of paint removed.
- B. The quantity of pavement striping and marking, shall be paid by the number of square feet of paint applied in accordance with the specifications and accepted by the City.

5.0 BASIS OF PAYMENT

- A. Payment shall be made at the Contract unit price per square foot for striping or marking removal. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools and incidentals necessary to complete the item.
- B. Payment shall be made at the Contract unit price per square foot for pavement striping, and marking, including the surface prep prior to paint application, paint and the reflective media. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools and incidentals necessary to complete the item.
- C. Payment will be made under:

Item P-621-1 Pavement Striping and Marking Removal – Per Square Foot.

Item P-621-2 Pavement Striping and Marking – Per Square Foot.

TESTING AND MATERIAL REQUIREMENTS

Test and short title	Material and short title
TT-B-1325C1	Beads (Glass Spheres) Retro-reflective
TT-P-1952E1	Paint, Traffic and Airfield Marking, Waterborne
Federal STD 595	Colors used in Government Procurement

END OF SECTION P-621

SECTION P-660 CONCRETE FILLED STEEL GUARD POSTS

1.0 DESCRIPTION

- A. This item shall consist of constructing concrete filled steel guard posts. This item shall be constructed in accordance with this specification, or as required by the Engineer.

2.0 MATERIALS

- A. Concrete and other required materials shall conform to the requirements of Article 441.02 of the Georgia Department of Transportation's Standard Specifications.
- B. Structural steel (plates, etc.) for guard posts shall meet the requirements of ASTM A36-75. Steel pipe shall conform to the requirements of ASTM A53 Schedule 40.

3.0 CONSTRUCTION METHODS

- A. This item shall be constructed in accordance with the requirements of the applicable portions of Article 441.03 of the Georgia Department of Transportation's Standard Specifications.
- B. The compaction and testing requirements for the subgrade materials under these items shall be the same as the requirements for the roads where this item is required.
- C. The contractor shall cast three (3) 12" x 6" cylinders for each concrete pour, one cylinder tested at 7 days and 2 at 28 days. Slump and air test shall also be made for each sample.

4.0 METHOD OF MEASUREMENT

- A. Guard posts will be measured by each post completed in-place and accepted.
- B. Excavation and backfill will not be measured for payment.

5.0 BASIS OF PAYMENT

- A. Payment will be made at the contract unit price per each guard post, completed in-place and accepted. This price shall be full compensation for furnishing and placing all materials necessary and for all labor, equipment, tools, and incidentals necessary to complete the item.
- B. Payment will be made under:

Item P-660-1 - Concrete Filled Steel Guard Post - Per Each.

END OF SECTION

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

Concessions

**New Construction and
Modifications**

Design Standards

Structural Engineering

Design Standards Structural

Table of Contents

Section	Page
1.0 Purpose	3
2.0 General	3
A. Modifying Existing Structures	3
B. Floor, Wall and Roof Penetrations	3
C. Design Calculations	3
D. Loads and Loading Combinations	4
E. Foundation Systems	4
F. Drawings	4
G. Specifications	4

Design Standards Structural

1.0 Purpose

The purpose of this document is to outline the minimum structural engineering requirements for new construction and/or modifications related to Concessions submitted projects at the City of Atlanta's Hartsfield-Jackson Atlanta International Airport (ATL).

2.0 General

All design work shall be performed in accordance with generally accepted professional principles and practices for structural engineering and in compliance with all applicable Department of Aviation Design Standards, Federal, State and City of Atlanta Design Codes, Standards and Regulations.

A. Modifying Existing Structures

1. The installation or relocation of heavy equipment shall be evaluated and endorsed by a Structural Engineer in the state of Georgia.²
2. Proposed improvements that require partial or complete, severing, altering or removal of structural members shall require evaluation and design by a Structural Engineer.
3. Walls proposed for partial or full demolition shall be evaluated by a Structural Engineer to determine whether they are load-bearing. If they are, drawings shall indicate the sequence of operations required to avoid collapse.
4. Modifications to existing structures shall not be made without prior approval by the Department of Aviation.

B. Floor, Wall, and Roof Penetrations

1. Proposed penetrations and openings for existing floors, walls and roofs shall be located where there are no impacts to existing concrete reinforcements. Contractor shall be required to locate existing reinforcements prior to commencing coring operations.
2. If reinforcements must be severed due to the size of the opening or its required location, evaluation and design shall be made by a Structural Engineer.
3. Proposed rectangular openings in existing walls, floor slabs and roof shall be detailed with required core holes of sufficient diameter at each corner to prevent over cut upon installation.
4. Concessionaire shall be responsible for reinstating any existing wall, floor and roof penetrations and/or openings in the space, which are to be abandoned (See Architectural Guidelines for penetration repair details)

C. Design Calculations

1. Basis-of-design calculations shall be prepared for any project that propose modification to an existing joist, beam, column or foundation, and shall demonstrate (the airport's satisfaction) that designed alterations do not degrade overall structural capacity to resist code prescribed loads.
2. Calculations shall be neatly presented and include sketches proportioned to reflect relative scale, illustrating design intent. Provide linkage in the calculations for all primary structural members proposed. All commercial computer software utilized in the production of the design shall be identified by name and version. All input files and corresponding output files (in native format), shall be recorded to DVD/CD optical media, suitably labeled and included with the submittal.
3. Any in-house proprietary computer software utilized in the design shall have the

solution of verification problems documented in the appendix.

4. All final calculations shall be sealed, signed and dated by the Structural Engineer of Record.
- D. Loads and Loading Combinations
1. Load combinations used for the design/modification of airport structures shall be in strict compliance with the requirements of the applicable provisions of ASCE/SEI 7- 16, Minimum Design Loads for Buildings and Other Structures (current printing) and the structural codes identified in the general requirement section above.³
- E. Foundation Systems
1. Where applicable, foundation designs shall be based on the recommendations of a Georgia registered geotechnical engineer unless the structural support demand is deemed to be of minor significance and with the concurrence of the Department of Aviation.
- F. Drawings
1. All structural drawing packages shall include at a minimum, the following sheets in addition to other sheets that are necessary to depict the work of the project.
 - a. General Notes – General notes applicable to the overall design and structural materials proposed, abbreviations used within the structural drawings, symbol legend(s) as appropriate. The general notes shall include all the information required by section 1603 of the IBC 2018.⁴
 - b. Demolition plans shall be prepared for all projects that propose new slab or other structural member penetrations. Proposed and existing slab penetrations shall be identified on the demolition plan indicating sizes and spatial relationships to known points on the floor plan.
 - c. Penetrations for roof-mounted equipment shall be supported by supplementary members designed by a Georgia structural engineer, unless it is demonstrated by calculation, to the airport's satisfaction, that supplemental members are not required.
- G. Specifications
1. Specifications defining the quality of workmanship and materials to be incorporated into the work shall be prepared as a separate document or placed on the structural drawings.

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

Concessions

New Construction and Modifications

Design Standards

Architectural

Design Standards Architectural

Table of Contents

Section	Page
1.0 Purpose	3
2.0 General	3
A. Applicable Codes and Standards	3
B. Existing Space Requirements.....	3
1. Modifying Existing Structures.....	3
2. Existing Ceilings	3
3. New Floor, Wall & Roof Penetrations.....	3
4. Repair of Existing Floor & Roof Penetrations	4
5. Demising Walls... ..	4
6. Temporary Construction Walls	4
7. Floor Waterproofing	4
3.0 Design	4
A. General... ..	4
B. Storefront Design.....	5
C. Storefront Design Control Zone	5
D. Storefront Signage.....	6
E. Food Court Ceiling Design	7
F. Appendices	7
1. Appendix.....	7

- Detail No.1 Concrete on Steel Deck Floor Repair
- Detail No.2 Concrete Floor Repair
- Detail No.3 Steel Deck Roof Repair
- Detail No.4 Concrete on Steel Deck Roof Repair
- Detail No.5 Concrete Deck Roof Repair
- Detail No.6 Pipe Thru System over Conc. On Steel Deck
- Detail No.7 Pipe Thru Roofing System over Steel Deck
- Detail No.8 Pipe Thru Roofing System over Conc. Slab
- Detail No.9 Satellite Mast and Pad on Conc. Slab
- Detail No.10 Satellite Mast on Concrete
- Detail No.11 Satellite Mast on Metal Deck
- Detail No.12 Tenant-Storefront Signage Standards

Design Standards Architectural

1.0 Purpose

The purpose of this document is to outline the minimum Architectural requirements for New Construction and/or Modifications related to Concessions submitted projects at the City of Atlanta's Hartsfield-Jackson Atlanta International Airport (ATL).

2.0 General

A. Applicable Codes and Standards

1. All design work shall be performed in accordance with generally accepted professional principles and practices for Architectural Design and in compliance with all applicable Federal, State and City of Atlanta Design Codes, Standards and Regulations and the Department of Aviation (DOA), Planning & Development Bureau (P&D) Design and Construction Standards for Concessions New Construction and Modifications.
2. here there may be conflicting requirements in the codes, standards and regulations, the most stringent provision, as determined by P&D shall be applied.

B. Existing Space Requirements

1. Modifying Existing Structures

- a. Proposed space modifications shall comply with all P&D's Design and Construction Standards for Concessions New Construction and Modifications.
- b. Additions or modifications that impact or interface with existing Terminal roof systems shall be compatible with in-place roof systems and conditions. The ATL standard roofing system is a single-ply membrane fully adhered (Per Manufacture's Specification) 135 mil Fleeceback TPO roofing system (80 mil w/55 mil Fleeceback) over new insulation with heat welded TPO sheet seams
- c. Penetrations of existing CPTC Roof Installer must utilize and maintain all Atlanta Airlines Terminal Corporation (AATC) required approvals and shut down requests criteria including roof warranty approvals during satellite antenna installation.

2. Existing Ceilings

- a. Replacement, demolition and/or removal of existing ceiling(s) and associated lighting and mechanical systems above concessionaire (lease) spaces, food court seating and circulation areas shall include the removal of all abandoned hangers, supports, electrical feeds, mechanical ducts and/or other appurtenant items above the ceiling.
- b. Re-attach /Replace all missing junction box covers.

3. New Floor, Wall and Roof Penetrations

- a. Proposed penetrations and/or openings for existing floors, walls and roofs shall comply with the all P&D's Design and Construction Standards for Concessions New Construction and Modifications.
- b. Roof penetrations shall comply with existing TPO roof manufacturer's detail(s) recommendations in order to maintain integrity of roof system and its warranty.
- c. Cabling, conduits and/or other appurtenant connectivity items are not allowed to be run and/or lay directly on top of the existing TPO roofing.

4. Repair of Existing Floor and Roof Penetrations
 - a. Repair/filling of existing cores and/or openings for Concrete Floors, Concrete Floors on Steel Deck, Steel Deck Roof, Concrete on Steel Deck Roof and Concrete Deck Roof shall comply with Detail No.1 through No. 11 (Appendix No. 1)
5. Demising Walls
 - a. New demising walls between Concessions spaces shall be one (1) hour fire rated construction and shall extend to the underside of building structure.
6. Temporary Construction Walls
 - a. Temporary construction walls shall be full height (to underside of finished ceiling)
 - b. Walls shall be constructed of metal studs with gypsum wall board, on the public side, and be attached to the existing floor. The gypsum board shall be painted and shall include finished baseboard (Colors to be selected by DOA)
 - c. Any damage to existing base building finishes shall be repair by Concessionaire at no cost to the DOA.
7. Floor Waterproofing
 - a. At all Food Service Spaces, a waterproof membrane shall be installed prior to the finished floor. The waterproofing membrane shall be continued to six inches (6") high at all perimeter walls and sealed.
8. Floor Mounted Appurtenances
 - a. Any appurtenances such as vendor dispensing equipment, seating, advertisement, and any other floor mounted equipment throughout the airport's interior and exterior public facilities, shall not be a safety hazard to public circulation, obstruct passenger flow or impede any emergency path of travel or exit. Locations shall be submitted to the DOA /P&D for review and acceptance.

3.0 Design

A. General

1. The design of Concession spaces shall utilize a dynamic, progressive modern architecture.
2. The use of materials at the Storefronts shall provide continuity between the Concession design elements and the existing base building architectural elements.
3. Designers shall incorporate good design practices including, but not limited to:
 - a. Sustainable design (See Section 4, Sustainability Standards)
 - b. Adaptability
 - c. Healthy design (Air Quality)
 - d. Utilize materials native to the region when possible
 - e. Utilize materials that are permanent, high quality and durable
 - f. Design for energy efficiency
4. Concept Design shall be review and approve by DOA Concessions before proceeding with Design Development.

B. Storefront Design

1. The existing base building soffit band height at the Domestic Terminal, Concourses and International Terminal shall be maintained.
2. Existing base building columns inside, adjacent to and/or in front of a concession space shall be maintained.
3. Existing base building finishes outside a concessions lease line (Horizontal and Vertical) shall be maintained.
4. No element of a proposed storefront design shall extend beyond the approved lease line (Except for blade signs which must comply with DOA Signage Standards).
5. Concession design affecting adjacent Airline Hold Room spaces shall be reviewed and approved by DOA Concessions, DOA Properties and the Airline Tenant.
6. Security storefront closures shall be open mesh rolling side-mounted or overhead-mounted grilles. Grill housings and rails shall be recessed and concealed from public view.

C. Storefront Design Control Zone

1. The Design Control Zone elements include floor, wall & ceiling finishes, displays, fixtures, lighting, menu boards, counter casework and identity graphics.
2. The Design Control elements shall not obstruct visibility into the Retail/Food Service space.
3. The Design Control Zone for Retail Spaces shall be the area from the front lease line to a point five feet (5 ft.) inside the Retail space.
4. The Design Control Zone for Food Service Spaces shall be the area from the front lease line to a point ten feet (10 ft.) inside the food Service space.
5. All materials and finishes used within the Design Control Zone shall be of high quality and shall be review and approved by DOA Concessions.
6. Use of the following materials within the Design Control Zone shall not be permitted:
 - a. Simulated brick, stone wood or replication of other natural materials
 - b. Plastic Laminates (never as a countertop)
 - c. Multi-colored wall coverings
 - d. Textured paint and/or stucco
 - e. Carpet or fabric
 - f. Rough Cut Lumber
 - g. Mirrored finishes
 - h. Fabric covered panels as display backdrops
7. Ceilings within the Design Control Zone shall be painted gypsum board.
8. No wall partitions shall cross the Design Control Zone.
9. Concession's floor finishes shall be level with the existing abutting base building public area floor. Floor finishes shall be of high quality materials and shall be reviewed and approved by DOA.
10. Lighting within the Design Control Zone shall not be less than 90-foot candles.

D. Storefront Signage

1. Concessions Signage shall be of the best quality and shall be compatible with adjacent storefronts.
 2. One horizontal sign and one blade sign per storefront as a primary business identity shall be allowed. These signs shall be limited to trade name and logo/symbol only.
 3. The total horizontal sign area shall not exceed a square foot area equaling 10% of the total storefront square footage. Trade name and Logo/Symbol shall fit within the total square footage of the allowable sign area.
 4. The blade sign shall not project more than 36" from the soffit and shall not exceed 20" H x 26" W. Circular blade signs shall not exceed 24" in diameter. Blade signs shall maintain a minimum 8 ft. from AFF to bottom of sign.
 - a. Signage shall be Underwriter Laboratory approved.
 - b. Signage raceways, ballasts and transformers shall not be exposed to public view.
 5. Signage shall be installed on the soffit band and shall maintain a minimum 8 ft. from AFF to bottom of sign.
 6. Pin mounted, rear-lit channel or halo-reversed lit channel letters illuminated with neon two inches (2") away from background plane of the soffit band shall be used.
 - a. Neon-formed letter tubing and/or logos shall not be permitted.
 - b. Signage shall not have and/or use the following:
 - i. Moving or flashing lights
 - ii. Surface mounted light boxes or cabinets
 - iii. Hand lettered signs of any type
 - iv. Freestanding floor signs either within the Design Control Zone or outside the Concessions lease Line
 7. Menu Boards shall not be allowed within the Design Control Zone.
- E. Food Court Ceiling Design
1. New food court ceiling(s) replacement shall include integrated or accompanying LED lighting. The new ceiling system may be designed to be complementary to other elements of the overall concessions concept, and shall include high quality, low maintenance materials (mineral fiber or similar acoustical tiles are not allowed). Design and materials shall be reviewed and approved by DOA Concessions.

4.0 Appendices

1.1 Appendix No. 1

Detail No.1	Concrete on Steel Deck Floor Repair
Detail No.2	Concrete Floor Repair

Detail No.3	Steel Deck Roof Repair
Detail No.4	Concrete on Steel Deck Roof Repair
Detail No.5	Concrete Deck Roof Repair
Detail No.6	Pipe Thru System over Conc. On Steel Deck
Detail No.7	Pipe Thru Roofing System over Steel Deck
Detail No.8	Pipe Thru Roofing System over Conc. Slab
Detail No.9	Satellite Mast and Pad on Conc. Slab
Detail No.10	Satellite Mast on Concrete
Detail No.11	Satellite Mast on Metal Deck
Detail No.12	Tenant-Storefront Signage Guidelines

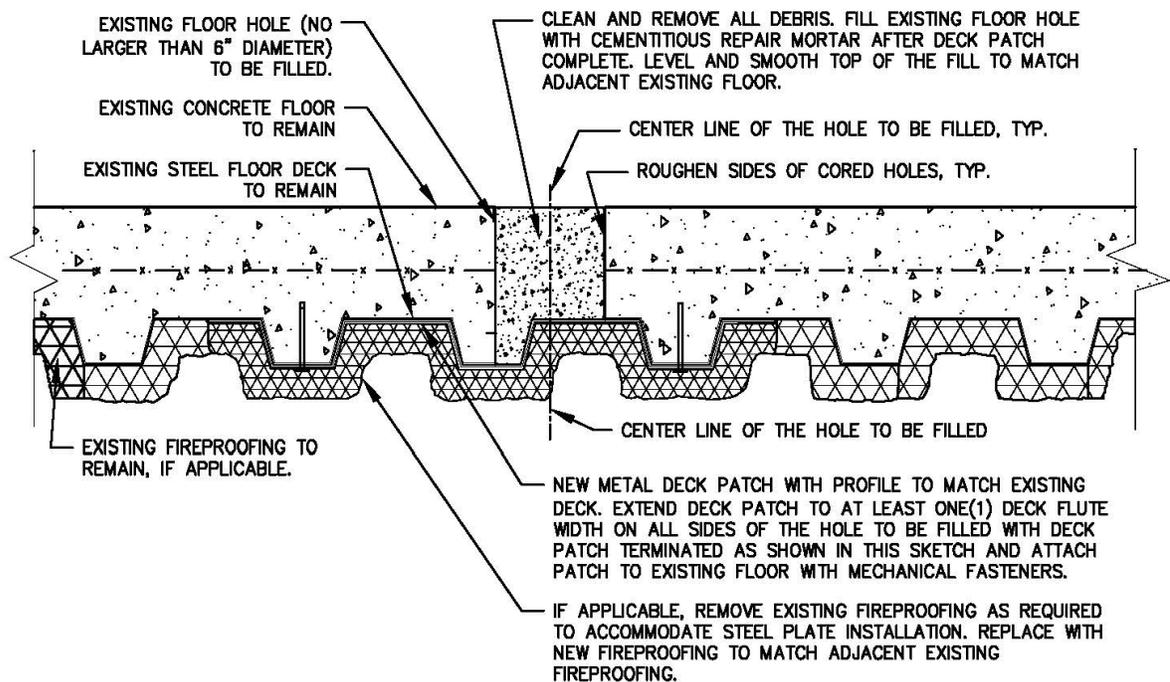
Detail No.1 Concrete on Steel Deck Floor Repair

Requirements for Filling Penetrations in Existing Elevated Concrete Slabs

Proposed filling of cores or openings in existing elevated concrete slabs shall be evaluated by a Georgia registered structural design professional, who shall provide stamped requirements in the construction documents whenever either:

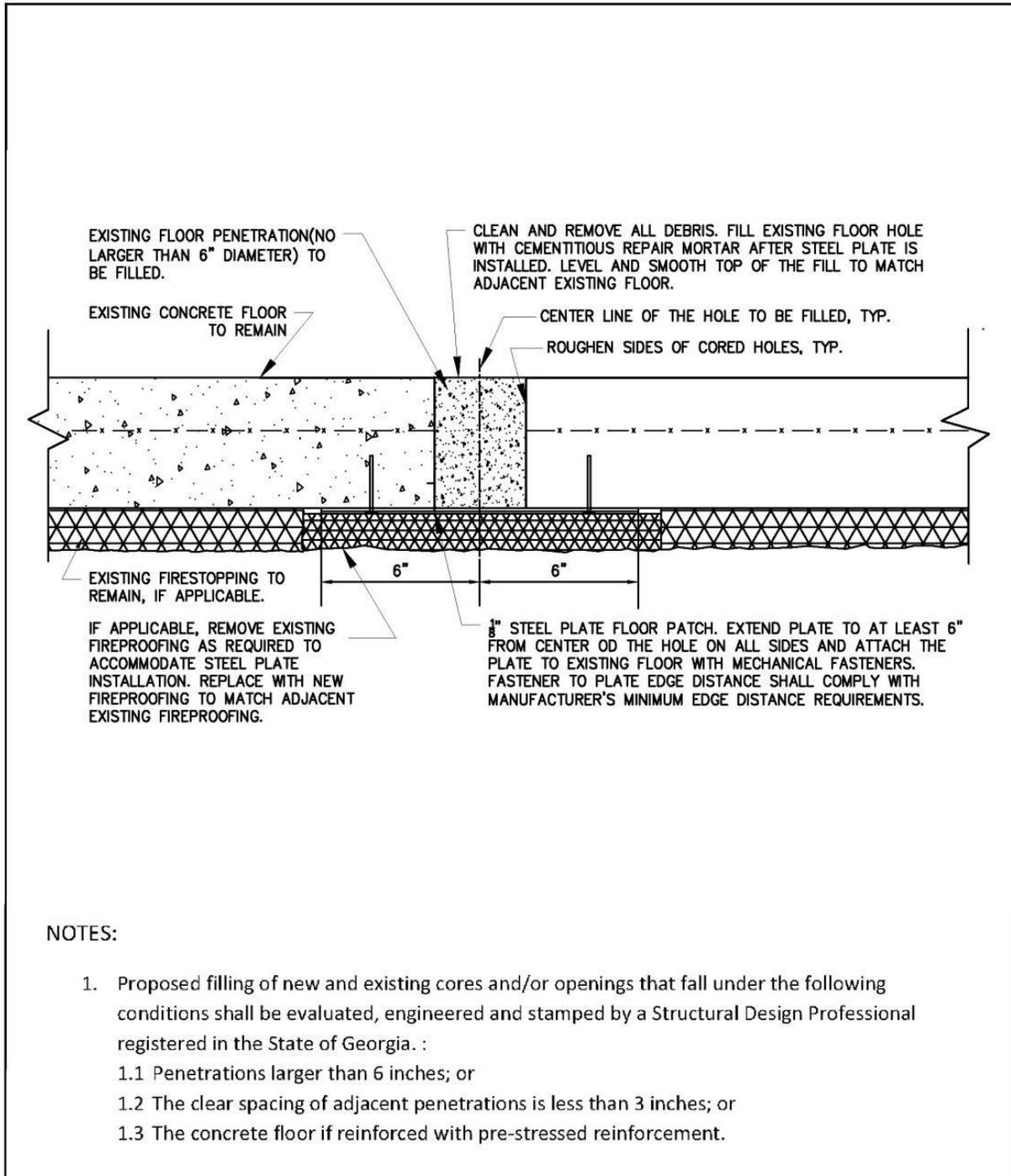
1. The clear spacing of adjacent cores or openings will be less than 3 inches; or
2. The core or opening is proposed for a concrete floor reinforced with prestressed reinforcement; or
3. The greatest dimension for the opening or core proposed exceeds 6 inches.

Cores or openings in concrete slabs, for which none of the above restrictions are applicable, shall be reinstated with a cementitious repair mortar in accordance with the manufacturer's written instructions for preparation, mixing, placement, finishing and curing. Also, see detail below for more information.



PROJECT: ELEVATED FLOOR REPAIR FOR OPENING 6" OR LESS			SKETCH NO.
DRAWING NAME: CONCRETE ON STEEL DECK FLOOR REPAIR			1
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: CM	REFERENCE DWG. NO. NONE
No.		DESIGNED BY: CM	
No.		CHECKED BY: CHECK	
No.		CONTRACT: NONE	
No.		WBS: NONE	
No.		SCALE: NTS	
		DATE: 08/20/2013	

Detail No.2 Concrete Floor Repair

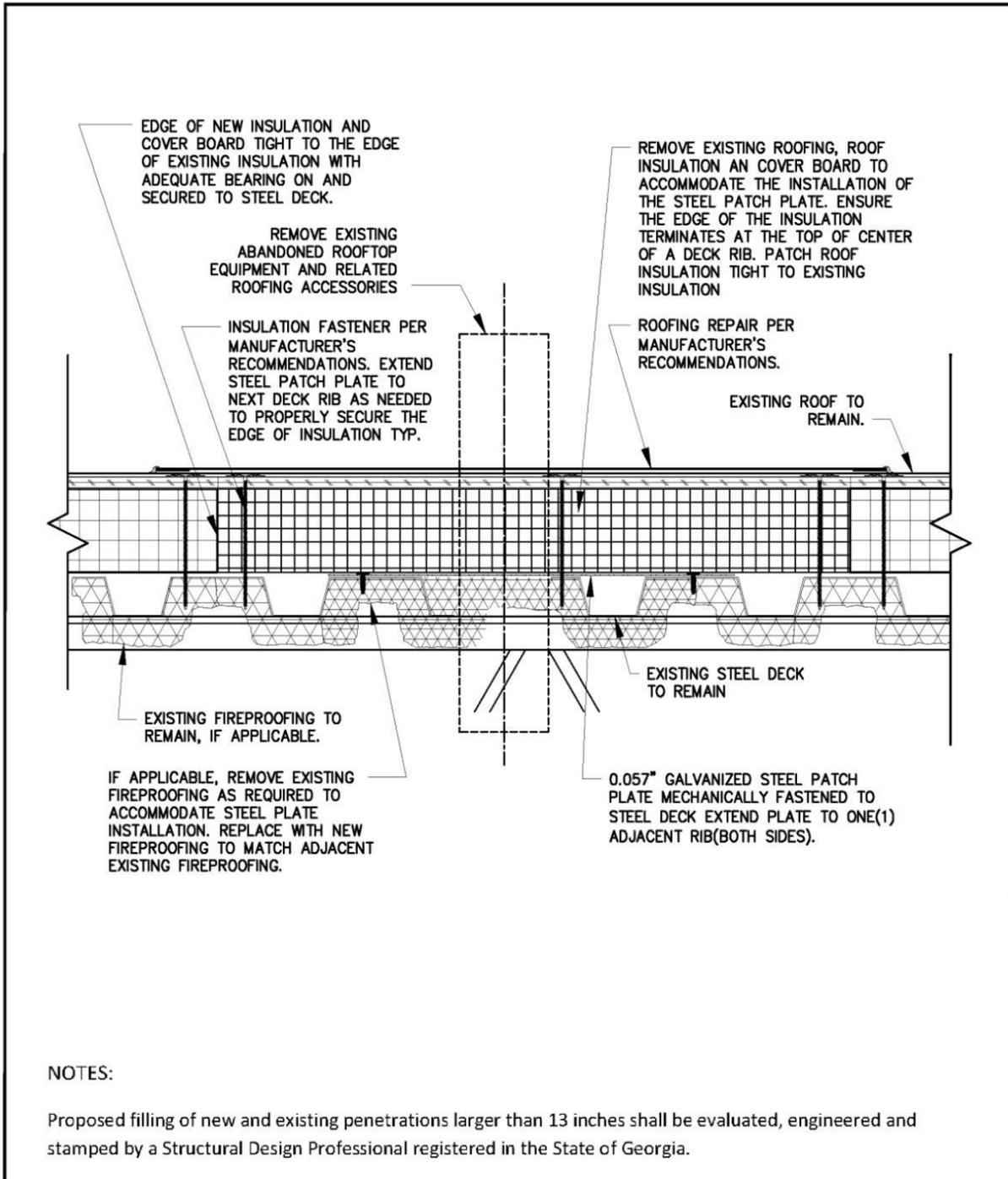


NOTES:

1. Proposed filling of new and existing cores and/or openings that fall under the following conditions shall be evaluated, engineered and stamped by a Structural Design Professional registered in the State of Georgia. :
 - 1.1 Penetrations larger than 6 inches; or
 - 1.2 The clear spacing of adjacent penetrations is less than 3 inches; or
 - 1.3 The concrete floor if reinforced with pre-stressed reinforcement.

PROJECT: ELEVATED FLOOR PENETRATION REPAIR DETAIL			DETAIL NO.
DRAWING NAME: CONCRETE FLOOR REPAIR			2
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: CM DESIGNED BY: CM CHECKED BY: CHECK CONTRACT: NONE WBS: NONE SCALE: NTS DATE: 03/26/2014	REFERENCE DWG. NO.
No.			NONE
No.			

Detail No.3 Steel Deck Roof Repair

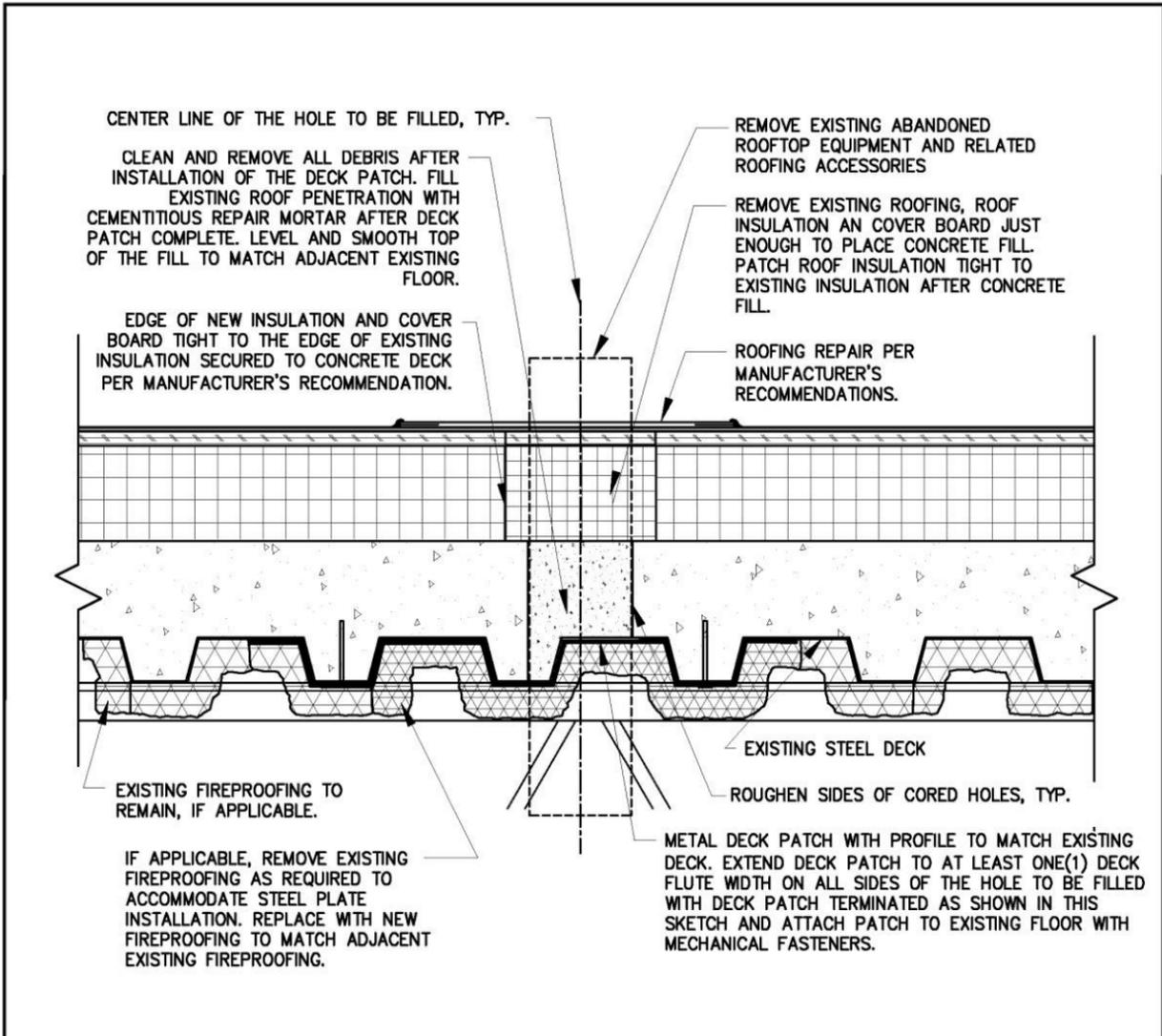


NOTES:

Proposed filling of new and existing penetrations larger than 13 inches shall be evaluated, engineered and stamped by a Structural Design Professional registered in the State of Georgia.

PROJECT: ROOF PENETRATION REPAIR DETAIL			DETAIL NO.
DRAWING NAME: STEEL DECK ROOF REPAIR			3
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: CM DESIGNED BY: CM CHECKED BY: CHECK CONTRACT: NONE WBS: NONE SCALE: NTS DATE: 03/26/2014	REFERENCE DWG. NO.
No.			NONE
No.			

Detail No.4 Concrete on Steel Deck Roof Repair

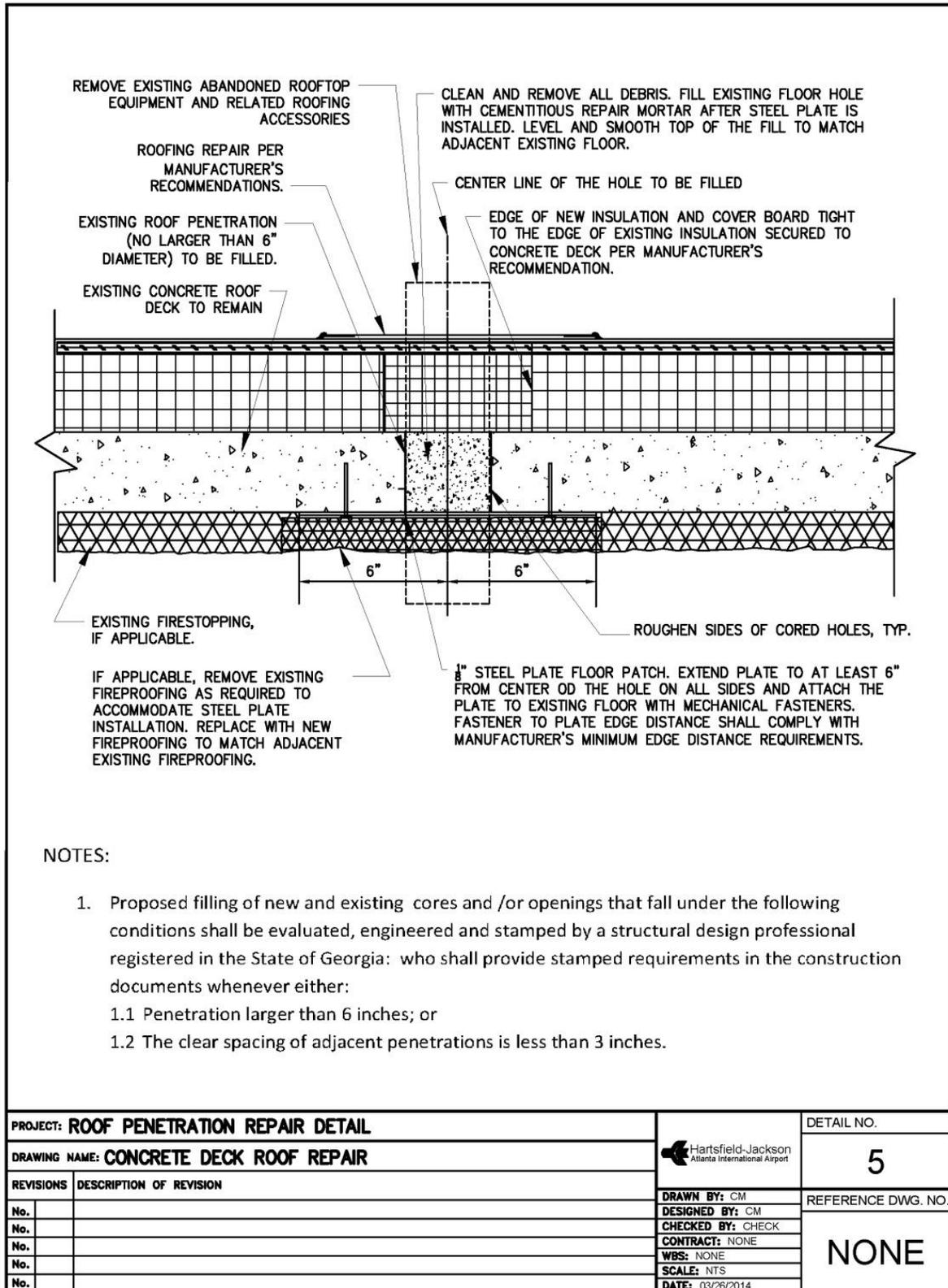


NOTES:

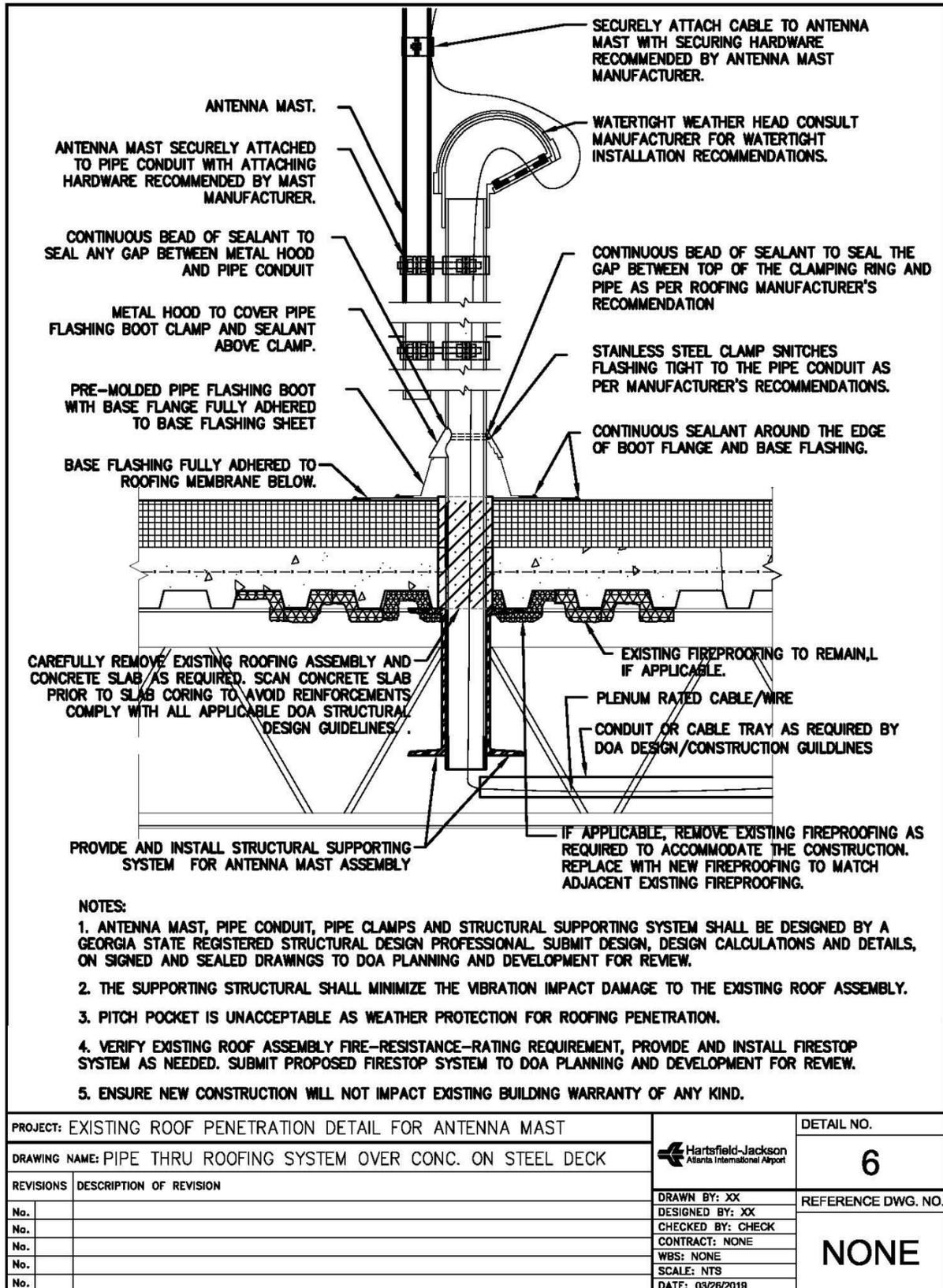
1. Proposed filling of new and existing cores and /or openings that fall under the following conditions shall be evaluated, engineered and stamped by a structural design professional registered in the State of Georgia: who shall provide stamped requirements in the construction documents whenever either:
 - 1.1 Penetration larger than 6 inches; or
 - 1.2 The clear spacing of adjacent penetrations is less than 3 inches.

PROJECT: ROOF PENETRATION REPAIR DETAIL			DETAIL NO.
DRAWING NAME: CONCRETE ON STEEL DECK ROOF REPAIR			4
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: CM DESIGNED BY: CM CHECKED BY: CHECK CONTRACT: NONE WBS: NONE SCALE: NTS DATE: 03/26/2014	REFERENCE DWG. NO.
No.			NONE
No.			

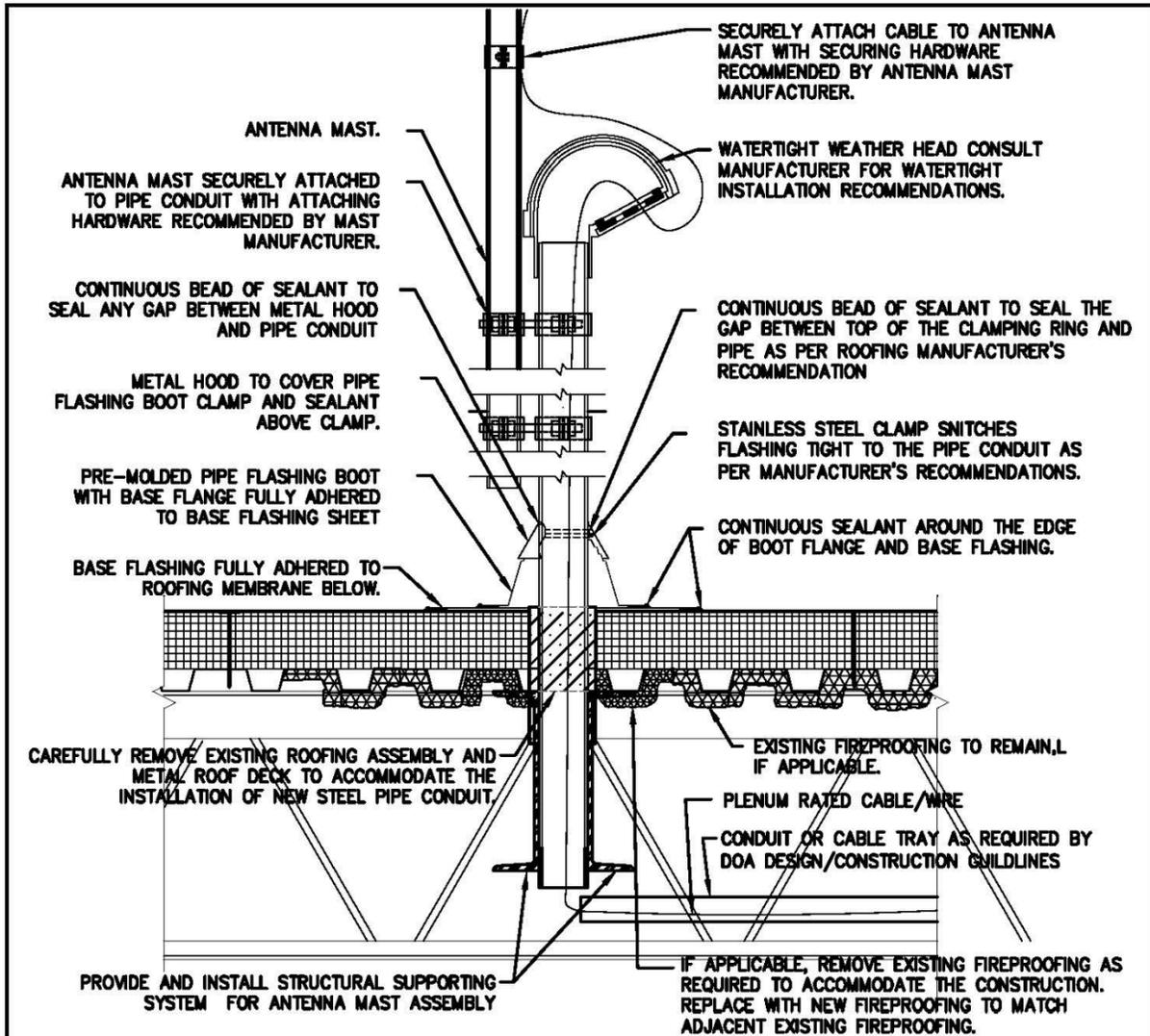
Detail No.5 Concrete Deck Roof Repair



Detail No.6 Pipe Thru Roofing System Over Conc. On Steel Deck



Detail No. 7 Pipe Thru Roofing System Over Steel Deck

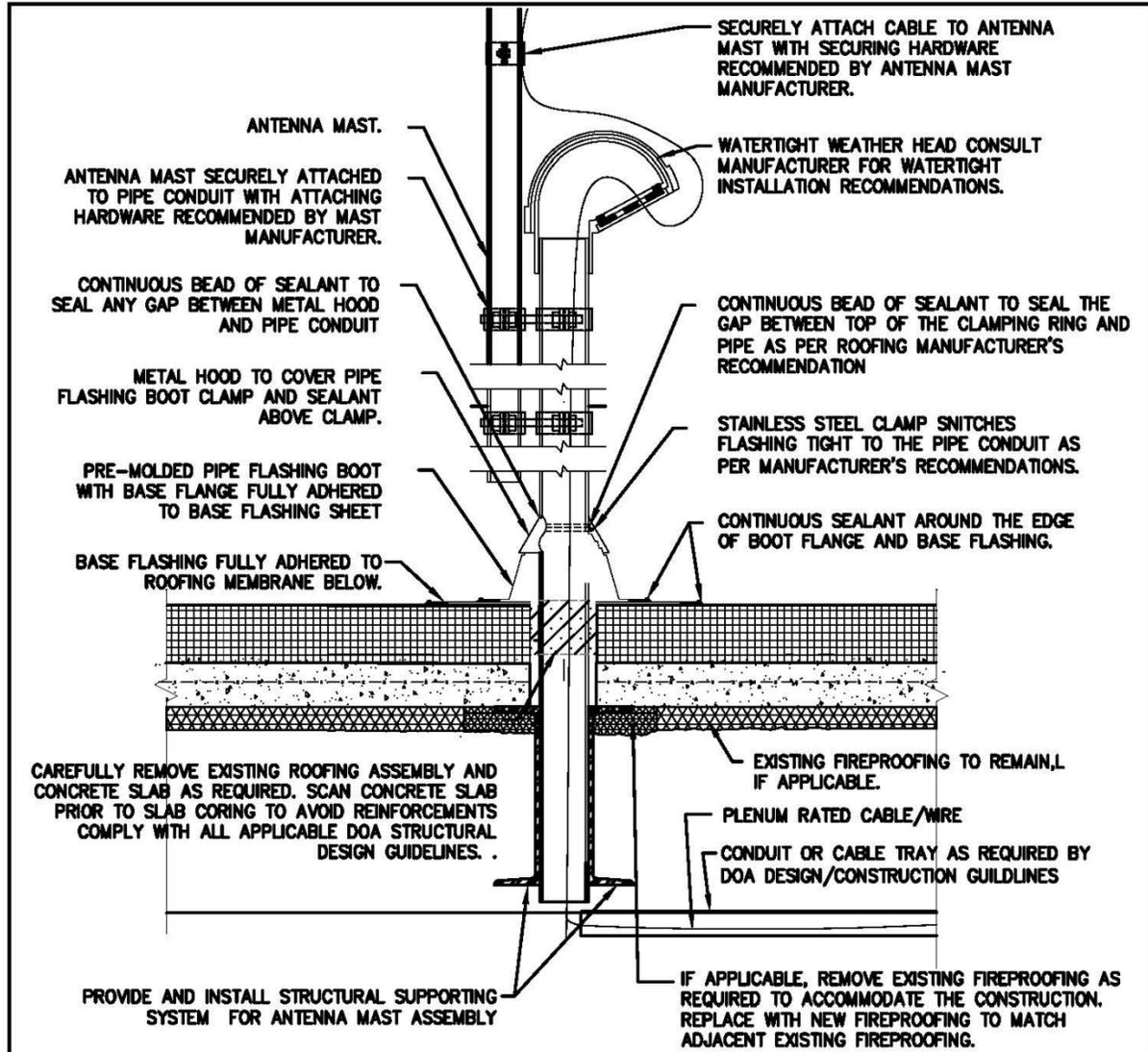


NOTES:

1. ANTENNA MAST, PIPE CONDUIT, PIPE CLAMPS AND STRUCTURAL SUPPORTING SYSTEM SHALL BE DESIGNED BY A GEORGIA STATE REGISTERED STRUCTURAL DESIGN PROFESSIONAL. SUBMIT DESIGN, DESIGN CALCULATIONS AND DETAILS, ON SIGNED AND SEALED DRAWINGS TO DOA PLANNING AND DEVELOPMENT FOR REVIEW.
2. THE SUPPORTING STRUCTURAL SHALL MINIMIZE THE VIBRATION IMPACT DAMAGE TO THE EXISTING ROOF ASSEMBLY.
3. PITCH POCKET IS UNACCEPTABLE AS WEATHER PROTECTION FOR ROOFING PENETRATION.
4. VERIFY EXISTING ROOF ASSEMBLY FIRE-RESISTANCE-RATING REQUIREMENT, PROVIDE AND INSTALL FIRESTOP SYSTEM AS NEEDED. SUBMIT PROPOSED FIRESTOP SYSTEM TO DOA PLANNING AND DEVELOPMENT FOR REVIEW.
5. ENSURE NEW CONSTRUCTION WILL NOT IMPACT EXISTING BUILDING WARRANTY OF ANY KIND.

PROJECT: EXISTING ROOF PENETRATION DETAIL FOR ANTENNA MAST			DETAIL NO.
DRAWING NAME: PIPE THRU ROOFING SYSTEM OVER STEEL DECK			7
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: XX DESIGNED BY: XX CHECKED BY: CHECK CONTRACT: NONE WBS: NONE SCALE: NTS DATE: 05/13/2019	REFERENCE DWG. NO.
No.			NONE
No.			

Detail No. 8 Pipe Thru Roofing System Over Conc. Slab

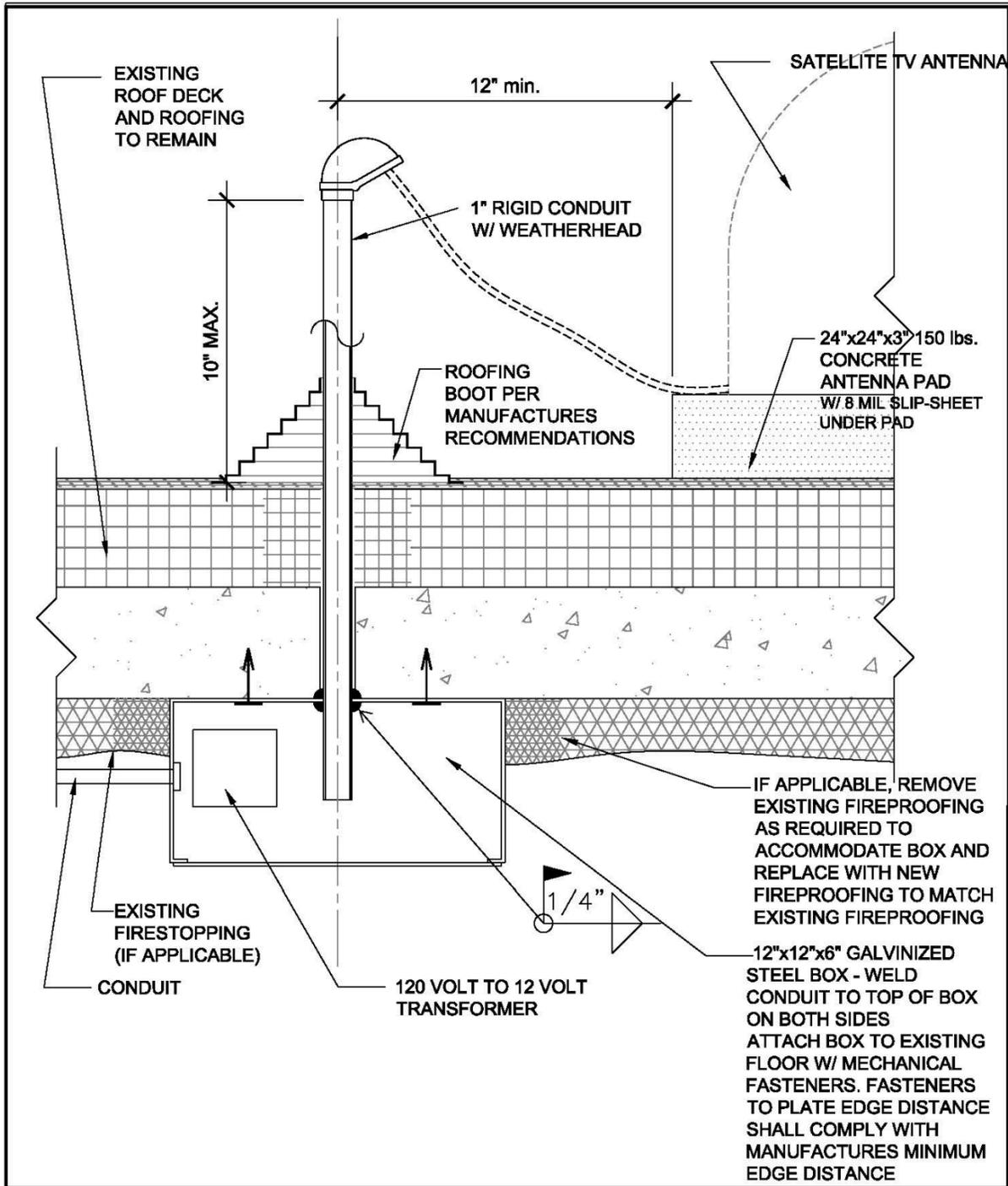


NOTES:

1. ANTENNA MAST, PIPE CONDUIT, PIPE CLAMPS AND STRUCTURAL SUPPORTING SYSTEM SHALL BE DESIGNED BY A GEORGIA STATE REGISTERED STRUCTURAL DESIGN PROFESSIONAL. SUBMIT DESIGN, DESIGN CALCULATIONS AND DETAILS, ON SIGNED AND SEALED DRAWINGS TO DOA PLANNING AND DEVELOPMENT FOR REVIEW.
2. THE SUPPORTING STRUCTURAL SHALL MINIMIZE THE VIBRATION IMPACT DAMAGE TO THE EXISTING ROOF ASSEMBLY.
3. PITCH POCKET IS UNACCEPTABLE AS WEATHER PROTECTION FOR ROOFING PENETRATION.
4. VERIFY EXISTING ROOF ASSEMBLY FIRE-RESISTANCE-RATING REQUIREMENT, PROVIDE AND INSTALL FIRESTOP SYSTEM AS NEEDED. SUBMIT PROPOSED FIRESTOP SYSTEM TO DOA PLANNING AND DEVELOPMENT FOR REVIEW.
5. ENSURE NEW CONSTRUCTION WILL NOT IMPACT EXISTING BUILDING WARRANTY OF ANY KIND.

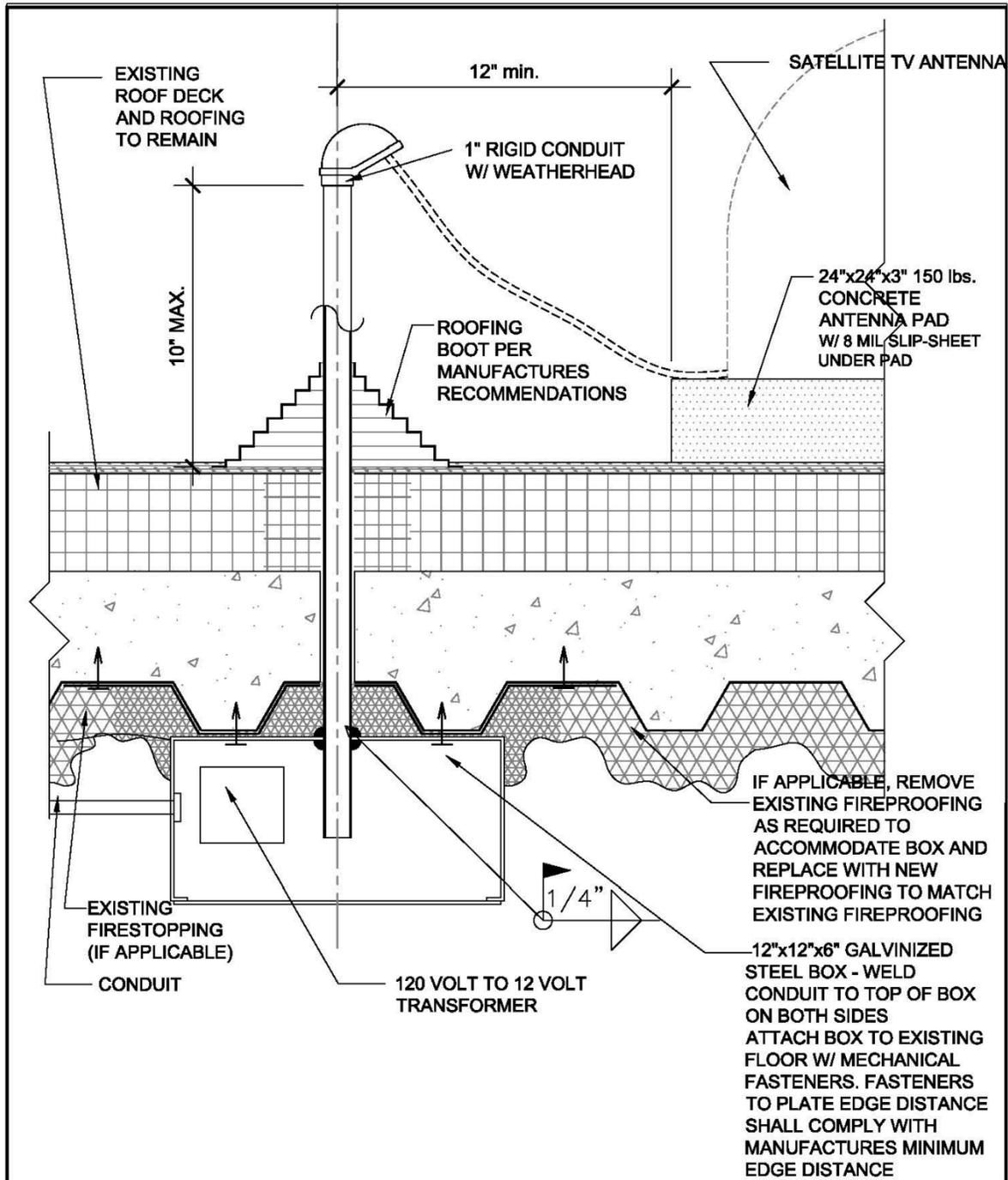
PROJECT: EXISTING ROOF PENETRATION DETAIL FOR ANTENNA MAST			DETAIL NO.
DRAWING NAME: PIPE THRU ROOFING SYSTEM OVER CONC. SLAB			8
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: XX DESIGNED BY: XX CHECKED BY: CHECK CONTRACT: NONE WBS: NONE SCALE: NTS DATE: 05/13/2019	REFERENCE DWG. NO.
No.			NONE
No.			
No.			
No.			

Detail No. 9 Satellite Antenna Conduit and Pad on Concrete Roof Slab



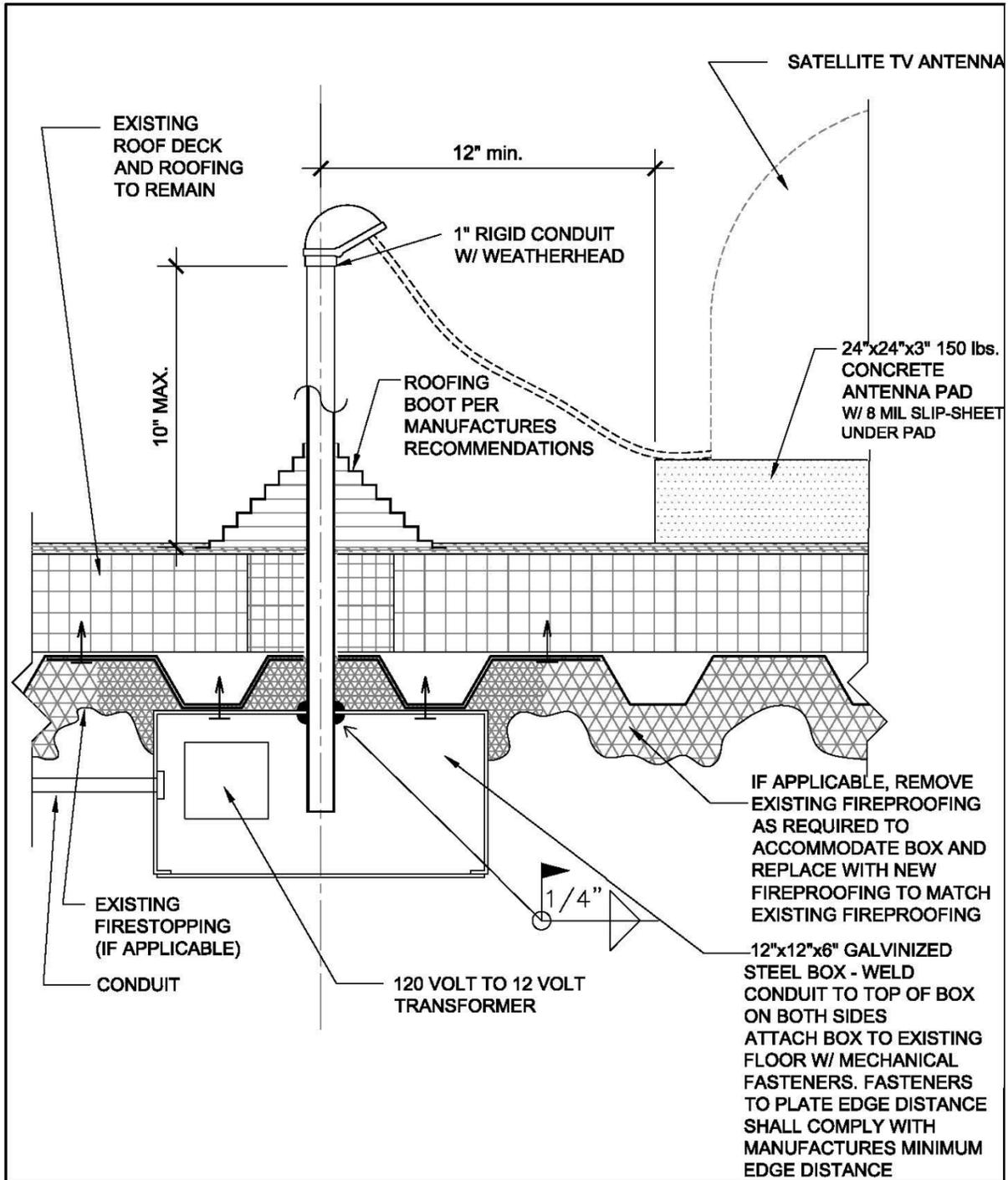
PROJECT: SATELLITE ANTENNA CONDUIT AND PAD ON CONCRETE ROOF SLAB			DETAIL NO.
DRAWING NAME:			9
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: XX	REFERENCE DWG. NO.
No.		DESIGNED BY: XX	NONE
No.		CHECKED BY: CHECK	
No.		CONTRACT: NONE	
No.		WBS: NONE	
No.		SCALE: NTS	
		DATE: 05/13/2019	

Detail No. 10 Satellite Antenna Conduit and Pad on Conc. on Metal Deck



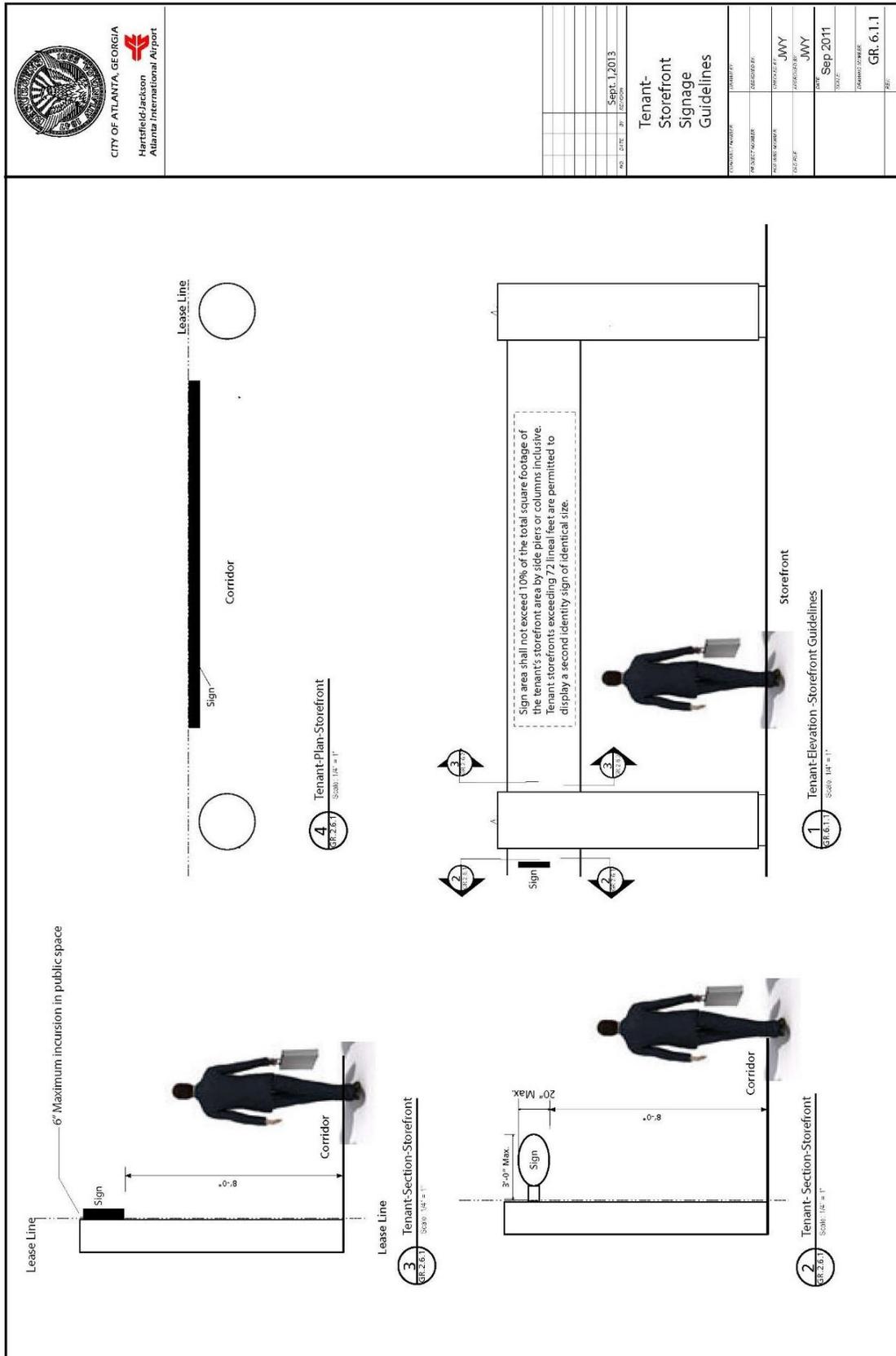
PROJECT: SATELLITE ANTENNA CONDUIT AND PAD ON CONCRETE			DETAIL NO.
DRAWING NAME: ON METAL DECK			10
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: XX	REFERENCE DWG. NO.
No.		DESIGNED BY: XX	NONE
No.		CHECKED BY: CHECK	
No.		CONTRACT: NONE	
No.		WBS: NONE	
No.		SCALE: NTS	
		DATE: 06/13/2019	

Detail No. 11 Satellite Antenna Conduit and Pad on Metal Deck



PROJECT: SATELLITE MAST AND PAD DETAILS			DETAIL NO.
DRAWING NAME: SATELLITE ANTENNA CONDUIT AND PAD ON METAL DECK			11
REVISIONS	DESCRIPTION OF REVISION	DRAWN BY: XX	REFERENCE DWG. NO.
No.		DESIGNED BY: XX	
No.		CHECKED BY: CHECK	
No.		CONTRACT: NONE	
No.		WBS: NONE	
No.		SCALE: NTS	
		DATE: 05/13/2019	NONE

Detail No. 12 Tenant Storefront Signage Standards



Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

Concessions

New Construction and Modifications

Design Standards

Sustainable Development

The Sustainable Development Standards incorporate sustainability components and City of Atlanta ordinance requirements into all Department of Aviation projects. The Sustainable Development Standards should be recognized as best practices and will contribute to the Airport's overall sustainability goals of reducing energy and water consumption, waste generation, and greenhouse gas emissions.

P&D requests that the Sustainable Development Standards be implemented in all Concession projects at ATL to the greatest extent possible. This implementation is voluntary and in no way a contractual requirement. However, incorporating the components will support reducing utility usage and gas emissions, helping to lower overhead costs and improve the indoor and outdoor environmental quality for passengers, concessionaires, and employees.

The standards can be accessed by clicking [here](#).

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

**Airport Facilities Landside/
Airside New Construction
and Modifications**

Design Standards

Mechanical Engineering

**Design Standards
Mechanical
Table of Contents**

Section	Page
1.0 Purpose.....	5
A. Purpose of this Document.....	5
2.0 Codes and Standards	5
A. All Construction Documents	5
B. All Governing codes and Standards	5
C. A&E Firms Shall Design To	5
D. Applicable Codes	5
E. Standards	5
3.0 General Drawing Requirements	6
A. Drawing Layout.....	6
B. Mechanical Plans (HVAC, Plumbing, and Fire Protection)	6
C. Drawing Conventions.....	6
4.0 Trade Specific Drawing Requirements	6
A. HVAC	6
B. Plumbing	7
C. Fire Protection	8
5.0 Primary Utilities Overview	8
A. Central Plant Configuration	8
B. CHW Distribution	8
C. HHW Distribution	9
D. Domestic Water Configuration	9
E. Sanitary Sewer Configuration	9
F. Natural Gas Distribution	9
G. Fire protection Configuration	9
6.0 Space Specific System Descriptions (HVAC).....	10
A. Large CPTC Public Spaces HVAC	10
B. Zoned CPTC Public Spaces HVAC	10
C. Computer Rooms	11
D. Transformer, Substation and Switchgear Rooms	11
E. Apron Level Support Areas	11
F. Communication Closets	11
G. Restrooms	12

H. Hold Bag Screening Facilities	12
I. Spaces requiring Major Equipment Replacement	12
7.0 Space Specific System Description (Plumbing)	12
A. Infrastructure	12
B. Restrooms	12
C. Back of House Restrooms	13
D. Back of House Break Rooms	13
E. Apron Level Support Areas	13
F. Parking Decks	13
8.0 Space Specific System Descriptions (Fire Protection)	13
A. Infrastructure	13
B. Design Criteria	13
C. Accessible toilet chases	13
D. Large CPTC Public Spaces	13
E. Back of House Areas	13
F. Freeze Protection.....	14
G. MDF/T - 3 DAS – Clean Agent Fire Protection System	14
9.0 HVAC Materials and Equipment	14
A. Roof-Mounted Air Handling Units (RMU)	14
B. Interior Modular Air Handling Units (AHU)	14
C. Variable Air Volume Boxes (VAV)	15
10.0 Ductwork.....	15
A. Ductwork	15
B. Duct Insulation	15
C. Air Distribution Devices	15
D. Controls	15
E. Test and Balance	16
F. Utility Piping	16
11.0 Plumbing Materials and Equipment	17
A. Sanitary, storm and Kitchen Waste and Vent Piping	17
B. Kitchen (greasy) waste	17
C. Domestic Water Piping	17
D. Natural Gas Piping	17
E. Insulation	18
F. Water Heater	18

12.0 Fire Protection Materials and Equipment18

- A. Fire Protection piping18
- B. Fire Protection Equipment18
- C. Sprinkler Heads18

Appendices

Appendix A - Standard Multizone Sequence20

Appendix B - Single Zone AHU Standard Sequence24

Appendix C - Standard Terminal Unit Control Sequence29

Appendix D - BMS Points Standard Lid Details30

Table 1 – Passenger Terminals – HVAC Operating Parameters32

Design Standards

Mechanical Engineering

1.0 Purpose

- A. The purpose of this document is to outline the minimum design standards and installation requirements for mechanical systems (HVAC, plumbing and fire protection), which are installed to serve various spaces through the Central Passenger Terminal Complex (CPTC) at Hartsfield-Jackson Atlanta International Airport (H-JAIA or "Airport").

2.0 Codes and Standards

- A. All construction documents shall be by professional engineers registered in the discipline specific to the trade work indicated on the contract drawings.
- B. All governing codes and standards indicated in the trade sections of this document will be adhered to by the designers of record for all new construction and renovation projects initiated on any facility inside the bounds of H-JAIA or under the jurisdiction of DOA.
- C. A&E firms shall design to the most current codes adopted by the City of Atlanta and State of Georgia. Code conflicts shall be resolved by using the more stringent applicable code. Notify DOA-P&D of any substantive discrepancies between various codes or with any of these standards.
- D. Applicable Codes (Building Codes and regulations as adopted by the State of Georgia with amendments)
 - 1. International Plumbing Code (With Amendments)
 - 2. International Building Code (With Amendments)
 - 3. International Fuel Gas Code (With Amendments)
 - 4. International Mechanical Code (With Amendments)
 - 5. International Energy Conservation Code
 - 6. National Fire Protection Association (NFPA) Codes
 - 7. NFPA 70 National Electrical Code
 - 8. NFPA 90A Standard for the Installation of Air Conditioning and Ventilation Systems
 - 9. NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems
 - 10. NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
 - 11. NFPA 101 Life Safety Code
 - 12. NFPA 13 Standard for the installation of Sprinkler Systems
 - 13. NFPA 14 Standpipe and hose systems
 - 14. NFPA 20 Installation of stationary pumps
 - 15. Standard Building Code
- E. Standards
 - 1. AATC Building Automation Systems Standard -- Version 2.0
 - 2. ANSI American National Standards Institute

3. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality
4. ASHRAE 90.1 Energy Standard for Buildings
5. ASME American Society of Mechanical Engineers
6. National Green Building Standards
7. Bureau of Watershed, Grease Interceptor design

3.0 General Drawing Requirements

- A. Drawing layouts shall be neat, orderly and complete, showing all information required to convey the scope of work to general contractors or reviewing entities. Drawings will be prepared under the supervision of a Georgia state licensed professional engineer and shall bear his/her seal.
- B. Mechanical plans, (HVAC, Plumbing, and Fire Protection) shall be consistent with the Architectural plans (e.g., same scale, match lines, common graphic standards) as the base set of documents. Part plans for mechanical equipment rooms, restrooms, kitchens and all rooms shall be provided where the density of support equipment prohibits clear documentation of the systems serving the space at the architectural base scale.
- C. Provide all necessary drawing conventions to aid in the easy identification and location of spaces within the CPTC, Items shall include, but not be limited to project north indicators, column lines and call outs, room identification (rm number and/or function/name as space allows)

4.0 Trade Specific Drawing Requirements:

- A. HVAC
 1. Show all primary and secondary ductwork and major HHW/CHW piping using double line graphic standards. HVAC plan drawings shall be 1/8" or larger.
 2. Provide sections as required to show inter-trade coordination in space restricted areas (i.e. ceiling plenums, mechanical chases, baggage handling areas, etc.)
 3. Provide mechanical enlarged part plans as required to show equipment, ductwork, and piping in mechanical rooms. Enlarged plans shall be 1/4" scale.
 4. Provide riser diagrams for CHW, HHW, outside air, and exhaust air as required.
 5. Provide HVAC installation details, as required, for major equipment and devices that have complex installation requirements.
 6. Provide schedules for all HVAC equipment
 7. Provide air flow balance summations for space (or building) as required to indicate/validate positive pressure relationship between critical building components.
 8. Provide Control schematic diagrams for all equipment tied to DDC system or under stand-alone control. Provide I/O summary and written sequence of operation on drawings.
 9. Provide HVAC calculations (Bldg. load, OA requirement, pump, fan, air flow balance, etc.) for review.
 10. Provide specifications using standard division nomenclature with all sections required to describe all equipment and all construction methods utilized.
 11. See Table 1 for Operating Parameters.

B. PLUMBING

1. Large scale plumbing plans shall be 1/16" scale plans. Coordinate with DOA if the project requires the use of a different scale. Use 1/8" scale plans (as a minimum) for all restrooms and food service areas.
2. Piping systems shall be shown on the plan background that corresponds to the level on which the piping is to be installed. (i.e- sanitary piping that serves a boarding level FD will show up on the apron level plan in the ceiling plenum)
 - a. Backgrounds should clearly indicate where designated electrical rooms, communications rooms control rooms and IT (MDF/IDF) rooms are located. Piping should not route thru these rooms. If piping must run thru these spaces, show major equipment in the room(s) and indicate provisions to protect and critical equipment below.
 - b. EOR must coordinate pipe routing with other major systems that support ramp services. Show systems like baggage handling conveyors and carousels, tug lanes, electrical gear and any item that needs O&M clearance to operate on plans and indicate provisions for maintenance.
3. Provide riser diagrams for all sanitary waste and vent, grease waste, domestic water systems, and natural gas systems.
4. Provide schedules for all major plumbing devices including but not limited to, water heaters, pumps, air compressors, etc. Example:
 - a. Plumbing Fixture Schedule with Mark, description, pipe connection sizes, manufacturer, model number and description as a minimum.
 - b. Water Heater Schedule with location, make and model number, gallons, number of elements Voltage and delivery temperature.
 - c. Pump Schedule with Mark, manufacturer, model number electrical, RPM/GPM, Head Description as a minimum.
 - d. Drain Schedule with mark, manufacturer, model number, and description as a minimum.
 - e. Equipment schedule, Mark description, manufacturer, model number, description, etc.
5. Indicate clearly locations and line sizes of all connections to existing systems. (coordinate with civil drawings and DOA master utility locations)
6. Provide detail sheets with detail that are edited for the specific project.
7. Indicate rainfall rate used for design and indicate roof square footage for each roof drain and pipe.
8. Calculations (Fire Protection)
 - a. Provide Hydraulic calculations on all major designs and renovations.
9. Specifications using standard division nomenclature with all sections required to describe all equipment and all construction methods utilized.
10. Demolition Drawings
 - a. Provide demo drawings as shown on architectural drawings. (Size, scale, area)
 - b. Show existing utilities that are being demoed.
 - c. Provide scope for provision to connect in future or remove abandoned piping.

C. FIRE PROTECTION

1. Provide design criteria drawings, 1/8" scale or larger with existing and new sprinkler head locations, lights and diffusers (for coordination), Hazard classification, including density and remote square footage and location of same for all spaces within a design.
2. Provide piping layout plans for major renovation projects and new construction.
3. Provide specifications including but not limited to, piping, sprinkler heads, equipment, ETC. Provide specifications using standard (xxx) division nomenclature with all sections required to describe all equipment and all construction methods utilized.
4. Provide hydraulic calculations with shop drawings done by a certified fire protection system designer. Sprinkler shop drawings and as-built drawings are to be submitted to DOA in an approved format.
5. Provide fully coordinated RCP's showing sprinkler head locations and types. RCPs shall show ceiling types, light and diffuser locations for coordination.
6. Calculations

5.0 Primary Utilities Overview

A. Central Plant Configuration

1. The majority of the CPTC is served by two Central Utility Plants (CUP's). The T-CUP plant is located at the east end of the Main Passenger Terminal on the Apron level between the center spine roads. The E-CUP plant is located at the west end of E concourse on the Pedestrian Mall (Plane-Train) level next to the Bombardier train maintenance shop.
2. Chilled Water (CHW) and Heating Hot Water (HHW) are distributed thru a traditional four pipe system. Because of environmental requirements we are not allowed to operate boilers during summer months (approx. May- September). As an energy savings measure, we shut down the chilled water system based on OA temp. (typically when OA temp falls below 60 degrees. Neither CUP has water side economization. EOR's should consider the CUP's as functioning as 2-pipe systems with the exception of limited periods during shoulder seasons when OA temperatures dictate the energization both chillers and boilers.

B. CHW Distribution

1. The CHW system is a Primary/Zoned Pumping system. With a cross connection that allows concourses loads (specifically C& D CON's) to be feed from either CUP. T-CUP serves the North & South Terminal, the Atrium and CON's T-D. The piping system in the main utility tunnel was originally designed to serve A-D Concourses from T-CUP and Concourses E & F from E-CUP. The cross connection is valved and sized to allow both C&D CON's (as a pair) to be fed from either CUP.
2. Primary Pumps circulate CHW thru the chillers within the CUP. Primary Pumps are paired with the chillers and sized to pump the chiller and charge the main loop. Each plant typically has at least N+1 redundancy for major equipment.
3. Zone Pumps are located within each concourses' individual pump room and are sized to circulate CHW thru the tunnel the full distance back to the CUP, for CON's T-D. Main Terminal pumps are in T-CUP. Concourse E&F zone pumps are in E-CUP. There are typically 2 zone pumps per concourse sized at 50% of full load. (note: DOA usually requires the selection each zone pump to handle 60-

70% of full load by riding the curve) Consult with P&D whenever a Concourse addition adds a significant amount of load to the CHW system, as pump replacement will need to be evaluated by the EOR

C. HHW Distribution

1. The HHW system is a Primary/Secondary/Tertiary Pumping system. T-CUP serves the North & South Terminal and CON's T-D while HHW for Concourses E & F are served from E-CUP
2. Primary Pumps circulate HHW thru the boilers within the CUPs. Primary Pumps are paired with the boilers and sized to pump the boiler and charge the main loop. Each plant typically has at least N+1 redundancy for major equipment
3. Secondary Pumps are typically located in the CUPs and are sized to circulate HHW thru the facility loop
4. Tertiary Pumps are located within each concourses' individual pump room and are sized to circulate HHW thru the concourse, for CON's T-D. The pumps that serve the various Main Terminal tertiary loops are located in the T-CUP. Concourse E&F Tertiary pumps are in E-CUP. There are either 2 or 3 Tertiary pumps per concourse. For Concourses with 2 pumps each pump is sized at 100% of full load. For Concourses with 3 pumps, each pump is sized for 50% of full load flow. Consult with P&D whenever a Concourse addition adds a significant amount of load to the HHW system, as pump replacement will need to be evaluated

D. Domestic Water Configuration

1. Water is supplied from Hapeville and College Park. The airport is looped with water mains.
2. Each concourse is fed with one domestic water and a combination domestic and fire service.
3. The water pressure is at or above 80PSI and requires a PRV.

E. Sanitary Sewer Configuration

1. Sanitary sewers run North and South toward the center point
2. Each concourse has 4" and 6" laterals connecting the concourse waste to the mains.
3. Grease Waste from large food and Beverage areas require Grease Waste, (GW), to discharge into one or two 1,500-gallon underground grease interceptors or a 1,500 or a 3,000 gallon above-ground grease interceptor.

F. Natural Gas Distribution

1. Natural Gas is supplied by Atlanta Gas Light.
2. Gas piping is routed underground between the taxi way and the NLVR with a branch off to the south side of each concourse.
3. Piping is regulated to 5PSI or higher on the roof
4. Gas piping for Concourse E and F is routed inside each building and on the roof
5. Gas piping for T-CUP is fed from the 6" gas main on the roof of Concourse-T.
6. The Food & Beverage Concessions service to each space is metered

G. Fire Protection Configuration

1. Each concourse is equipped with a 750 GPM fire pump and jockey pump.

2. Each fire pump room is equipped with a double check valve assembly, alarm check valves, (Dry or wet), controllers, test headers, Fire and Jockey pumps, fire department connections, distribution piping and a fire hydrant in the area.
3. There are Fire Valve Rooms on the Apron Level with FDC and alarm valves, (Wet or Dry).
4. The existing sprinkler system is designed at a minimum design density of Ordinary Hazard Group I. (Any new systems are to be designed at a minimum of Ordinary Hazard Group I)
5. Critical Rooms and MDF rooms are to be protected with clean agent fire suppression systems.
6. Areas that are subject to freezing are protected with a dry sprinkler system or NFPA approved Heat Trace and insulation.
7. Parking Structures are protected with a manual dry standpipe system, and with wet sprinklers in any office areas.

6.0 Space Specific System Descriptions (HVAC)

A. Large CPTC Public Spaces HVAC

1. Spaces which fall under this heading are free of interior partitions, relatively large volumes which can either be interior zones or combination interior/exterior zones with the provision that both thermal and air diffusion through the space is relatively uniform and unencumbered. Spaces which generally fall under this category include (but are not limited to) Terminal ticketing and baggage claim areas, Large Terminal Atria, Public seating & Circulation areas, TSA and Concession Cue areas
2. Large CPTC Public spaces are to be served by medium and low pressure VAV Roof Mounted units RMU's (or RTU's) wherever possible. VAV indoor AHUs can be used as an alternate, when practical, provided a clean source for OA can be routed to the interior mechanical room. Sufficient space for 100% economizer and relief air must also be provided. Separated ductwork and motorized damper for minimum and economizer outside air shall be provided. Outside air and return air in mechanical rooms shall be ducted to AHUs.
3. Provide Single Zone VAV RMU's or AHUs for these large-open volume public spaces which have relatively uniform heating and cooling load distributions. These AHUs/RMU's will utilize chilled and hot water from the central plant water loops.
4. Distribution ductwork in these spaces need to ensure very good air circulation to minimize the chance of hot or cold spots.

B. Zoned CPTC Public Spaces HVAC

1. Spaces which fall under this heading are located adjacent to each other but have varying load profiles due to external heat gains, or differences in internal space utilization. Spaces which generally fall under this category include (but are not limited to) Concourse main circulation corridors, Hold Rooms, smaller Concourse Atria, Food Courts, and Concession, Tenant Cue areas, General Office and Back of House spaces.
2. Zoned CPTC Public spaces are to be served by medium and low pressure VAV Rooftop RTUs (RMU's) wherever possible. VAV indoor AHUs can be used as an alternate, when practical, provided a clean source for OA can be routed to the interior mechanical room. Sufficient space for economizer and relief air must also

be provided.

3. Provide VAV AHUs/RMU's for these spaces. These AHUs/RMU's will utilize chilled and hot water from the central water loops. Provide VAV terminal units with hydronic heating.
4. Use of Fan powered terminal units/power induction units (PIUs) is discouraged in the CPTC base systems. Coordinate with DOA/AATC to receive prior approval before using PIUs in any special applications.

C. Computer Rooms

1. AIS has several server rooms located throughout the facility. Main server rooms utilize dedicated "Leibert Type" CRU's. The main train control server rooms are conditioned with similar CRU's.
2. In the future, on a case-by-case basis, we will have different types of equipment based on the critical nature of the equipment being cooled.
3. Typical systems run from DX cooling split systems or package thru-wall systems up to chilled water or air-cooled computer room units. Special care must be used for rooms conditioned from the base building system as the central plant is de-energized when the OA temp. is below 60 degrees F.

D. Transformer, Substation & Switchgear Room

At a minimum, provide ventilation as the load dictates, eight (8) to ten (10) air changes per hour is considered minimum ventilation for typical CPTC applications. Base building air conditioning can be used in lieu of ventilation where existing RTU's/ AHU's have sufficient AC spare capacity to all rooms, GA Power separate. No plumbing shall be run through these rooms whenever possible. If plumbing routing through the room is unavoidable, provisions shall be made to protect equipment from water. If plumbing routing through the room is unavoidable, provisions shall be made to protect equipment from water.

E. Apron Level Support Areas

1. Areas with heavy tug traffic that is exposed to outside air, (under the terminal) need to provide exhaust and fresh air (cross-ventilation) fan systems. Heated ventilating units may be required if large amounts of un-tempered outside air are needed to ventilate a given Apron level space.
2. In locations where baggage handling operators are located for extended periods of time, (i.e. make up stations) provide supplemental heating systems (typically, radiant heat) for operator comfort.

F. Communication Closets

1. Type of AC is dependent on location and critical nature of application. If base building AC is available, it is acceptable to use a dedicated VAV terminal unit.
2. If the application is critical, a backup fan may be required to provide ventilation in case of a system failure.
3. Where Base Building AC is not available, (typical on Apron level), provide DX unit or split system AC systems.
4. In critical spaces, two DX units or back up fan ventilation systems may be required.
5. Water source heat pump tied into domestic water system is not allowed under any circumstances.
6. AGT Level Communication Rooms: Due to the location of these communication rooms, heat rejection is problematic. Use DX split systems to condition space

Reject heat into the closest AGT Mechanical Room, only if a path to the apron level cannot be created.

G. Restrooms

1. Public Restrooms will be directly exhausted to the exterior of the building. Provide heating and cooling VAV terminal units to condition the space. Provide transfer air duct systems to allow make-up air into any restroom if required.
2. Back of House Restrooms will be directly exhausted to the exterior of the building. Provide heating and cooling VAV terminal units to condition the space as required. Provide transfer air duct systems, or door grilles, to allow make-up air into any restroom.

H. Hold Bag Screening Facilities

1. Screening Rooms: These spaces are where the large CTX automated baggage screening systems are located along with the associated baggage handling conveyer systems. These spaces are considered critical application spaces, with high heat output equipment.
2. These spaces are to be served by medium and low-pressure single zone AHUs. Provide a clean source for OA to the mechanical room. Sufficient space for economizer and relief air must also be provided.
3. Provide Single Zone VAV AHUs for these large-open volume spaces which have relatively uniform cooling load distributions. These AHUs will utilize chilled and hot water from the central water loops. Provide hot water pre-heat coils for freeze protection as required.

I. Spaces requiring Major Equipment Replacement

1. When a space requires a straight one for one replacement of a major piece of equipment, the EOR shall, at a minimum, be sure to coordinate the following:
 - a. Current manufacturers can provide the same features as the original manufacturer.
 - b. Equipment dimensions can be made to work in the existing space allocated for the original equipment.
 - c. Existing structure can accommodate the new equipment weight.

7.0 Space Specific System Descriptions (Plumbing)

Water Service rooms for new development shall be sized to accommodate all required assets.

- A. Infrastructure consists of domestic water supplied from the city water system at a pressure of 60 to 70 pounds. There is a sanitary sewer system at each concourse and terminals. There is natural gas supplied on the roof of concourse T, A, C, D, and inside E and F. Gas is routed to concourse B but not installed on the roof. The natural gas is for limited use mainly for cooking by concession with a separate meter. T CUP gas is supplied from piping routed from the south end of concourse t on the roof to the center point. E CUP gas is supplied from piping in the tunnel between concourse E and F.
- B. Restrooms
1. Public restrooms shall be ADA accessible with touch free metering low flow fixtures (Per IPC).
 2. All public restrooms shall have floor drains in each fixture area.

3. All accessible toilet chases will have floor drains.
 4. All public restroom areas will be equipped with a janitor closet with an electric water heater with mixing valve, floor drain and a mop sink as a minimum.
- C. Back of House Restrooms
1. Restrooms shall be ADA accessible with low flow fixtures (per IPC)
 2. Restrooms shall have floor drains.
- D. Back of House Break Rooms
1. Break rooms with sinks can use storage heaters or instant electric water heaters
 2. If cooking is required or a dishwasher is required, a grease trap or interceptor may be required.
- E. Apron Level Support Areas
1. If cooking is required or a dishwasher is required a grease trap or interceptor may be required.
- F. Parking decks
1. Storm Drainage, Top Level and exterior ramps shall be designed per IPC Rainfall Criteria for City of Atlanta.
 2. Lower levels are to be designed for minimum run-off from cars and blowing rain.
 3. Elevator Penthouse and stair towers roofs are to be designed with primary, and overflow drains or scuppers.
 4. Parking deck entrance will be designed to capture runoff from cars only unless exterior grade requires more rainfall rate.
 5. Drainage and pipe calculations shall be noted on each deck drain and trench drain on top level, (Square footage, area and GPM), will be noted on each deck drain and trench drain on top level, all vertical and horizontal piping along with pipe size.
 6. Domestic Water, (If required), entrance will be in heated space in a secure box or with heat trace and insulation, shut-off valve and drain. Hose bibbs will be equipped with a vacuum breaker. Maximum flow of 10GPM unless approved by DOA.

8.0 Space Specific Systems Descriptions (Fire Protection)

- A. Infrastructure, Fire protection is supplied by a fire pump or pumps and jockey pump or pumps on each concourse and terminals. Dry pipe systems or heat trace and insulation are provided where fire protection is subject to freezing.
- B. Design Criteria, all areas in the CPTC are to be designed to Ordinary Hazard Group I as a minimum.
- C. Accessible toilet chases will have sprinklers.
- D. Large CPTC Public spaces and zoned CPTC public spaces, including restrooms shall have All sprinkler heads be concealed type with color to match ceiling cover.
- E. Back of House Areas Back of house areas will be protected with concealed heads or semi-recessed where lay-in ceiling is installed. Areas without ceiling will be protected with upright heads.

- F. Freeze Protection Exposed Apron level spaces
 - 1. Areas subject to freezing will be dry pipe system or be heat traced and insulated.
- G. MDF/T-3 Das – Clean Agent Fire Protection System
 - 1. MDF/T-3 DAS and other critical computer rooms will be protected with a Clean Agent Fire Suppression System.

9.0 HVAC Materials and Equipment

- A. Roof-Mounted Air Handling Units (RMU)
 - 1. Roof-Mounted air handling units shall be custom built and sized to meet the cooling, heating and ventilation needs of the spaces it will serve. The requirements are application specific and will be coordinated with P&D-E during the validation and /or early (30%) design phase. Typical features include:
 - 2. RMU's shall be all aluminum construction including unit base rails.
 - 3. RMU's shall include (as required by application) chilled water-cooling coil section, hot water pre- heat coil section, supply fan, mixing section with dampers, Return section, discharge section and access sections between coils and between filters. RMU's shall have interior access corridor (min 54" clear width). Outside air dampers shall be split into a section for minimum requirements and a section for economizer outside air. Minimum outside air sections shall be configured to allow MFG required installation and proper operation of the flow meter at all velocities.
 - 4. Camfil Merv 14 high flow bag filters, 30% efficient pre-filters.
 - 5. Provide UV light assemblies as a means of coil sterilization
 - 6. Provide relief fan section for odor and (nonlife safety) smoke purge to be used after a fire event occurs on a given concourse.
 - 7. Where required by extensive return air duct runs, units shall be provided with return fans and relief dampers.
 - 8. Where possible RMU's will utilize fan array assemblies to increase reliability.
 - 9. Provide variable frequency drives on all VAV RMU's, mounted inside the unit. Provide redundant variable frequency drives on all critical RMU's,
 - 10. Interior lights and service receptacles shall be wired to a junction box for single-point 120-volt feed that can be powered when the main unit components is de-energized.
- B. Interior Modular Air Handling Units (AHU)
 - 1. Interior air handling units shall be modular, double-wall units and shall include (as required by application):
 - chilled water-cooling coil, hot water pre-heat coil,
 - Camfil Merv 14 high flow bag filters, 30% efficient pre-filters.
 - Provide UV light assemblies as a means of coil sterilization
 - Utilize Fan array or centrifugal supply fan, depending on unit size.
 - Mixing box section with dampers and interior lights.
 - Where required by extensive return air duct runs, units shall be provided with return fans and relief dampers.
 - Variable air volume units shall be provided with variable frequency drive.
 - Interior lights and service receptacles shall be wired to a junction box for single-point 120-volt feed.
 - AHU shall be able to operate in 100% outside air economizer mode.

2. Outside air intake location shall be analyzed for requirement of including carbon filtration. Dedicated OA injection fan may be required to ensure minimum required OA is achieved if OA route pressure drop is larger than 0.75" W. C.'1.
- C. Variable Air Volume Boxes (VAV)
1. VAV Boxes shall be single-duct terminal unit complete with modulating damper, airflow measuring sensor, and internally insulated casing. Reheat boxes shall be provided with hot water reheat coils. DDC controls and damper actuator will be provided by Controls contractor.
 2. Power wiring for damper actuators shall be provided for in design.

10.0 Ductwork

- A. Ductwork shall be galvanized steel sheet metal designed and constructed per SMACNA duct construction standards. Fiberboard duct is not permitted. Main duct trunks shall be located over common areas or corridors whenever possible. Balancing dampers shall be provided at proper locations to allow balancing of systems. Provide turning vanes to help system balance and minimize effect.
- a. Flex duct run outs to diffusers shall not be longer than 6 feet. Flex duct shall not be used in exhaust systems.
 - b. Coordinate RCP to ensure access to all devices located above hard ceilings.
- B. Duct Insulation
1. Duct insulation for supply air, return air, and outside air ducts above ceilings shall be fiberglass blanket wrap, 2" thick, 1.5 lb./cu.ft. density with a factory-applied FSK vapor barrier. Insulation thermal conductivity at 75°F shall be 0.27 BTU-in./hr./sq.ft./°F. On rectangular ducts 24 inches wide and larger, apply stick pins and washers on 18-inch centers on bottom side of duct.
 2. Duct insulation for supply air, return air, and outside air ducts in exposed unconditioned spaces shall be rigid fiberglass board insulation, 2.5" thick, 3 lb./cu.ft. density with factory-applied FSK vapor barrier.
 3. All insulation R-values shall meet the current energy code requirements.
- C. Air Distribution Devices
1. Air distribution devices selected shall match the style of devices in existing areas and in new facilities. Devices shall be provided with dampers and shall be selected based on throw and noise criteria. Linear slot diffusers shall be used at large glass areas on exterior walls.
- D. Controls
1. Controls for all new equipment installations and renovation of old systems shall be DDC and shall be fully BACnet IP compatible. Systems shall connect and be fully integrated with the existing Niagara system frontend. Maintained and operated by AATC. Graphics shall be seamlessly integrated into the Niagara front end for end user ease of use.
 2. Multizone AHU programming shall comply with Multizone Standard Sequence (see appendix A). Single zone AHU programming shall comply with Single Zone Standard Sequence (see appendix B). Terminal Units shall comply with Terminal Unit Standard Sequence (see appendix C).
 3. The BACnet points required for the BMS shall be configured, exposed, and viewable from the base building BMS front end and comply with the BMS Points Standard List for naming conventions and descriptions (see appendix D).

4. Zone temperature thermostats shall be networked type sensors, communicating on either the SA or BACnet bus.
- E. Test and Balance
1. All HVAC systems shall be tested and balanced upon completion of installation. The TAB services shall be performed by an AABC-certified contractor.
- F. Utility Piping
1. Chilled Water and Heating Hot Water pipe shall be ASTM A-53 Grade B pipe carbon steel. Piping 2-1/2" and smaller shall be threaded and coupled with 150 lb. threaded fittings. Piping 3" and larger shall be plain end pipe with 150 lb. butt-welded fittings. *Welded or threaded fittings shall be used on all CHW & HHW piping in the following locations:*
 - *CUP's*
 - *Utility tunnels*
 - *Ceiling plenums or chases that will be difficult to access. Coordinate with DOA to evaluate accessibility thresholds.*
 2. Other piping materials and joining methods are allowed outside of these three specific areas as indicated below:
 - a. Type L hard-drawn copper with solder joint fittings may be used for piping 2 - 1/2" and smaller. (This is typically for HHW distribution piping to TU's and possibly on CHW & HHW in mechanical rooms)
 - b. Mechanical joining systems pressed joint & grooved-joint systems may be used in mechanical spaces, (AHU rooms, RMU Piping vestibules, etc) exterior or exposed spaces and on distribution piping where reasonable access is assured.
 - c. Mechanical joint systems may be used for piping 2 1/2" thru 8". Couplings 2 1/2" through 8" to be of installation-ready design (requiring no disassembly to install)
 - d. Gaskets for mechanical joint systems on hydronic services shall be EPDM. The gasket material shall be suitable for the fluid service type and temperature.
 - e. Quality assurance- The EOR shall coordinate their specification with the mechanical joint manufacturer to ensure the performance of the system meets the products intended use. A factory-trained representative (direct-employee of the MFG) shall periodically visit the job site and review installation. The mechanical joint manufacturer will train the mechanical contractor's field and fabrication shop installers in accordance with proper piping practices and manufacturer's recommended installation methods. Mechanical Subcontractor shall use only manufacturer's approved mechanical joining tools, equipment and methodology for all piping installed in a system.
 - f. Mechanical Subcontractor shall use the same mechanical joining method for all piping installed in a system.
 - g. Provide adequate valving to ensure major runs of mechanically joined piping can be isolated. *At a minimum, provide isolation valves on all CHW & HHW piping mains (regardless of joining method-welding included) where these systems cross a building expansion joint.*

- h. Piping headers shall be routed over corridors or common areas for access where possible. Route piping as to not impede access to existing or new equipment that may be installed above. Minimize piping runs over escalator wells and other spaces that cannot be accessed from a standard scissor lift.
- i. Cooling coil condensate will be routed to sanitary system (floor sinks, hub drains or mop sinks). Condensate piping shall be type L copper.
- j. Refrigerant piping shall not be assembled using any mechanical pipe joining methods.
- k. Pipe insulation shall be rigid fiberglass pipe insulation with all-service jacket vapor barrier. Piping located outside and in unconditioned areas (typically found on ramp, apron, baggage and train levels) shall be closed cell covered with aluminum jacketing.
- l. New piping shall be thoroughly cleaned and flushed before placing into service.
- m. Avoid routing CHW/HHW piping in electrical and MDF-IDF rooms. No mechanical joints on any piping that must run thru critical IT and electrical rooms
- n. Labeling: Provide color coded labeling with directional arrows for all CHW & HHW piping

11.0 Plumbing Materials and Equipment

- A. Sanitary, Storm and Kitchen Waste and Vent Piping
 - 1. Sanitary waste and vent and storm piping shall be service weight cast iron pipe and fittings with factory asphalted coating.
 - a. Underground piping shall be hub and spigot with push-on compression joints with neoprene gaskets.
 - b. Above ground piping shall be no-hub joints with stainless steel bands and neoprene sealing sleeve.
- B. Kitchen (greasy) waste, from dishwasher, floor drains, floor sinks, three compartment sink, mop sink and food grinder wastewater to exterior grease interceptor shall be stainless steel piping with hub and spigot DWV fittings with push on joints. Provide joint restraints as recommended by the manufacturer.
- C. Domestic Water Piping
 - 1. Potable water piping shall be type "L" copper.
 - 2. Fittings 4" and smaller shall be solder using 95/5 lead free solder or press fittings with neoprene "O" ring.
 - 3. Fittings larger than 4" shall be rolled groove.
 - 4. Fittings 4" and less shall be press fitting with neoprene "O" ring.
- D. Natural Gas Piping
 - 1. Above ground gas piping shall be schedule 40 black steel.
 - a. Gas piping in return air plenum and larger than 2" shall be welded.
 - b. Gas piping 2" and smaller shall be threaded.
 - c. Above ground piping exposed outdoors shall be coated and wrapped or painted with a minimum two coats of yellow epoxy paint.

2. Underground gas piping.
 - a. Outdoors at building entrance, schedule 40 black steel piping with threaded or socket welded fittings and coated with protective coating and wrapping.
 - b. In concealed locations shall not have unions, fittings or couplings unless tubing is brazed, piping is welded, or fittings are listed for use in concealed spaces.
 - c. Below slab piping shall be installed in a trench or be contained with containment piping vented to the exterior.
- E. Insulation
 1. Domestic cold water, 1" thick fiberglass pipe insulation
 2. Domestic hot and hot water return, 1" thick fiberglass pipe insulation.
 3. Domestic water piping exposed in kitchen or wash down areas shall be "1" for cold and 1" for hot and hot water return closed cell insulation with aluminum jacket.
 4. Domestic water piping exposed outdoors will be heat traced and insulated with a minimum of 1" insulation and aluminum jacket.
 5. Roof drain body and horizontal piping 1/2" duct wrap.6'
 6. Sanitary drainage, p-trap and horizontal piping, serving HVAC condensate, ice machines and ice boxes, shall be insulated the same as roof drains and horizontal piping.
 7. P-traps, sanitary piping, and kitchen piping, (GW), exposed to freezing shall be heat traces and insulated with aluminum jacket.
- F. Water Heaters
 1. Water Heaters shall be electric where possible or approved by DOA

12.0 Fire Protection Materials and Equipment

- A. Fire Protection Piping
 1. All components of the fire protection systems and installation shall meet NFPA 13 requirements.
 2. Underground piping shall be ductile iron with mechanical joint fittings and thrust blocks or tie-rods.69
 3. Above ground sprinkler piping shall be schedule 40 carbon steel with welded or threaded joints and schedule 10 rolled grooved. Fittings shall be UL-listed and FM-approved for fire protection service. Mechanical Grooved fittings and couplings which are UL-listed and FM-approved are permitted.
 4. All dry pipe sprinkler systems shall be schedule 40 galvanized steel.
- B. Fire Protection Equipment
 1. Wet sprinkler systems shall be designed through an alarm check valve in lieu of a straight way check valve with flow switch.
 2. Dry sprinkler system shall be designed through a dry alarm valve with air compressor.
- C. Sprinkler heads
 1. Concealed type sprinkler heads shall be in sheet rock ceilings and 2X4 lay-in

ceiling (at 1/2 points).

2. Semi-recessed heads shall be used in 2X4 lay-in ceiling (at 1/2 points)
3. Upright heads shall be used for areas without ceiling or for dry systems.
4. Concession can use any UL, FM approved head in their space, except sprinkler heads designated for residential applications

Appendix A - Standard Multizone Sequence

1.0 Standard Multizone Sequence

All setpoints, values, and time delays referenced are initial values that must adjustable

- A. Occupied-unoccupied mode control:
 - 1. Air handling unit (AHU) default is a 24/7 run schedule, where supply fan runs continuously.
- B. Start-stop control:
 - 1. Provide hand-off-auto switch. In auto position, the air handling unit shall start. Upon receiving a start command, the smoke damper shall open, and minimum outside air damper shall open to its minimum position. After the smoke damper and either the maximum outside air or return air damper are proven open via end switches, the supply fan shall start.
- C. Warm up mode control:
 - 1. The space temperatures shall be monitored and compared to the warmup setpoint (65 °F). The air handling unit will enter in warm up mode if more than 25% of zones are lower than warm up setpoint. It will remain in warm up mode until less than 15% of the boxes are less than warm up setpoint. In morning warm up mode. The air handling unit's minimum and maximum outside air dampers, relief air damper, and chilled water valve will be closed the return air damper and the preheat valves shall remain open.
- D. Minimum outside air damper control:
 - 1. Each AHU shall be provided with a minimum outside air flow (OAF) controller consisting of an air flow measuring station with active damper control.
 - 2. Each AHU shall regulate OAF SP between two outside air cfm setpoints, from minimum occupancy/ building minimum ventilation up to maximum occupancy OAF cfm. Refer to the AHU schedule for the two minimum OAF cfm setpoints for each AHU.
 - 3. When not in warm up or cool down mode, the minimum outside air control shall initially open to building minimum of scheduled outside air.
 - 4. Upon a rise in any of the critical space or return CO₂ sensors above setpoint (initially 900 ppm), the minimum OAF SP shall modulate between minimum and maximum values to maintain CO₂ setpoint.
 - 5. The minimum outside air damper modulates to maintain OAF at OAF SP.
 - 6. The controls will have a building pressure control enable selector. Only if enabled, if building space static pressure falls to -0.02 in wc for more than 5 minutes, the minimum outside air flow setpoint shall be overridden between minimum and maximum OA cfm setpoint as required to maintain a positive building space static pressure setpoint of 0.02 in wc.
- E. Discharge air temperature setpoint control (DAT SP):
 - 1. The discharge air setpoint will be reset from a minimum of each unit's scheduled "duct supply temperature" (typically 52 F) to 65 F maximum based on the cooling demand of the associated terminal units.
 - 2. If greater than 30 % of associated terminal units have flow set points that are within 95% of cooling maximum flow set point, then the discharge air setpoint will be decreased 1 deg. F every 10 minutes. If less than 20% of associated terminal

units have flow set points that are within 95% of cooling maximum flow set point, then the discharge air setpoint will be increased 1 deg. F every 10 minutes.

3. If outside air temperature (OAT) is greater than 75 F, DAT SP is set to minimum setpoint.
 4. When counting terminal units, boxes serving exclusive or sensitive areas shall be given a weight of 1.5. Terminal units feeding open common areas shall be given a weight of 1.
 5. If return air humidity rises above 60% for 10 minutes the discharge air setpoint will be overridden to minimum cooling temperature. When return air humidity is less than 58% for 10 minutes, the normal discharge air temperature control will resume.
- F. Discharge air temperature control modes:
1. Economizer mode (maximum outside air damper):
 - a. Whenever the OAT is below the economizer switchover setpoint of 65°F the unit shall operate under the economizer mode
 - b. The economizer outside air damper modulates as the 1st stage of cooling control for discharge air temperature (DAT) to meet discharge air temperature setpoint (Econ mode). If the economizer damper is at 100% and the chilled water system is enabled, the chilled water valve will modulate as the 2nd stage of cooling if required (Econ + mech mode).
 - c. A mixed air low limit program will modulate the maximum outside air damper to closed position on a fall in mixed air temperature below setpoint of 45 deg. F.
 - d. The economizer damper shall be interlocked via hard wired connection with the freeze-stat to cut the power off for the spring return actuated damper in case temperature falls below 40°F.
 2. Cooling mode
 - a. When economizer is not enabled, economizer damper is closed and chilled water modulates for DAT to meet DAT SP.
 1. Heating mode
 - a. If economizer is active, but the damper is closed and discharge air falls below DAT SP, preheat valve will begin to control to DAT SP.
 - b. The pre-heat coil hot water valve will be modulated as required to maintain a preheat discharge air setpoint above 45 deg. F. This control is always active, even during fan shutdown as a freeze protection measure.
- G. Return damper and fan control:
1. Return damper position equals 100% minus the economizer damper position.
 2. If a return fan exists, it will control to a plenum pressure determined at test and balance.
- H. Discharge Air Pressure Setpoint Control (DAP SP)
1. Max duct pressure set point will be determined by test & balance and is the initial setpoint when the unit starts. The minimum duct pressure setpoint is 0.2 in wc.
 2. The effective setpoint will modulate between the minimum and maximum to maintain all zones under 74 °F and no more than 3 zones “starved” (greater than 90% damper position).

- a. If fewer than 3 zones are starved, and no zone is over 75 °F, then the duct pressure setpoint shall decrease by 0.05" every 2 minutes.
 - b. If greater than 3 zones are starved, or a single zone is over 75°F, than the duct pressure shall increase by 0.06" every two minutes.
 - c. If neither condition is true, setpoint remains unchanged.
 - d. Zone temperatures over 82°F are assumed to be bad readings and terminal unit is ignored in the count.
 - e. When counting terminal units, boxes serving exclusive or sensitive areas shall be given a weight of 1.5. Terminal units feeding open common areas shall be given a weight of 1.
- I. AHU supply fan control:
1. Supply fan speed shall modulate for supply air pressure to meet DAP SP.
- J. Relief fan and damper control:
1. If the building pressure control selector is enabled, upon a rise in building space static pressure above 0.05 in wc for more than 5 minutes, the relief damper shall open. After 10 minutes if space static pressure is still above 0.05 in wc and after limit switch proves the relief damper is open the relief fan shall start. The relief fan's VSD will be modulated as required to maintain a positive static pressure discharge of 0.05 in wc. When the building space static pressure is less than 0.05-inch wc for 5 minutes, and the relief fan is at minimum speed, the relief fan will be stopped.
- K. Purge mode control: (RMU units only)
1. The purge mode will be activated by a signal from the fire alarm system or manually commanded at the OWS. The minimum and maximum outside air dampers and the relief air damper will fully open, and the return air damper will fully close. Once the damper limit switches prove the OA and relief dampers are open, the supply and relief fans will be started and run at 100% speed. All VAV boxes will be open to 100%.
- L. Fan shutdown:
1. The DDC controller shall verify the status of the supply fan and the relief fan via current sensing switches. Upon sensing that the supply fan is off, the DDC controller shall close the minimum and maximum outside air dampers, close the relief air damper, open the return air damper, close the chilled water valve, and send a 0% command to the supply and relief fan variable minimum and maximum outside air dampers, close the relief air damper, open the return air damper speed drives. The heating valve will continue to modulate as required to maintain a preheat discharge air setpoint of 45 deg. F.
- M. Safeties:
1. A fire alarm shutdown relay will stop the unit upon receiving a signal from the fire alarm system.
 2. A temperature low limit will stop the unit and open the hot water and chilled water valves upon sensing a fall in temperature below setpoint.
 3. Static pressure high limit switches mounted in the supply and relief fa discharges shall stop the unit upon a rise in discharge static pressure above set point.

N. Hard wired interlocks:

1. The smoke detectors freeze protection thermostat; float switch and duct over-pressure switch shall be hard wired in the fan motor control circuit. These hardwire devices shall send a signal from an auxiliary contact to the DDC control system.
2. The smoke detectors and fire thermostat shall send a signal to the building fire alarm system. The smoke detector on the relief fan shall be hard wired to the fan motor control circuit.

O. Shutdown alarms:

The control system shall turn off the air handling unit supply fan and alarm the user interface whenever any of the following conditions occurs:

1. Motor current plus or minus 10% of full load amps for 2 minutes or longer. Full load current shall be as determined during test and balance.
2. No air flow for 2 minutes or longer.
3. Smoke or heat detected in the air handling unit.
4. Drain pan filled with condensate.
5. Freeze protection thermostat indicating freezing temperatures in air handling unit.
 - a. The freeze stat should stop the supply fan, close all outside air dampers, open the hot water valve and chiller water valve.
6. Supply duct pressure exceeds 3.0 inches w.c. high limit

P. Non-shutdown alarms:

The control system shall alarm the user interface whenever any of the following conditions occurs:

1. Discharge air temperature +/- 5 deg F of setpoint for five minutes or longer.
2. Supply duct static pressure +/- 0.5 in w.c. of setpoint for 5 minutes or longer.
3. When the supply fan is operating in manual override as determined by fan operation outside the control of the control system.
4. Supply fan alarm

Appendix B - Single Zone AHU Standard Sequence

1.0 Single Zone AHU Standard Sequence

All setpoints, values, and time delays referenced are initial values that must adjustable

A. Start-stop control:

1. Provide hand-off-auto switch. In auto position, the air handling unit shall start. Upon receiving a start command, the smoke damper shall open, and minimum outside air damper shall open to its minimum position. After the smoke damper and either the maximum outside air or return air damper are proven open via end switches, the supply fan shall start.

B. Warm up mode control:

1. The space temperature shall be monitored and compared to the warmup setpoint (65 °F). The air handling unit will enter in warm up mode if the space temperature is below the warmup setpoint. The air handling unit's minimum and maximum outside air dampers, relief air damper, and chilled water valve will be closed the return air damper and the preheat valves shall remain open.

C. Minimum outside air damper control:

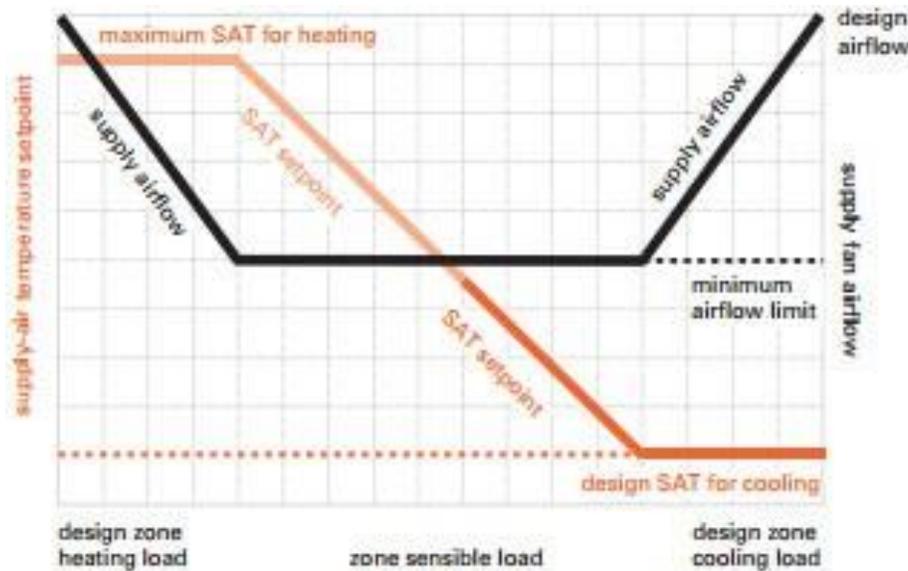
1. Each AHU shall be provided with a minimum outside air flow (OAF) controller consisting of an air flow measuring station with active damper control.
2. Each AHU shall regulate OAF SP between two outside air cfm setpoints, from minimum occupancy/ building minimum ventilation up to maximum occupancy OAF cfm. Refer to the AHU schedule for the two minimum OAF cfm setpoints for each AHU.
3. When not in warm up or cool down mode, the minimum outside air control shall initially open to building minimum of scheduled outside air.
4. Upon a rise in the return CO2 sensor above setpoint (initially 900 ppm), the minimum OAF SP shall modulate between minimum and maximum values to maintain CO2 setpoint.
5. The minimum outside air damper modulates to maintain OAF at OAF SP.
6. The controls will have a building pressure control enable selector. Only if enabled, if building space static pressure falls to -0.02 in wc for more than 5 minutes, the minimum outside air flow setpoint shall be overridden between minimum and maximum OA cfm setpoint as required to maintain a positive building space static pressure setpoint of 0.02 in wc.

D. Return damper and fan control:

1. Return damper position equals 100% minus the economizer damper position.
2. If a return fan exists, it will control to a plenum pressure determined at test and balance.

E. Zone temperature control (heating/cooling valves and fan speed)

1. In this sequence, zone temperature can refer to return temperature OR zone temperature depending on the operator selection.
2. Graphically, the zone temperature control will operate per the below diagram and as described in this section:



F. Mode Selection and Operation:

1. Cooling Mode: The AHU will operate in cooling mode, when zone temperature is greater than cooling mode enable setpoint (73 °F).
 - a. Discharge Air Temperature Setpoint:
 - i. At minimum fan speed, the discharge air temperature setpoint will modulate between cooling minimum setpoint (52 °F) and heating maximum setpoint (90 °F) to maintain zone temperature at zone cooling effective setpoint (74 °F).
 - b. Discharge Air Temperature Control:
 - i. Whenever the outside air temperature is below the economizer switchover setpoint of 65°F the unit shall operate under the economizer mode.
 - ii. The economizer outside air damper modulates as the 1st stage of cooling control for discharge air temperature (DAT) to meet discharge air temperature setpoint (Econ mode). If the economizer damper is at 100% and the chilled water system is enabled, the chilled water valve will modulate as the 2nd stage of cooling if required (Econ + mech mode).
 - iii. A mixed air low limit program will modulate the maximum outside air damper to closed position on a fall in mixed air temperature below setpoint of 45 deg. F.
 - iv. The economizer damper shall be interlocked via hard wired connection with the freeze-stat to cut the power off for the spring return actuated damper in case temperature falls below 40°F.
 - v. When economizer is not enabled (mech mode), economizer damper is closed and chilled water modulates for discharge air temperature to meet setpoint.
 - vi. The preheat valve discharge air temperature control is deactivated in cooling mode. However, the preheat valve control to maintain mixed air temperature above 45 °F always remains active in all modes.

c. Supply Fan Speed:

- i. In cooling mode, the fan speed starts at minimum fan speed (50%). If the discharge air temperature setpoint has been at minimum (52°F) for 10 minutes, it will hold that minimum setpoint, and supply fan speed control will become primary control. It will modulate fan speed to maintain zone cooling effective setpoint (74°F).
- ii. If load drops and fan speed remains at minimum for 10 minutes, fan speed control will return to being held at minimum speed, and discharge air temperature setpoint will return to the primary zone temperature control, modulating for zone temperature to equal 74 °F cooling setpoint.
- iii. If a supply air flow station exists, the minimum and maximum fan speeds referenced in this sequence can instead be % of maximum air flow. In this case, the fan speed modulates to control actual supply flow to meet supply flow setpoint.

2. Heating Mode:

The AHU will operate in heating mode, when zone temperature is less than heating mode enable setpoint (69°F).

a. Discharge Air Temperature Setpoint:

- i. At minimum fan speed, the discharge air temperature setpoint will modulate between cooling minimum setpoint (52 °F) and heating maximum setpoint (90 °F) to maintain zone temperature at zone heating effective setpoint (68 °F).

b. Discharge Air Temperature Control:

- i. The economizer damper and chilled water valves are closed, and the return damper is open in heating mode.
- ii. The preheat valve controls discharge air temperature to setpoint.

c. Supply Fan Speed:

- i. In heating mode, the fan speed starts at minimum fan speed (50%). If the discharge air temperature setpoint has been at maximum (90°F) for 10 minutes, it will hold that maximum setpoint, and supply fan speed control will become primary control. It will modulate fan speed to maintain zone heating effective setpoint (68°F).
- ii. If heating load drops and fan speed remains at minimum for 10 minutes, fan speed control will return to being held at minimum speed, and discharge air temperature setpoint will return to the primary zone temperature control, modulating for zone temperature to equal 69 °F heating setpoint.

3. Satisfied mode: The AHU will operate in satisfied mode if zone temperature is in between heating (69 °F) and cooling enable (73°F) setpoints.

- a. In satisfied mode, the economizer damper, hot water valve, chilled water valve all remains closed. The return damper opens, and the fan runs at minimum speed setpoint (50%).

G. Unoccupied mode control

1. Unoccupied mode is scheduled during lower occupancy times of 11 PM to 4 AM.
2. Fan continuously runs with same sequence as occupied. Only difference is new set points:

- a. Unoccupied cooling enable setpoint = 76 °F
 - b. Unoccupied effective cooling setpoint = 77 °F
 - c. Unoccupied heating enable setpoint = 68 °F
 - d. Unoccupied effective heating setpoints = 67 °F
 - e. Unoccupied minimum fan speed = 25%
- H. Relief fan and damper control:
1. If the building pressure control selector is enabled (operator can adjust disable/enable mode), upon a rise in building space static pressure above 0.05 in wc. for more than 5 minutes, the relief damper shall open. After 10 minutes if space static pressure is still above 0.05 in wc. and after limit switch proves the relief damper is open the relief fan shall start. The relief fan's VSD will be modulated as required to maintain a positive static pressure discharge of 0.02 in wc. When the building space static pressure is less than 0.05 in wc, the relief fan is at minimum speed, the relief fan will be stopped. The relief air damper will be modulated as required to maintain the building space static pressure setpoint determined by the test and balance contractor.
- I. Purge mode control: (RMU units only)
1. The purge mode will be activated by a signal from the fire alarm system or manually commanded at the OWS. The minimum and maximum outside air dampers and the relief air damper will fully open, and the return air damper will fully close. Once the damper limit switches prove the OA and relief dampers are open, the supply and relief fans will be started and run at 100% speed.
- J. Fan shutdown:
1. The DDC controller shall verify the status of the supply fan and the relief fan via current sensing switches. Upon sensing that the supply fan is off, the DDC controller shall close the minimum and maximum outside air dampers, close the relief air damper, open the return air damper, close the chilled water valve, and send a 0% command to the supply and relief fan variable minimum and maximum outside air dampers, close the relief air damper, open the return air damper speed drives. The heating valve will continue to modulate as required to maintain a preheat discharge air setpoint of 45 deg. F.
- K. Safeties:
1. A fire alarm shutdown relay will stop the unit upon receiving a signal from the fire alarm system.
 2. A temperature low limit will stop the unit and open the hot water and chilled water valves upon sensing a fall in temperature below setpoint.
 3. Static pressure high limit switches mounted in the supply and relief fan discharges shall stop the unit upon a rise in discharge static pressure above set point.
- L. Hard wired interlocks:
1. The smoke detectors freeze protection thermostat; float switch and duct over-pressure switch shall be hard wired in the fan motor control circuit. These hardwire devices shall send a signal from an auxiliary contact to the DDC control system.
 2. The smoke detectors and fire thermostat shall send a signal to the building fire alarm system. The smoke detector on the relief fan shall be hard wired to the fan motor control circuit.

- M. Shutdown alarms: the control system shall turn off the air handling unit supply fan and alarm the user interface whenever any of the following conditions occurs:
1. Motor current plus or minus 10% of full load amps for 2 minutes or longer. Full load current shall be as determined during test and balance.
 2. No air flow for 2 minutes or longer.
 3. Smoke or heat detected in the air handling unit.
 4. Drain pan filled with condensate.
 5. Freeze protection thermostat indicating freezing temperatures in air handling unit.
 - a. The freeze stat should stop the supply fan, close all outside air dampers, open the hot water valve and chiller water valve.
 6. Supply duct pressure exceeds 3.0 inches w.c. high limit

N. Non-shutdown alarms:

The control system shall alarm the user interface whenever any of the following conditions occurs:

1. manual override as determined by fan operation outside the control of the control system.
2. Supply fan alarm
3. Zone temperature +/- 3 deg F of setpoint.

Appendix C - Standard Terminal Unit Control Sequence

1.0 Standard Terminal Unit Control Sequence

2.0 Zone temperature sensor shall modulate terminal unit air damper between scheduled maximum and minimum primary cooling air flow in response to space cooling setpoint, initially 74 °F.

3.0 On fall in space temperature below 68 °F after minimum cooling air flow has been reached, the terminal unit hot water valve shall modulate open to maintain heating setpoint (initially 68 °F). If scheduled minimum heating cfm is greater than scheduled minimum cooling cfm, increase VAV box cfm to minimum heating cfm setpoint after heating valve is activated.

4.0 DDC system will prevent the terminal unit from going to heating flow or opening the hot water valve if secondary hot water system is not enabled.

5.0 The zones will be scheduled unoccupied between 11 pm and 4 am. They will follow the same sequence but control to unoccupied cooling SP (77 °F) and unoccupied heating SP (67 °F) and separate unoccupied cooling min cooling air flow and unoccupied heating air flow.

A. Note:

In order for the air handlers to properly respond to terminal units, there are several air handler logic tables and interlock programming that must be updated on the Johnson Controls NAEs even if one terminal unit is installed or upgraded. The corresponding terminal unit points must be added to the below:

B. VAV Counts LCT

C. Purge-INT

D. HTGMODE (Interlock)

E. Warmup-LCT

F. Schedule-INT

G. Zone temp warnings for 2.5 deg above effective cooling setpoint or below effective heating setpoint

H. Delete any no longer in service boxes from the system

I. Update all graphics including floor plans

J. Ensure that key flow and temperature setpoints for occupied and unoccupied are exposed. Refer to typical points list and naming convention.

K. All terminal unit point names must have the air handler and box number included. For example:

1. RMU-95A-BL-V04.ZN-T or RMU-95A-BL-V04.EFFCLG-SP

a. Points labeled as only ZN-T and EFFCLG-SP without the prefix is not acceptable.

Appendix D - BMS Points Standard Lid Details

<u>Naming convention example</u>	<u>Description</u>	<u>Additional Parameters</u>
<u>VVR-MT-01-2-01-AL.HTG-EN</u>	<u>Box Heating Enable Command</u>	
<u>VVR-MT-01-2-01-AL.CLG-MAXFLOW</u>	<u>Cooling Max Flow Setpoint</u>	
<u>VVR-MT-01-2-01-AL.SA-F</u>	<u>Supply Air Flow</u>	
<u>VVR-MT-01-2-01-AL.ZN-T</u>	<u>Zone Temperature</u>	
<u>VVR-MT-01-2-01-AL.EFFHTG-SP</u>	<u>Effective Heating Temp Calc Setpoint</u>	
<u>VVR-MT-01-2-01-AL.DA-T</u>	<u>Discharge Air Temperature</u>	
<u>VVR-MT-01-2-01-AL.DPR-O</u>	<u>Supply Air Damper Output</u>	
<u>VVR-MT-01-2-01-AL.SAFLOW-SP</u>	<u>Supply Air Flow Calculated Setpoint</u>	
<u>VVR-MT-01-2-01-AL.EFFCLG-SP</u>	<u>Effective Cooling Temp Calc Setpoint</u>	
<u>VVR-MT-01-2-01-AL.OCC-SCHEDULE</u>	<u>Occupancy Schedule</u>	
<u>VVR-MT-01-2-01-AL.SYSTEM-MODE</u>	<u>System Mode</u>	<u>Cool only, heat only, purge, etc.</u>
<u>VVR-MT-01-2-01-AL.ZNT-SP</u>	<u>Common Setpoint</u>	
<u>VVR-MT-01-2-01-AL.ZN-Q</u>	<u>Zone Quality</u>	<u>CO2</u>
<u>VVR-MT-01-2-01-AL.ZNQ-ALMSP</u>	<u>Zone Quality Alarm Setpoint</u>	
<u>VVR-MT-01-2-01-AL.HTG-O</u>	<u>Heating Output</u>	
<u>VVR-MT-01-2-01-AL.CLGOCC-SP</u>	<u>Occ Cooling Setpoint</u>	
<u>VVR-MT-01-2-01-AL.CLGUNOCC-SP</u>	<u>Unocc Cooling Setpoint</u>	
<u>VVR-MT-01-2-01-AL.HTGOCC-SP</u>	<u>Occ Heating Setpoint</u>	

<u>VVR-MT-01-2-01-AL.HTGUNOCC-SP</u>	<u>Unocc Heating Setpoint</u>	
<u>VVR-MT-01-2-01-AL.CLGOCC-MINFLOW</u>	<u>Occ Cooling Min Flow Setpoint</u>	
<u>VVR-MT-01-2-01-AL.HTGOCC-MINFLOW</u>	<u>Occ Heating Min Flow Setpoint</u>	
<u>VVR-MT-01-2-01-AL.WC-C</u>	<u>Warmup Cooldown Status</u>	
<u>VVR-MT-01-2-01-AL.TUNING-RESET</u>	<u>Application Tuning Reset</u>	
<u>VVR-MT-01-2-01-AL.AUTOCAL-C</u>	<u>Autocalibrate Commnad</u>	
<u>VVR-MT-01-2-01-AL.UNITEN-MODE</u>	<u>Unit Enable Mode</u>	
<u>VVR-MT-01-2-01-AL.ZNT-STATE</u>	<u>Zone Temperature Status</u>	<u>Cooling, heating, satisfied, etc.</u>
<u>VVR-MT-01-2-01-AL.CLGUNOCC-MINFLOW</u>	<u>UnOcc Cooling Min Flow Setpoint</u>	
<u>VVR-MT-01-2-01-AL.HTGUNOCC-MINFLOW</u>	<u>UnOcc Heating Min Flow Setpoint</u>	
<u>VVR-MT-01-2-01-AL.WC-ADJ</u>	<u>Warm Cool Adjust</u>	

Table 1 – Passenger Terminals – HVAC Operating Parameters

Table 1 – Passenger Facilities – HVAC Operating Parameters

		Passenger Facilities HVAC Operating Parameters				HVAC Load Data			
Space/Function	Indoor Design Condition				People FT ² /PPL	Outside Air CFM/PPL	Lights Watts/FT ²	Equipment Watts/FT ²	
	Summer-°F	% RH	Winter-°F	% RH					
Hold Rooms	74	50	70	-	200 PPL/Gate	10	1.5	2.0	
Interior Corridors	74	50	70	-	100 FT ² /PPL	10	1.5	1.5	
Concessions (Restaurant)	74	50	70	-	30 FT ² /PPL or Count	10	3.0	10.0	
Concessions (Retail Store)	74	50	70	-	45 FT ² /PPL or Count	10	6.0	3.0	
Crown Room	74	50	70	-	45 FT ² /PPL or Count	20	3.0	3.0	
Break Room/ Group Room	74	50	70	-	100 FT ² /PPL or Count	10	1.5	1.5	
Officer/ Administration	74	50	70	-	100 FT ² /PPL or Count	20	1.5	1.5	
Third Level Tenant Space	74	50	70	-	100 FT ² /PPL	20	2.5	2.5	
Smoking Room	74	50	70	-	15 FT ² /PPL	60	1.5	1.5	
Apron Level (Air Conditioned Spaces)	74	50	70	-	100 FT ² /PPL or Count	20	2.5	1.5	
Classroom/Training/Conference	74	50	70	-	30 FT ² /PPL or Count	20	2.5	1.5	
Toilet Room/Locker Room	74	50	70	-	0	0	1.5	0.0	
Storage Area	74	50	70	-	0	0	1.5	1.0	
OUTDOOR DESIGN CONDITIONS									
Summer	94 °F DB/ 74 °F WB				Chilled & Hot Water Design: Supply- Return Delta T				
Winter	17 °F DB				Secondary CHW: 16 °F				
Cooling Supply Air Design									
Supply air Delta T (Space Temp- Leaving Coil Temp): 23 °F				Air Handling Unit CHW: 18 °F				Secondary HW: 40 °F	

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

**Airport Facilities Landside/
Airside New Construction
and Modifications**

Design Standards

Electrical Engineering

Electrical Design Standards

Table of Contents

1.0 Purpose	4
A. Purpose of Design Standard – Electrical	4
2.0 Codes and Standards	4
A. Applicable Codes, Standards & Circulars	4
3.0 General Drawing Requirements	5
A. Facilities Electrical Drawings and Master Drawings (including systems).....	5
B. Electrical and System Drawing Updates.....	6
C. Drawing Request and Revision Process.....	8
4.0 Design Requirements	10
A. General Design Requirements.....	10
B. Administrative Requirements.....	10
C. Landside Technical Design Requirements.....	11
D. Airfield Technical Design Requirements	19
5.0 Lighting System Design	24
A. Interior Lighting Systems Design	24
B. Exterior Parking Lot Lighting System Designs to include Electric Vehicle Areas	27
C. Parking Deck Lighting Systems Design	28
D. Airfield Lighting Systems (150/5340-30J or latest revision)	29
6.0 Power Receptacle System Design	31
A. Definition	31
B. Locations/Minimum requirements	31
C. Electric Vehicle Supply Equipment (EVSE) Charging Stations	32
7.0 Low Voltage Power Systems Design (<600 volts)	32
A. General power requirements	32
B. Lightning Protection System Designs	42
C. Building Grounding System Designs	43
8.0 Design Calculations	45
A. Calculation Requirements.....	45
B. Short Circuit, Circuit Breaker Coordination Study	45
C. Load Calculations	47
D. Emergency Generator/Transfer Switch Sizing Calculations	48
E. Arc Flash Calculations	49
F. Harmonic Calculations	49

Design Standards - Electrical

G. Voltage Drop Calculations.....50

H. Lighting Calculations.....50

9.0 Equipment Identification51

A. Branch Circuit Panelboards Directories51

B. Identification Nameplate Labels.....51

C. Color Scheme for Engraved Electrical Nameplate Labels52

D. Nameplates: Electrical Equipment Identification Methodology53

E. Source Identification Methodology.....55

10.0 Quality Assurance56

A. Requirements56

B. Redi-Check Interdisciplinary Coordination Reviews56

C. Quality Assurance (QA) Checklists56

Figure Index:

Figure 1 - Equipment Nameplate Detail Examples.....57

Figure 2 - Equipment Nameplate Detail Examples.....58

Figure 3 - Equipment Identification Riser Diagram.....59

Figure 4 - Electrical Equipment Room Layout Diagram60

Electrical Design Standards

1.0 Purpose

A. Purpose of Design Standard – Electrical

The purpose of this document is to outline the minimum design standards and installation requirements for systems (electrical power, control, fire detection and others), which are installed to serve various spaces throughout the Central Passenger Terminal Complex (CPTC) and other DOA facilities to include Landside/Airside New Construction, Modifications, Concession and Tenant spaces at Hartsfield-Jackson Atlanta International Airport (H-JAIA or “Airport”).

2.0 Codes and Standards

A. Applicable Codes, Standards & Circulars

All design work shall be performed “In Accordance With” (IAW) generally accepted, professional principles and practices for electrical engineering and in compliance with all applicable Department of Aviation (DOA), Planning & Development (P&D) Facilities/Landside/Airside New Construction and Modification Standards included in this document. Compliance with the latest Federal, State and City of Atlanta Codes, Standards and Regulations along with the latest Advisory Circular (AC) for Airport Projects is required. The codes, standards and practices listed herein generally apply to airport projects. Other codes, standards or practices that are more specific will be referenced within a specific section (the list below is for reference and not all inclusive).

1. Codes

- a. National Fire Protection Association (NFPA) 70 National Electrical Code
- b. NFPA 72 National Fire Alarm Code
- c. NFPA 101 Life Safety Code
- d. NFPA-110 Emergency and Standby Power Systems
- e. Standard Building Code
- f. NFPA 780 Standard for the installation of Lightning Protection System
- g. Georgia State Minimum Standard Electrical Code
- h. Occupational Safety and Health Administration (OSHA)

2. Standards

- a. American National Standards Institute (ANSI)
- b. Institute of Electrical and Electronics Engineers (IEEE)
- c. Underwriters Laboratories (UL)
- d. Illuminating Engineering Society (IES) Lighting Handbook

Design Standards - Electrical

- e. National Electrical Manufacturers Association (NEMA)
 - f. Hartsfield Jackson Atlanta International Airport, City of Atlanta, Department of Aviation – Aviation Information systems, (AIS) Infrastructure Standards (latest revision)
 - g. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
3. Circulars
- a. Federal Aviation Administration (FAA), Series - 150 Advisory Circular (AC) for Airport Projects (only AC numbers are indicated in this standard)

3.0 General Drawing Requirements

A. Facilities Electrical Drawings and Master Drawings (including systems)

Table 1: is a recommended list of “Drawing Types” required to illustrate the design scope and to be issued as acceptable DOA construction “As-Built” project deliverables.

Master drawing deliverables are designated below

Table 1 - Drawings			
Project Electrical/System As-Built Drawing Types	Scale	Master Deliverables	Deliverable Format
Legend	NTS		Acceptable Electronic Formats for drawings: AutoCAD (.dwg) Revit (.rvt) Adobe (.pdf) BIMS (contact DOA BIMs manager for specific details). Early coordination with the DOA Project Manager is required to establish the acceptable
Electrical Site Plan	1 inch = 20 feet		
Lightning Protection and Counterpoise Composite Plan	1 inch = 20 feet		
Lightning Protection Details	NTS		
Grounding Site Plan	1 inch = 20 feet		
Grounding Riser diagram(s)	NTS		
Grounding Details	As required		
Primary Electrical System: One-line/Single-line and/or Riser Diagrams -Full and partial	NTS	Master Drawing (3.B.2.d)	
Power Electrical riser diagram (for multi-story buildings)	NTS	Master Drawing (3.B.2.d)	
Power Layout floor plans	$\frac{1}{4}$ inch = 1.0 feet $\frac{1}{8}$ inch=large spaces	Master Drawing (3.B.2.d)	
Power layout enlarged floor plans, specifically electrical vaults, electrical rooms, electrical closets	$\frac{1}{4}$ inch = 1.0 feet All plans listed shall be drawn to scale	Master Drawing (3.B.2.d)	

Design Standards - Electrical

Panelboard schedules and Directories	NTS	Master Drawing (3.B.2.d)	drawing format for project deliverables. Acceptable Hard Copy Formats for drawings: Full and/or Half size drawings shall be printed to scale when requested.
Site Lighting Plans	1 inch = 20 feet		
Site Lighting Photometrics Plans (when required)	1 inch = 40 feet		
Interior Lighting Plans	¼ inch = 1 feet 1/8 inch=large spaces		
Interior Lighting Photometric Plans (when required)	As required		
Lighting fixture schedule	NTS		
Special Systems layout Floor Plans (Fire Alarm,)	¼ inch = 1.0 feet 1/8 inch=large spaces		
Special Systems Details	As required		
Low Voltage Switchgear, Switchboard and Motor Control Center Elevation and Details	As required	Master Drawing (3.B.2.d)	
Miscellaneous Elementary and Wiring Diagrams (when required)	NTS		
Electrical Equipment List for (EPMS)	NTS	Master Drawing (3.B.2.d)	
Electrical Power Monitoring System (EPMS) user interactive graphic screen/input lists	NTS	Master Drawing (3.B.2.d)	
Electrical Power Monitoring System (EPMS) One-line and/or Riser Diagrams	NTS	Master Drawing (3.B.2.d)	
Power Duct Bank Plan and Profile (Civil Work Drawing)	1 inch = 50 feet horizontal		
Equipment Pad details for Switchgear, Switchboard, Transformer, Motor Control Center and floor mounted equipment	As required		
Electric Manhole Plan, Details and Sections	As required		

Note: electrical symbols and equipment placed on drawings shall match the layout plan drawing scale.

B. Electrical and System Drawing Updates

1. The Design Service Providers (DSP) shall request and update the Department of Aviation's Facilities Master Electrical/System Drawings along with prepare and deliver stand-alone Final Project Electrical/System "As-Built" drawings whenever a project is performed at the Central Passenger Terminal Complex (CPTC) and a DOA property. Facilities Master Electrical/System Drawings (shown on Table 1), and the required stand-alone Final Project Electrical/ System "As-Built" drawings shall be developed and updated for each concourse/building located within the CPTC and DOA property as described within this design standard and IAW the contract project Scope of Work (SOW)

documents. All document requested for check-out/check-in shall be through the PMWeb web-based Project Management software system, IAW P&D Policies and Procedure 02-002 "Document Control" (latest revision).

2. Definitions:

- a. **CPTC:** The area within the Hartsfield-Jackson Atlanta International Airport (HJAIA) referred to as the Central Passenger Terminal Complex (CPTC) to include all Concourse's and Terminal buildings.
- b. **Design Service Provider (DSP):** is a service organization contracted to provide electrical system design solutions and services starting at the design initiation phase and ending at a successful system turn over. The Design Service Provider is responsible for the project design as stipulated in the Design Contract and Task Orders.
- c. **Electrical Construction Drawings:** designated as working drawings issued before actual construction begins. Construction drawings are also known as Issued for Construction (IFC) drawings during the last phase of the design effort.
- d. **Facilities Master Electrical/System Drawings:** Facilities Master Electrical/Systems drawings are revised drawings which reflect ALL changes created by every project performed at the CPTC and a DOA property. Drawings considered "Master Drawings" to be incorporated into the Facilities Master Electrical/Systems are defined on Table 1. Drawings are DSP contract deliverables and independent of the Final Project Electrical/System "As-Built" drawings.
- e. **Final Project Electrical/System As-Built drawings:** Final project Electrical/System "As-built" drawings are independent of the Facilities Master Electrical/System Drawings and are project specific. The project "As-Built" drawings shall reflect all changes made during the construction process and provide an exact rendering of the finished project. Final project "As-Built" drawings are contract deliverable documents and shall be prepared and managed IAW, P&D Policies and Procedure 08-008 "Project As-Built Documentation" (latest revision). Drawings are DSP contract deliverables and independent of the Facilities Master Electrical/System Drawings.
- f. **Progress Electrical As-Built drawings:** progress electrical "As-built" drawings (also denoted as marked up-to-date or red-line drawings) are the revised sets of paper copy drawings on the Jobsite which provides an accurate record of all deviations between work as shown and work as installed during construction. All "As-Built" drawings shall be prepared and managed IAW, P&D Policies and Procedure 08-008 "Project As-Built

Documentation” (latest revision).

C. Drawing Request and Revision Process

1. Project Initialization:

- a. Upon a project initialization, the DSP shall contact the DOA’s Document Control Specialist (DCS) IAW, P&D Policies and Procedure 02-001 “Document Control” (latest revision) who is responsible for managing all project related documents during the project life cycle.
- b. The DSP is responsible for identifying all Facilities Master Electrical/Special Systems drawings required for project and Master Drawing revisions during project initialization.

2. Facilities Drawing Request:

- a. The DSP shall request from the DCS the Facilities Master Electrical/System Drawings pertinent to the design modification or new construction project.
- b. The DCS shall forward the drawing request to the DOA Electrical Department Design Manager (or designee) for review and approval when required.
- c. The revision number on the issued drawing shall be the current revision number or in general, revision X (such as revision 1).

3. Drawing Revisions

- a. The DSP shall establish revision completion dates to issue the Final Project Electrical/System “As-Built” drawings, and the revised Facilities Master Electrical/System Drawing(s). The DSP shall contact the Electrical Engineering Department Design Manager (or designee) on the established completion dates for both and provide progress status updates.
- b. Upon completion of a new construction or modification projects, the DSP shall revise the Progress Electrical “As-Built” drawings to reflect all changes made during construction which will become the official signed-off “Final Project Electrical/System “As-Built” drawing submittal.
- c. Final Project Electrical/System “As-Built” Drawings shall be delivered to DOA through the PMWeb web-based Project Management software system IAW, P&D Policies and Procedure 02-001 “Document Control”. The drawing(s) shall be in the software format identified on Table 1 with (1) one hard copy sealed and signed by a P.E. (Electrical) registered in Georgia. Drawings shall be stamped “As Built”.

Design Standards - Electrical

- d. After completion and submittal of the Final project Electrical/System “As-Built” drawing deliverables the DSP shall request and check-out the Facilities Master Electrical/System Drawings to be revised IAW the details outlined in this design standard and as described in the contract project Scope of Work (SOW) document. The DOA Electrical Design Manager (or designee) shall follow up with the DSP during the check-out period (predetermined time) to assess if the procedural requirements are being adequately implemented. The requested check-out period shall include adequate time to perform a quality review of the updated Facilities Master Electrical/System Drawings prior to the revised documents being check-in to the document control system.
 - e. The Final Project Electrical/System “As Built” Drawings and revised Facilities Master Electrical/System Drawings shall include the following information in the revision blocks:
 - i. New revision number, generally Revision number enclosed in a triangle (revision number shall increase with each submittal),
 - ii. Revision date,
 - iii. Engineer’s initials,
 - iv. A brief description of the revision such as project name and WSB number,
 - v. Sealed and signed by a P.E. (Electrical) registered in Georgia.
4. Facilities “As Built” and Master Electrical Drawings Deliverables
- a. The required Final Project Electrical/System “As Built” and Facilities Master Electrical/System drawing deliverables identified on Table 1 shall be officially transmitted to the DOA through the PMWeb web-based Project Management software system IAW, P&D Policies and Procedure 02-001 “Document Control. The project “As-Built” Drawings shall be comprised at a minimum all Electrical/System Drawings included in the issued for construction set along with the Facilities Master Electrical/System Drawings identified in Table 1.

4.0 Design Requirements

A. General Design Requirements

1. Keep abbreviations to a minimum.
2. Use only standard technical abbreviations from the American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE) on all drawings.
3. When "In Accordance With" (IAW) is annotated, it is referring to an agreement or conformity with an authority, code, standards, rules, procedures, etc.
4. All Electrical Components, Devices, and Accessories used as the basis of design shall be Underwriters Laboratories (UL) Listed as defined in NFPA 70, NEC, Article 100. The contract specifications shall identify the UL listed requirements for all electrical components, devices, and accessories.

B. Administrative Design Requirements

1. The DSP shall resolve code conflicts found during design and construction. The more stringent applicable portion of conflicting codes shall be used unless a written waiver letter with concise details and supporting evidence is submitted to the DOA Assistant Director (or designee) through the PMWeb web-based Project Management software system IAW, P&D Policies and Procedure 02-001 "Document Control" (approval shall be granted prior to performing any work).
2. The DSP shall provide details on the design contract documents to include raceways, wires, cables, equipment, controls, grounding, wiring diagrams and other details required to make complete electrical, control and all ancillary systems operational.
3. Design drawings are generally diagrammatic and are not intended to show exact locations of all raceways runs, outlet boxes, junction boxes, pull boxes, etc. In general, exact locations shall be determined and coordinated in the field which shall be illustrated on the "As-Built" construction documents. The locations of equipment, appliances, fixtures, raceways (conduit, cable tray, busduct, junction boxes, wireways, outlets boxes, and similar devices) shown on the drawings are approximately located to obtain accurate cost estimates unless "to-scale" placement is specifically required by the design to illustrate and avoid constructability design conflicts with the following exception:
Exception: All electrical rooms, electrical closets and major equipment placed within these electrical rooms such as switchgear, switchboards, distribution panelboards, panelboards, etc. shall be drawn "to scale".
4. Where circuits are shown as "homeruns" on drawings, place notes on contract

Design Standards - Electrical

documents indicating that all necessary fittings, supports, and boxes shall be provided to make complete raceway installations IAW code requirements.

5. The DSP shall show circuit layouts on drawings; however, layouts are not required to show all fittings, or all installation details. Details illustrating connections to equipment shall be shown as required, and IAW the accepted shop and manufacturer's design drawings.

C. Landside Technical Design Requirements

1. Raceway

- a. This Design Standard considers a Raceway System to consist primarily of cable tray, conduit and necessary hardware used to support cable runs between electrical equipment and physical protection to the cables. IEEE 422 is considered a valid reference when designing/installing a similar raceway system as described in this standard.
- b. Electrical metallic tubing (EMT) may generally be used for dry accessible concealed installations; however, Rigid metal conduit (type RMC) shall be used in most cases for exposed installations with the following exception:
Exception: When raceway is not subject to any physical or mechanical damage EMT can be used for exposed installations. When specified, EMT shall be used with compression fittings (coupling) and installed in accordance with the NEC.
- c. EMT couplings with set screws are not allowed.
- d. EMT shall be installed with appropriate fittings if used as an equipment grounding conductor IAW NEC and IEEE 422.
- e. Surface nonmetallic raceways shall not be permitted.
- f. Only cast metal boxes shall be used for exposed installation.
- g. Minimum conduit size to route electrical cables shall be $\frac{3}{4}$ ". This criterion applies to all HJAIA CPTC and DOA facilities. See FAA circulars for airside requirements.
- h. Signal cables may be installed in cable tray; however, J-hooks, D-rings and Bridal Rings are not allowed.
- i. Each three-phase circuit shall be run in a separate Raceway unless otherwise shown on the contract drawings.
- j. When PVC is specified, the schedule type shall be provided.
- k. Supporting raceways from cable trays/supports, wireways/ supports, and from

another raceway including supports is not allowed.

- I. Underground Raceway: All underground, direct buried, encased conduits, duct banks and other underground raceways installed at HJAIA CPTC and DOA facilities to include abandoned conduits capped in place, shall be equipped with “Electronic Utility Markers”. The DSP shall recommend to DOA the type of “Electronic Utility Markers” which will offer the best accuracy for locating underground utilities, complies with local codes/standards, industry color codes and are UL certified. Prior DOA approval is required before installation.
2. Wiring & Cables
 - a. Conductor/Wiring: All wire and cables shall be Underwriter’s Laboratories (UL) listed and shall meet all national, state, and local code requirements for their application. Insulated wire and cables shall conform to the minimum requirements of the Insulated Cable Engineer Association (ICEA) Standards. Conductivity shall be IAW the standardization rules of the Institute of Electrical and Electronics Engineers, Inc. (IEEE).
 - b. Cable Definitions
 - i. **Power:** cables are used to send energy from its source to downstream equipment.
 - ii. **Control and Instrumentation:** cable terminology may be used interchangeably to refer to the same cable. However, control and instrumentation cables have related functions and are used for sending signals that control equipment, as well as for measurement.
 - iii. **Signal:** include coaxial cables, twisted pair cables, and fiber optic cables which are used to transmit data.
 - c. All power, control, instrumentation and signal cables to include the following systems at a minimum: Power Systems, Fire Alarm (FA), Heating, Ventilation, Air Conditioning (HVAC), Lighting, Communication, Video Surveillance Cameras (CCTV), Access Control, Information Technology (IT), phone (data or voice) shall be routed in NEC raceways. Coordination with the project design specifications is required.
 - d. Branch circuit power cables (conductors) shall be minimum #12 American Wire Gauge (AWG) and shall be copper, type THHN/THWN unless otherwise noted on design documents and approved by DOA electrical.
 - e. Control and instrumentation cables (signal wiring) for all systems identified shall be minimum #14 American Wire Gauge (AWG) unless otherwise noted on design

Design Standards - Electrical

documents and approved by DOA.

- f. Communications Installation: Fiber Optic cabling, copper data cabling, communications conduit, pathways, grounding/bonding, firestopping, testing, and all associated task involved in communications installation, shall be designed and specified IAW Aviation Information Systems (AIS) infrastructure Standards and Telecommunications Industry Association (TIA) Standards (latest version).
- g. Metal Clad (MC) cable shall only be used for final connections to light fixtures from ceiling junction boxes (less than 72 inches) or inside existing walls where concealed. MC cable is not allowed for feeder and branch circuits.
- h. Feeders and service wiring shall be copper.
- i. Aluminum feeders shall only be allowed for 400 Hz feeders/ branch circuits.
- j. No abandoned cable or raceway due to demolition shall be allowed. Remove all the wiring, conduit, and other associated raceways back to the source. Requirements apply to interior and exterior building installations.
- k. Where existing switchgear, switchboards, panelboards and other electrical components are being replaced, the associated feeders shall also be replaced.
- l. No reduced sized neutrals will be allowed. Each single pole overcurrent device shall have its own separate neutral conductor.
- m. Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.
- n. Multi-wire branch circuits are not allowed.
- o. Include equipment grounding conductors sized per NEC with all power and control circuits over 50 volts.
- p. Install computer-related circuits and receptacles separate from motor load circuits. If required by the manufacturer to minimize noise, provide a separate grounding conductor back to the branch circuit breaker for each circuit, consistent with NEC grounding criteria. Provide an isolated ground receptacle as needed.
- q. All underground wirings shall be protected by conduit and concrete encasement for areas with heavy vehicle traffic such as roadways, parking lots, etc.. The minimum burial depth cover shall be IAW NEC (latest version).
- r. Wiring in light pole handholes: Provide at least 18" of slack at handholes or as otherwise defined in specifications. The type of cable splicing used shall be detailed

in the project specifications and shall comply with the NEC and industry standards. See section titled "Splices" for additional details.

3. Voltage Drop Assessments

- a. The DSP shall perform voltage drop calculation (s) IAW Section 8.G and increase the conductor and conduit sizes as required. This increase shall compensate for any voltage drop concerns which will reduce the operating efficiency of motors, lights or other electrical equipment. If during construction a cable voltage drop concern is identified due to unforeseen circumstances, the electrical DSP shall re-analyze to determine a new cable size and provide results to the contractor for installation.
- b. Mid to large projects: If a substantial quantity of cables is specified, the electrical DSP shall provide a "Voltage Drop Table" and place details on the contract drawings. This table shall specify the conductor's maximum allowable length and amperage to ensure that the electrical components can operate efficiently.
- c. Small projects: the DSP may provide voltage drop notes on drawings to identify acceptable cable sizes.

4. Splices

- a. If it is determined by the DSP construction team that a cable splice may be required or a cable replacement is more practical, this occurrence shall be brought to the attention of the DOA Design Manager (or designee) for all normal and emergency branch circuits. Splices in handholes near spouts or other water sources shall be waterproof and approval is required prior to any work being performed.
- b. Cables for life safety branch circuits shall not be splices, cable replacement is required.

5. Circuiting

- a. A shared neutral wire is not allowed.
- b. Branch circuit design for general use power receptacle outlets shall be limited as identified in section 6.B.8.
- c. Only "Life Safety" (S) circuits shall be connected to the emergency power system.
- d. Emergency Feeder Circuit Wiring: Wiring for emergency systems shall meet the requirements of NEC 700.10 (D).
- e. Maintain a minimum of four spare circuit breakers and/or spaces in existing panel boards when practical. Provide new panel boards to accommodate the circuit

Design Standards - Electrical

excess.

- f. Main circuit breakers shall be sized 25% above connected load as a minimum.
 - g. Provide and install dedicated electrical circuits fed from local panels (when required) to power loads for general office spaces, data centers, communications complexes that use electrically sensitive equipment (computers), data processing equipment and other similar devices.
 - h. Dedicated panel boards should be fed from separate feeders to the service entrance if possible.
 - i. For small loads explore the possibility of using existing circuits vs. proposing new circuits.
 - j. Circuit Loading and Metering: The following requirements shall apply to all electrical designs to include HJAIA Capitol, DOA facilities, Concessions and Tenant projects. The requirements for electrical load calculations for Criteria 1 and 2 shown below are described in section 8.C titled "Load Calculations". The metering requirements are identified in Criteria 2 below.
 - i. Criteria 1: for minor load additions provide a load calculation with conclusions and any recommendations shown on a contract drawing panelboard schedule or in a stand-alone load calculation.
 - ii. Criteria 2: If Criteria 1 is not practical due to the complexity of projects, then a) obtain metered load measurement data which validates the maximum demand load for a 1-year period for input into a load calculation. If data is not available, then b) obtain services from a certified electrical contractor to place meters on equipment in question and record existing load data over a 30-day period. Either scenario a) or b) can be used when adding loads to the existing switchboards and panelboards. Once load data measurements are successfully captured and analyzed the output shall then be used as the design basis input for a formal load calculation.
 - iii. The load analysis for Criteria 1 and Criteria 2 shall be performed IAW the latest edition of the NEC, article 220.87 which is a requirement for the City of Atlanta permitting department.
6. Exclusions
- a. No welding or cutting of structural steel for electrical systems is allowed unless it is specifically approved by DOA structural engineering in writing.
 - b. No saw cutting of flooring to install raceway (conduits) used to route cables is allowed

for new circuits.

7. Miscellaneous Requirements

- a. **Conduit Color Coding:** All electrical conduits shall be identified by color-coding. Apply color-coded identification on electrical conduit in a neat and workmanlike manner and as specified in the project specifications.
- b. **Conduit Labeling requirements:** include requirement for the contractor to provide and install labeling for all new conduits that are connected to switchgears, switchboards, motor control centers, panelboards, junction boxes and wireways, located inside each electrical room.
 - i. Labels shall be (1) inch wide, Self-Adhesive, vinyl, laminating, (waterproof when required), fade resistant black letters, "normal" font size 36 on yellow continuous tape.
 - ii. Apply bands 50 feet on center along the raceway system and at each side of walls or floors, and at branches from mains.
 - iii. Instructions shall be provided to the contractor that before applying any identification products to the raceway systems, components shall be cleaned of any foreign substances that could prevent permanent bonding. Attachment methods and material recommended by the manufacturer shall be followed.
 - iv. Labeling shall include power source (name of switchgear, switchboard, distribution panelboard or panelboard), voltage level, circuit number and load serving.
 - v. The contractor shall provide label samples to DSP and construction manager for approval prior to installation.
- c. **Equipment Mounting Detail requirements:**

Prepare elevations and details to show the mounting method for all equipment such as large transformers, large junction boxes and large control cabinets. Any large equipment (example: transformer) when allowed by the NEC to be suspended from a ceiling structure, shall have an approved installation detail signed by a registered Professional Engineer (structural). Structural Mounting details are not necessary for small simple wall mounted devices, however details for the mounting height above the finished floor or above finished grade is required.
- d. **Floor mounted equipment to include electrical emergency generators:**

Design Standards - Electrical

All floor mounted equipment shall be placed on housekeeping pads with details shown on the electrical layout plan drawings. Provide reinforced concrete pads for floor mounted electrical equipment or unless otherwise noted (for electrical equipment installed in the Airfield Lighting Vaults see AC 150/5340-30J). The DOA recommendation: housekeeping pads shall be nominally four (4) inches high and shall exceed the dimensions of equipment being set on them, including future sections, by six (6) inches on all sides, except when equipment is flush against a wall, then the side or sides against the wall shall be flush with the equipment. Concrete pads shall also be provided and installed for all electrical emergency generators. The DSP structural engineer shall be responsible for all housekeeping and generator pad structural calculations, elements and details.

e. Surface mounted equipment:

Surface-mounted fixtures, outlets, cabinets, panels, etc. shall have a factory-applied finish or shall be painted as accepted by the DSP. The mounting and anchorage for surface mounted equipment to building structural elements shall be specified in project specifications and approved by the DSP structural engineer.

f. Surface mounted raceway:

Raceways and fittings, where allowed to be installed surface mounted, shall be painted to match the finish on which it was installed. Paint and details for raceway and conduit supports shall be IAW specific project specifications.

g. Fire Barriers:

Indicate all fire barrier penetrations on electrical plan drawing; specification shall show how the wall/barrier will be labeled.

h. Fire Stops and penetrations:

Specify fire stopping rated sealant for electrical penetrations in fire-resistance rated walls, partitions, floors, and ceilings to maintain the fire-resistance rating. Specifically, seal all conduit penetrations at fire-rated partitions. Coordinate all conduit penetrations with architectural and structural drawings, field conditions and other trades. Provide sealing fitting to prohibit condensation and passage of gases or vapors and coordinate with the project architect and or consult with the method of sealing and sealant type.

i. Sleeves and Forms:

Design Standards - Electrical

Provide sleeves for Raceways penetrating floors, walls, partitions, etc. Locate necessary slots for electrical work and form before concrete is poured. Provide boxed out forms for raceway penetrations only were allowed by the Architect. Fill opening after raceway installation, with equivalent material. DSP Structural engineer shall be responsible for all design details.

j. Leadership in Energy and Environmental Design (LEED) Efficiency:

Electrical equipment specified must meet energy efficiency requirements to align with LEED certification.

k. Modifications:

Electrical equipment being added to an existing electrical system requires a circuit load calculation or metering to determine the suitability of any equipment's ability to accommodate new loads and perform as intended. See sections titled "Circuit Loading and Metering" and "Load Calculations" for requirements. In addition the DSP shall analyze the Form, Fit, and Function (FFF) for all new proposed electrical equipment to ascertain the integration with existing infrastructure. FFF refers to the identification and description as follows: Form: the shape, size, dimensions, weight, and other physical parameters that uniquely characterize an item; Fit: the ability of an item to physically interface or interconnect with or become an integral part of another item and Function: the action or actions that an item is designed to perform.

l. Field verification:

Site walkdown's of facilities and equipment shall be performed prior to any additions or modifications to verify and validate existing field conditions.

m. Electrical Rooms and Electrical Closets:

- i. Provide notes on electrical drawings to instruct the contractor to efficiently use wall and floor space in electrical rooms when installing new electrical equipment to maintain and reserve space for future electrical work.
- ii. See section "Building Grounding System Design" for electrical room grounding.
- iii. See section "Power Receptacles System Design" for requirements in or around electrical rooms and electrical closets.
- iv. Electrical rooms (wall and ceilings) shall be two-hour rated. The DSP shall coordinate with the "Architectural" and "Structural" drawings for validation.
- v. Smoke detectors shall be provided and installed in HJAIA electrical rooms, closets if space is not provided with sprinkler protection as defined by the Georgia State

Minimum Standard Building Code.

- vi. Information Technology (IT) Telecommunication system equipment to include cabling shall not be installed in any HJAIA - CPTC and DOA property electrical rooms, except if electrical equipment is served. Electrical rooms shall not be used as an IT telecommunication room.
- vii. Exit and exit access doors serving electrical rooms and working spaces shall swing in the direction of egress travel and shall be equipped with panic hardware or fire exit hardware where such rooms or working spaces contain one or more of the following: equipment operating at more than 600 volts, nominal.
- viii. Electrical rooms in the CPTC shall be fitted with CyberKeys in coordination with AATC requirements.

n. MDF and IDF rooms:

The details for the HJAIA – CPTC, Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) rooms are designed IAW, “AIS Infrastructure Standards” latest version. This standard also applies to the HJAIA - DOA external facility building telecommunication rooms. A review of this standard during all phases of design is required to ensure compliance.

8. Generators

- a. The DSP shall install permanent diesel generators when required to meet the requirements of NFPA 110, “Emergency and Standby Power Systems”, NEC Articles 700 “Emergency Systems”, 701 “Legally Required Standby Systems” or 702 “Optional Standby Systems”.
- b. Diesel generators installed shall meet EPA Tier 2 NOx emission Levels unless otherwise exempt. See DOA “Sustainability Standards” for additional EPA requirements.
- c. All generators shall be installed on a generator pad. See section 4.C.7.d titled “Floor mounted equipment to include electrical emergency generators”.
- d. See section 4.D.1.o for Airfield- “Emergency Generator” requirements.

D. Airfield Technical Design Requirements

- 1. The following sections include design standards for systems and items specific to the airfield, but Airfield Lighting Systems designs are not limited to the design standards

listed in this section. There are other sections contained within this Electrical Design Standard that will provide design standards for items that are common to both Airfield Lighting Systems Design and other facility designs. Where duplicate design standard sections common to both Airfield Lighting Systems and other facilities are covered within this design standard, the Advisory Circulars listed in this section shall govern airfield related items.

a. Airfield lighting vaults:

Are designed to include equipment that complies with the appropriate Advisory Circulars for that equipment. Equipment designed to be installed shall also comply with AC 150/5345-53D "Airport Lighting Equipment Certification Program" (or latest revision). The configuration for electrical power feeding the Airfield Lighting Vault Facility shall be designed to meet the standards of a Continuous Power Facility as defined in AC 150/5340-30J section 13.2.1 "Continuous Load" (or latest revision). The electrical power configuration for the existing North and South Airfield Lighting Vaults and structures were sized for both equipment needs at the time of design, and potential future developments based on information provided by HJAIA Planning & Development Department.

b. Airfield Lighting Vault design details:

The building shall be climate controlled and shall have a separately climate-controlled computer room exclusively for the ALCMS equipment. This room must have a window between the equipment area and the computer room. The vault shall have a workroom and a uni-sex restroom facility. Housekeeping pads were not previously provided for existing vault equipment locations, however, validation with the latest AC 150/5340-30J and others ACs shall take place to ensure compliance for current or future designs. The Vault shall have 10' X 10' roll up doors with electric operators. The roll up doors shall be aligned with inside movement areas which will allow for easy equipment installation and manipulation. The Vault shall have a paved parking area and an apron around the entire building. The Vault building shall have photocell-controlled area lighting. The Vault must have access and turn-around capability for large vehicles. See AC 150/5340-30J, section 12.13 "Vault" and AC 150/5370-10H for specific Vault requirements.

c. Airfield Lighting Vault Equipment:

All switchboards, panel boards and all other electrical equipment, except Airport lighting equipment items requiring FAA Approved, shall have UL approvals. See AC

150/5345-53D "Airport Lighting Equipment Certification Program" (or latest revision).

d. Conduit/Wiring:

Wiring for airfield lighting shall be in polyvinyl chloride (PVC) conduit schedule 80 or as described in AC 150/5370-10H (or latest revision). The circuit conductors for lighting shall be L-824 Type C Underground Electrical Cable for Airport Lighting Circuits. Lighting circuits for taxiway lighting shall be 8 AWG and 6 AWG for runway lighting. Cable size is not dependent on whether it is a runway or taxiway circuit but is based on the size Constant Current Regulator that is energizing the circuit. L-824C cables (6# AWG) are used for 50KW CCRs. See AC 150/5345-7F (or latest revision) for airport lighting circuit requirements to include L-824.

e. Exposed Conduits:

All exposed conduits shall be galvanized rigid. Flexible connections shall be of the "Sealtite" type flex. All surface mounted boxes shall be cast metal. All conduits and other steel shapes shall be properly cleaned, treated, primed and painted. All wall mounted devices and equipment shall be mounted on steel supports attached to the walls. See 150/5370-10H (or latest revision) for additional requirements.

f. Under Floor Conduits:

All under floor conduits shall be 1" minimum size PVC conduit. At every location where the under-floor conduit turns up to the surface, for extension, a rigid steel conduit coupling shall be installed with the top end flush with the finished floor. All wiring for control, monitoring, FAA RVR and CCR output circuits shall be installed in under-floor conduit. Spare 4" under floor conduits shall be installed from the quarter-points of each wall, or wall section, to the Break-out Boxes. See 150/5370-10H (or latest revision) for additional requirements.

g. Constant Current Regulators (CCRs):

Primary power distribution to the 2400-volt primary CCRs shall be by a totally enclosed and properly ventilated overhead 4160 Volt bus system. CCR Primary connections to the 4160 Volt bus shall be fully enclosed, hook-stick installable and operable fuses of the proper size for each CCR. All Constant Current Regulators (CCRs) above 15 KW shall have a 2400 Volt primary and all 15 KW CCRs or below shall have a 480-volt single-phase primary. Where possible all regulators will be either 15 KW or 30 KW with a 6.6-amp output to match existing equipment and utilize internal control equipment that is interchangeable with existing similar components.

See AC 150/5345-10H (or latest revision) for specification details.

h. Regulator Junction Box/meters:

All CCRs shall have cabinet front mounted digital input voltage, output amp and lapsed time meters. All regulators shall have a 10" X 18" X 8" deep junction box, with thumbscrew closed hinged cover, attachment installed in the field circuit conduit, for the installation of FAA L-823 connector kits specified in AC 150/5345-26E (or latest revision).

i. Runway lighting circuit:

Existing CCRs shall have a second 10" X 18" X 12" deep junction box attached and connected to provide for the installation of FAA RVR monitoring equipment. All Constant Current Regulators at HJAIA are manufactured by MANAIRCO (justification letter dated 02/05/2003) and have 5 intensity step settings. All CCRS shall have taps to allow 30KW CCRs to be taped down to a minimum of 15KW; 15 KW CCRs shall have taps to allow CCRs to be tapped down to a minimum of 7.5 KW. The DSP shall review "As-Built" drawings and perform a field survey prior to performing any new airfield modifications.

j. Break-Out Boxes:

Existing airfield lighting vaults currently have field circuits passing through a wall mounted "Break-Out Box" which was properly sized to allow alignment, support, identification, manipulation and splicing of each conductor with an FAA L-823 connector kit specified in AC 150/5345-26E (or latest revision). Existing duct banks consisting of 4" PVC duct, number as specified on drawings are installed from Break-Out Boxes to a manhole located on the outside of the existing airfield lighting Vault building. Duct banks are extended to the field locations as required to connect into airfield circuitry locations or the existing manhole/duct bank system. The DSP shall review "As-Built" drawings and perform a field survey prior to performing any new airfield modifications.

k. Duct bank:

Existing duct banks consisting of 4" PVC duct, number as specified, are installed from the computer room to a manhole located on the outside of the airfield lighting Vault buildings. Duct banks are extended to the field locations as required and connected into existing control and communications manhole / duct bank systems. The DSP shall review "As-Built" drawings and perform a field survey prior to

performing any new airfield modifications. and compliance with AC 150/5370-10H (or latest revision) is required for Duct Bank specification details.

I. Electrical Manhole:

Electrical manholes shall be equipped with spring assist, aircraft rated manhole covers. The cover shall be clearly identified as ELECTRICAL, COMMUNICATION or FAA with proper designation being cast into the cover. See AC 150/5370-10H (or latest revision) for manhole details.

m. Grounding:

All CCRs and other equipment shall be connected to a properly sized building ground loop using ground lugs bolted to pre-drilled and threaded ground brackets which are installed flush with the finished floor. Ground brackets must be installed at each location identified for future equipment installation. ¼" X 2" Ground bus shall be mounted along to the Vault walls to provide for grounding of future equipment. See FAA-STD-019F (or latest revision) for grounding requirements and details.

n. Lightning Arrestors:

All fields lighting circuitry shall have properly sized lightning arrestors connected to the circuit conductors immediately prior to the "Break-Out Boxes". See AC 150/5345-10H (or latest revision) for lightning arrestor details.

o. Emergency Generator:

A minimum of one emergency generator, meeting the requirements of AC 150/5340-17B Section 4.a.1, for a Continuous Power Facility, must be furnished. The generator must be properly sized to energize the entire connected load of the Vault. Additional capacity shall be provided to allow additional future loads to be added as needed. Each generator must be provided with a minimum of a 5000-gallon fuel tank. See AC 150/5340-30J and AC 150/5340-30H (or latest revision) for fuel storage tanks and any FAA generator details

p. Standby Generators:

The design for standby power system shall provide automatic changeover from commercial power to the engine generator within 15 seconds of loss of commercial power. The design must comply with the requirements for a "Configuration A" power system as described in AC 150/5340-30J, section 9.4.1.2.1 "Configuration A" which provides for ATCT activation of the generators(s) during low visibility conditions. Provide for a one second power transfer from generator to utility if the generator

should fail during low visibility operations. The generator shall be sized to power the entire airfield lighting vault with all existing connected loads. Refer to AC 150/5340-30J, section 9.12 for engine generator performance requirements.

q. Airfield Signage:

The signage guidance system provides the ability to easily determine the designation or name of the taxiway in which the aircraft is located, identify routes, indicate mandatory holding positions and identify boundaries. Signs are placed strategically to deter confusion among aircraft and to lessen the probability of accidents. General signage conventions, signage size and signage location requirements shall comply with FAA Circular AC 150/5340-18H D (or latest revision).

r. Monitoring Systems:

CCRs and all other controlled equipment must be equipped with or modified to accept Distributed Control and Monitoring Units (DCMU) that will be totally compatible with the existing Siemens Control and Monitoring System (ALCMS). Each field circuit or sub-circuit shall be equipped with individual circuit megging (IRMS) equipment and DCMU compatible with the existing ALCMS. Refer to FAA Circular AC 150/5340-30J, Chapter 13 and Appendix F (or latest revision). Compliance to AC 150/5345-53D (or latest revision) is also applicable.

s. Security:

The vault must be furnished with security entry control and CCTV monitoring capability. DSP shall coordinate with HJAIA - AIS and Security departments for any design modifications.

t. Miscellaneous Utilities:

The Vault must be furnished with potable water, sewer, and a minimum of 4 telephone lines. The DSP shall coordinate with HJAIA -AIS department for any modification requirements.

5.0 Lighting Systems Design

A. Interior Lighting Systems Design

1. Design Philosophy: Provide adequate, comfortable, and reliable indoor illumination levels appropriate for the tasks to be performed by using the most common unit of measure for quantifying light levels as follows:

Design Standards - Electrical

- a. DOA's design lighting levels measured in footcandles (fc) shall conform to the latest recommended average maintained footcandle levels established by the Illuminating Engineering Society (IES) Lighting Handbook published standards (latest revision) unless otherwise indicated.
2. Minimum to Maximum (brightness) ratio: The lighting minimum to maximum ratio, or uniformity ratio, is the ratio of the maximum illumination level to the minimum illumination level in a space. The uniformity ratio is a measure of how evenly the lighting is distributed throughout a space as perceived by our customers at HJAIA and DOA facilities.
 - a. Lighting designs shall be modified accordingly when dark spots (low uniformity ratios which are NOT allowed by DOA) are identified with a photometric analysis.
 - b. On occasion the electrical DOA Assistant Director (or designee) may request placement of additional lighting fixtures due to airport knowledge which is not readily accessible to the DSP. DOA recognizes that additional lighting fixtures may contribute to footcandle levels exceeding the IES recommendations, however, compliance is required unless an alternative lighting design solution is proposed to meet DOA concerns. If there are compelling circumstances which prevent meeting the requirements a consultation with the DOA electrical Assistant Director Electrical (or designee) is required. The DSP shall demonstrate that the alternate solution is adequate with a new photometric calculation design.
3. All interior lighting shall be Light Emitting Diode (LED) luminaires to save energy, reduce maintenance cost and to align with LEED certification requirements.
4. Lamp Color: Different color temperatures create different lighting effects and ambiance. Coordination with the DOA Architect shall take place during design to determine the ideal recommended lamp color temperature for the various interior spaces.
5. Small Rooms: If the lighted area contains small rooms enclosed by fixed partitions and/or is occupied by fixed structures or equipment, follow a nonsymmetrical pattern according to the IES Lighting Handbook, using the recommended practice for office lighting.
6. Large Bay Area: If the lighted area is a large bay and a suggested layout is not present in the Electrical Design Criteria, use a modular system so a bay or sectional area can be cut into equal sections without disturbing the fixture pattern.
7. Use natural or day lighting as much as possible, both for energy management and for architectural aesthetics.
8. Provide photo sensitive lighting controls to extinguish selected fixtures or lamps in

response to daylight contributions to space.

9. Utilize task lighting in workstations and consider day lighting from windows and skylights when determining lighting levels for the space.
10. Employ energy management tools such as occupancy sensors, time of day controls or other appropriate means. Energy management should be considered for all spaces. When a Lighting Control Management system is designed with zones, relays and other miscellaneous components provide a detail legend to describe the unique lighting circuit naming methodology and a lighting control wiring diagram for complex systems when required.
11. Lighting fixture maintenance and repair is an important design consideration and can supersede architectural considerations when life cycle cost is considered.
12. Do not locate light fixtures where they cannot be safely reached by ladders.
13. Coordinate fixture locations with other disciplines to ensure that equipment or other work will not occupy space below the fixture mounting planes.
14. Coordinate with other disciplines in the reflected ceiling plans to avoid equipment interference.
15. Air handling type light fixtures listed for installation in plenum (environmental air) space may be utilized in coordination with the mechanical design.
16. Proactively determine the programmatic use of the space, and do not locate fixtures where later installation of programmatic equipment will block fixture access. If this cannot be avoided or fully anticipated during the design phase, provide alternative access such as catwalks.
17. In areas subject to vibration (for example, equipment rooms and rooms near large motors), evaluate the need for a suitable adhesive for all nuts and screwed fittings involved in the fixture mounting. Proper seismic bracing shall be supplied for all fixture types.
18. In general battery packs for emergency egress lighting are not allowed. Where generator power is available, unswitched fixtures shall be utilized for emergency lighting and may also be designated as 'night lights. Keyed switches are not allowed. The requirements of the NFPA Life Safety Code states "Emergency generators used to provide power to emergency lighting systems shall be installed, tested, and maintained in accordance with NFPA 110, Emergency and Standby Power Systems". Compliance is required.
19. Where generator power is unavailable, provide a UPS for emergency egress lighting.

Design Standards - Electrical

20. Provide interior photometric lighting calculations (normal and emergency) as described in the "Design Calculation" section of this Design Standard -Electrical.

B. Exterior Parking Lot Lighting System Designs to include Electric Vehicle Areas

1. In general, all exterior building wall and pole mounted light fixtures shall be switched by photocell with an override switch accessible to qualified maintenance personnel.
2. Emergency Generators, automatic transfer switches and all required components necessary for a complete and operational emergency lighting system shall be provided for parking decks and parking lots. See section "Engine Generator" for details.
3. Parking lot lighting shall be LED luminaires which can efficiently direct light to where it is needed on the parking lot surface when required.
4. Parking lot lighting shall satisfy visibility requirements while providing a sense of safety and security, comfort and aesthetic appeal. Coordination with the DOA Architects is required with the fixture selection.
5. Parking lot light pole locations shall be shown on the site plan drawings with light pole details shown on associated drawings. Details such as round vs. square vs. tapered light pole, pole height, material of pole (DOA preference is Aluminum) and light fixture mounting details shall be specified. Light pole bases shall be shown on design drawings with the DSP structural discipline providing technical pole base requirements and details.
6. Each light pole shown on a site lighting plan shall be assigned a unique pole identification number.
7. Electric vehicle (EV) charging stations: Adequate footcandle levels for Electric vehicle (EV) charging stations shall be provided as recommended by the Illuminating Engineering Society (IES) to ensure safety and visibility. Based on industry data, the recommended lighting levels for outdoor parking areas, which can be applied to EV charging stations, are: 5-10 foot-candles for general parking areas, 10-20 foot-candles for areas with higher activity or where enhanced security is needed. Footcandle levels shall also consider any Americans with Disabilities Act (ADA) requirements.
8. Exterior Lamp Color: Different color temperatures create different lighting effects. Based on published industry data, DOA determined that the ideal recommended color temperature for parking lots, parking deck, and exterior lighting is 4,000 Kelvins (K) which is a natural white color with a low color rendering index (CRI) and good for visibility. Confirmation with the DOA Architect during the exterior lighting system designs is required.

Design Standards - Electrical

9. Provide the following illumination levels in areas shown below, measured at grade with all fixtures at full brightness, zero sky contribution, 15% variance permissible:

Design Footcandle Levels (fc):

- a. 10 fc at building entrances, with 5 fc for night emergency egress.
 - b. 5 fc at gates and perimeter fences where security assessment is an issue; maintain 3:1 ratio between maxima and minima.
 - c. 10 fc in parking lots, maintain 3:1 ratio, with 5 fc for emergency lighting.
 - d. 2 fc along illuminated HJAIA roadways. Coordination with other stakeholders may be required for non HJAIA roadways.
 - e. The illuminance for Roadway Tunnel lighting shall IAW the IES requirements. However, coordination with other stakeholders may be required for non HJAIA roadway tunnels.
 - f. 5 fc at major street intersections.
 - g. Dark spots are NOT allowed. Modify lighting designs accordingly to ensure compliance.
 - h. Provide exterior photometric lighting calculations (normal and emergency) as described in the "Design Calculations" section of this Design Standard.
- C. Parking Deck Lighting System Design
1. Parking deck lighting shall satisfy visibility requirements while providing a sense of safety and security, comfort and aesthetic appeal. Coordination with the DOA Architects is required with the fixture selection.
 2. Parking deck light levels shall conform to the latest recommended average maintained footcandle levels established by the Illuminating Engineering Society (IES) Lighting Handbook published standards.
 - a. Dark spots are NOT allowed. Lighting designs shall be modified accordingly to ensure compliance.
 - b. Adequate lighting levels shall be provided for parking deck's basic areas, ramps (Day/Night), entrance (Day/Night), stairwells, and roofs.
 3. Designs shall consider all factors to ensure the drivers and pedestrians' safety while providing consideration of columns and other obstacles.
 4. All parking deck lighting shall be LED luminaires to save energy, reduce maintenance costs and to align with LEED certification requirements.

Design Standards - Electrical

5. Light fixture selections shall consider installation, maintenance, energy consumption, efficacy and lifespan.
 6. See section 5.B.7 for Electric vehicle (EV) charging stations and 5.B.8 for exterior lamp color requirements.
 7. Do not locate light fixtures where they cannot be safely reached by ladders for maintenance.
 8. Provide parking deck photometric lighting calculations (normal and emergency) as described in the "Design Calculation" section of this Design Standard. Also provide photometrics lighting calculations specifically for the Electric vehicle (EV) charging station areas to include considerations to meet any ADA requirements.
- D. Airfield Lighting Systems (150/5340-30J or latest revision)
1. Specific Details: The following sections include details specific to the HJAIA, Airfield Lighting Systems designs. AC 150/5340-30J (or latest revision) shall govern all airfield related designs and shall take precedent over this electrical design standard unless otherwise noted or if any conflicts are identified. Other sections of this Electrical Design Standard are applicable to the airfield designs so the DSP shall perform a review to determine applicability and a field walkdown shall take place to determine all existing systems.
 2. Edge Lights: Edge lights are employed to outline usable operational areas of the airport during periods of darkness and low visibility weather conditions. The FAA approves airports for certain types of aircraft traffic. Based on an airport's approved FAA rating, AC 150/5340-30J (or latest revision) is used to determine whether lights shall have low, medium or high intensity light levels. Hartsfield-Jackson Atlanta International Airport (HJAIA) uses high intensity elevated L-862T runway edge lights with L-850C semi-flush lights in paved exits and LED L-852T semi-flush taxiway edge lights. See AC 150/5340-30J (or latest revision), Chapter 2 for specific light spacing based on the pavement geometry and to confirm the latest lighting types. This includes required spacing on curved taxiway sections and taxiway radii.
 3. Runway and Taxiway Centerline and Touchdown Lighting Systems
 - a. General: Runway centerline and touchdown zone lighting systems are designed to facilitate landings, rollouts, and takeoffs. The touchdown zone lights are primarily a landing aid while the centerline lights are used for both landing and takeoff operations. See AC 150/5340-30J, Chapter 3 for specific information regarding

runway centerline, touchdown zone lights and spacing criteria.

- b. Runway Centerline lights: The line of lights is offset at a maximum of 2'-6" to either the right or left side of the runway centerline and should be to the opposite side of the centerline marking from the major taxiway turnoffs. Centerline lights must be installed with a 1" maximum deviation from perfect alignment and with a + 0" – 1/16" maximum deviation from finished pavement grade. HJAIA utilizes a 2'-6" spacing from the joint line to the center of the light fixture or light base. See AC 150/5340-30J for Runway Centerline light details.
- c. Taxiway Centerline lights are installed on taxiways at H-JAIA. Taxiway centerlines lead off lights for runway exit taxiways emit alternating green and yellow lights to the first light past the runway holding position. In general, lead-off lights on high-speed exits are unidirectional. All taxiway centerline lights shall be equipped with LED lamps. See AC 150/5340-30J, Chapter 3, to obtain specific spacing criteria.
- d. touchdown zone lights are used to show where aircraft wheels should touch ground to ensure a safe landing. They emit a white light. The lights consist of 2 rows of transverse light bars located symmetrically about the runway centerline. Each light bar consists of 3 unidirectional lights facing the landing threshold. The rows of light bars extend to 3,000 ft. or half the runway length for runways less than 6,000 ft. from the threshold, with the first light bars located 100 ft. from the threshold. See AC 150/5340-30J Chapter 3 for more specific information regarding runway touchdown zone lights.

4. Miscellaneous Lighting Visual Aids

- a. Beacons serve as indicators to locate lighted airports. The type of beacon used is dependent upon its function. They can be used at airports that have a high or medium intensity lighting system or when it is necessary to warn airmen of an obstruction which presents a hazard to air commerce during periods of darkness or limited visibility. See AC 150/5340-30J, Chapter 6 for guidelines to determine which beacon would best serve HJAIA and the mounting method for the beacons.

5. Airfield Lighting Control System:

The existing airfield lighting control system at H-JAIA is/was a Siemens Airfield Solutions system, however, confirmation is required to determine if system is currently installed. All future controlled equipment, either in the lighting vault or individual fixture control and monitoring devices must be designed with equipment that is compatible with this system, or the current system installed. The system uses a Distributed Control and Monitor Unit

connected to each piece of controlled equipment and an integrated circuit megging unit for each circuit. All individual fixture control and monitoring equipment must be designed using power line carrier equipment that is compatible with the Siemens ALCMS. See AC 150/5340-30J, Chapter 13, Appendix F and other sections for details.

6.0 Power Receptacle System Design

A. Definition

The term outlet refers to the actual box where receptacles are present, receptacles are opening in the box which you plug your device into.

B. Location / Minimum Requirements

Locate receptacle symbols on power plan layout drawings. The minimum requirements for the receptacle system design shall include the following:

1. In general, flush mount receptacles shall be installed in all areas.
2. Surface mounted receptacles are allowed in spaces such as warehouses, equipment chases and electrical/mechanical rooms.
3. Provide dedicated receptacles for janitorial equipment in hallways and aisles maximum 50 feet apart; mount at 36 inches above the finished floor, and segregate from other receptacles.
4. Mounting heights for general duplex receptacles shall be mounted at 48" AFF unless noted otherwise.
5. Provide general-purpose receptacles in electrical and mechanical rooms; receptacles shall be Ground Fault Circuit Interrupter (GFCI) type. See reference 2.A.1.g, section 210.63 (B) for additional receptacle location requirements.
6. Only where specified on design drawings provide duplex receptacle, 20 AMP, 120V with USB-A and USB-C charging ports.
7. Avoid back-to-back receptacle installations.
8. Branch circuit design for general use power outlets shall be limited to no more than six receptacles per circuit.
9. Provide general-purpose receptacles adjacent to each exterior door; receptacles shall be weatherproof and GFCI type.
10. Provide rooftop maintenance outlets per NEC, outlets shall be weatherproof and GFCI protected.

Design Standards - Electrical

11. Do not wire GFCI's and non GFCI's in the same circuit.

C. Electric Vehicle Supply Equipment (EVSE) Charging Stations

1. A charging station, also known as a charge point, or EVSE, is a power supply device that supplies electrical power for recharging plug-in electric vehicles. When specified, typical units require a dedicated 40-Amp circuit to comply with the NEC requirements in Article NEC 625. A design-based vendor is required to determine the actual electrical requirements.
2. EVSE charging stations shall be installed at Parking Decks, Parking lots, and at various DOA facilities located throughout HJAIA when specified under the DOA project scope document.
3. Level 2 chargers shall be specified when required.
4. If multiple electric vehicle supply equipment (EVSE) units are connected to the same circuit, an EV charging load management systems shall be specified which allows the control of how much electricity each charging station can use.
5. The DSP shall review the City of Atlanta, ordinance 25-O-1011 for the comprehensive Electric Vehicle Charging Readiness Policy requirements to determine applicability.

7.0 Low Voltage Power Systems Design (<600 volts)

- A. General Power Requirements: Applicable to low voltage power system electrical components (systems less than 600 volts).
 1. Single Line Diagram Drawing details
 - a. Single line drawings shall be provided for all HJAIA CPTC, DOA facilities, Capital, Concessions and Tenant projects. A riser diagram can be submitted to illustrate designs; however, riser diagrams shall not be substituted for single lines diagrams. Riser diagrams AND single line diagrams shall be provided for multiple story buildings.
 - b. Electrical data such as voltage, amperage, phase, cable, conduits and breaker sizes, AIC ratings, metering (see section "Electric Power Monitoring System" (EPMS)), interconnection to utilities, downstream devices and ALL other pertinent electrical details to make a complete electrical distribution system shall be illustrated on the single line diagrams.

Design Standards - Electrical

- c. Single line diagrams shall be provided for each switchgear, switchboard, distribution panelboard and motor control center with partial single line diagrams provided for each switchboard showing downstream panelboards
- d. Single Line diagram drawing(s) representing the entire electrical distribution system infrastructure or sections of the affected electrical system shall be developed for each project scope of a HJAIA CPTC, DOA Capital, Concessions and Tenant project. Details can be added to existing As-Built single-line diagram drawings as required.
- e. Symbols used on single line diagram drawings shall be consistent with DOA CADD and ANSI standards.
- f. Single line drawing detail illustrations shall start at the top of drawing with the highest voltage levels at the utility transformer and generator with the incoming source of the power at the building transformers(s). Then show all pertinent electrical equipment downstream to the panel board level including cables. Details such as switchboard/switchgear, transformers, panel boards, motor control centers, generators, automatic transfer switches, uninterruptible power supplies, inverter systems, motors, starters, main disconnect switches, etc. shall be included to show a complete system.
- g. Transformers: note the kVA size, primary and secondary voltages, available fault current (at the transformer terminals) and phasing (building service entrance only).
- h. Switchgears, Switchboards, and Distribution Panelboard equipment shall be shown in the "expanded" form. Drawings shall detail main breaker, tie breaker, feeder breakers, spare breakers, CT's, PTs, and meter(s). Annotate switchboard rated amperage, voltage, short circuit capability to include frame and trip sizes of all breakers in the gear and distribution panelboard.
- i. Starters: show starter/breaker/fuse and NEMA ratings for all starters.
- j. Generators and Transfer switches when required: details shall include generators, automatic transfer switches and their respective single line diagrams. Note the service entrance, feeder wire and conduit sizes.
- k. Provide short circuit information for Kilo Ampere Interrupting Capacity (KAIC) on single lines for all buses.
- l. Circuit Breakers or fuses rated 1200 Amps or more must have a documented means of Arc Energy Reduction in accordance with NEC Section 240.67 and 240.87.

2. Electric Power Monitoring System (EPMS)

- a. The DOA utilizes an Electrical Power Monitoring System (EPMS) consisting of power digital smart meters, data connections, converters, gateways, hubs, cables, software and programming, interactive graphic displays, circuit breakers, receptacles and other accessories as required by the manufacturer to make a complete/operational system.
- b. The DSP shall include an EPMS scope of work to include EPMS single line diagram or riser diagram drawing (s) with notes, interactive graphic screen updates (with new or revised floor plans showing EPMS meter locations and graphic screen single line diagrams), software and programming details for the EPMS metering equipment to integrate and communicate with the existing EPMS system. The installation of software along with programming of the EPMS monitoring equipment and interactive graphic screens (new or updates) shall be provided by the AATC's preferred contractor and in conjunction with the EPMS contract service provider. The EPMS component naming methodology shall be consistent throughout the HJAIA CPTC and match construction documents.
- c. When metering for switchgear, switchboards, motor control centers, distribution panelboards and panelboards is specified, provide instruction indicating that meter(s) shall be integral to the equipment, supplied and installed by the original equipment manufacturer at the factory.
- d. Digital smart meters shall be provided to monitor the mains of switchgear, switchboards, motor control centers, distribution panelboards and panelboards. The digital smart meters shall be capable of aggregation to provide building-level usage representing total building energy consumption.
- e. Load Separation: The DSP shall include the separation of electrical circuits for electrical monitoring in their power system design. The system(s) shall be designed so that measurement devices can monitor the electrical energy usage of the following load types: lighting (interior and exterior), HVAC, boarding bridges, and receptacle loads. All load types shall be separately metered as required by ASHRAE 90.1-2013/2016 and LEED requirements.
- f. Separate metering: For new construction, lighting, HVAC (heating, cooling), boarding bridges, elevators, and escalators shall be metered separately which may require additional panelboards. The DOA electrical Assistant Director shall be notified as early as practical if additional panelboards are required.
- g. Concessions/Tenants: Concessions must draw power through a digital smart energy

meter. Each distribution section of new concession switchboards shall be equipped with (10) sub-meters for individual concessions feeder breaker monitoring. Sub-meters shall be factory pre-wired to main meter. Coordinate with AATC for concession revenue meter requirements (EPMS metering not required for internal concession spaces). *Tenant* space power consumption is covered under separate lease agreements with AATC.

- h. Cyber Security: The vendor of the EPMS software shall have a cybersecurity evaluation program which is certified under UL 2900. Verification shall be provided by the DSP under the shop drawing review process.
 - i. Specifications - for small projects EPMS specification requirements can be included on the EPMS drawings.
 - j. Specifications - for large projects a Division 260913, Specification section titled "Electrical Power Monitoring System (EPMS)" shall be included as a standalone electrical specification section deliverable.
 - k. Digital Smart Meter Levels - Provide embedded main digital smart metering with display on new switchgear, switchboards, motor control centers and panelboards as follows: (Feeder metering is not required)
 - i. Highest Level: Switchgear main metering shall be the highest-level product of the manufacturer.
 - ii. Midrange Level: Switchboards meters shall be of the next highest-level product type of the manufacturer.
 - iii. Lowest Level: Panelboard meter shall be of the basic lowest level product type required for wattage, voltage and current.
 - l. Data Storage: meters shall be able to store data for a minimum of 1 year and shall be capable of sending data to a server for use in a power monitoring software application.
3. Low Voltage Switchgear (SG)/Switchboards (SB)
- a. All new SGs and SBs shall be purchased with new Digital Smart Meters as described in section titled "Electric Power Monitoring System (EPMS)".
 - b. All new and existing SGs and SBs shall be located on power plan drawings.
 - c. Detail feeder and branch circuit wiring sizes shall be shown on single -line diagram.
 - d. For all SG and SB provide load information, voltage, phase, Kilo Ampere

Design Standards - Electrical

Interrupting Capacity (KAIC) ratings, mains ratings, load summary, demand load summary, circuit breaker sizes, spare sizes and space information in panel schedules.

- e. Provide elevation front view drawings for each SG and SB showing all circuit breaker locations in each section with compartment / cubicle assigned with a unique identification number.
- f. Provide any additional details on constructions drawings as necessary to make a complete and operational system.
- g. Locate SGs and SBs indoors where possible, avoid outdoor locations.
- h. Locate SGs and SBs in dedicated electrical rooms accessible only to qualified personnel.
- i. For service entrance equipment, provide rear access when possible.
- j. SG's/SB's shall be equipped with:
 - i. Copper main bus; 100 percent capacity full length.
 - ii. Copper neutral bus, if required; 100 percent capacity full length.
 - iii. Copper ground bus; full length.
- k. Main and feeder circuit breakers shall be arranged for compression connectors.
- l. All circuit breakers for SGs/SBs shall be constructed according to NEMA standards and shall have provisions for lockout/tag out.
- m. All circuit breakers shall include electronic interchangeable trip with adjustable LTPU, LTD, STPU, STD and INST functions. When required, provide integral GFPU and GFD functions.
- n. The design for SGs/SBs shall include:
 - i. a minimum of 20 percent spare capacity with the connected load not exceeding 80% of main circuit breaker rating.
 - ii. at a minimum 1-spare circuit breaker of each frame size (excluding main) used.
 - iii. future bus extensions and dedicated space for at least one future section.
- o. Provide integral TVSS to meet requirements of NFPA 780, when required.
- p. Where draw out circuit breakers are specified, provide manufacturer's overhead lifting device suitable for all circuit breaker sizes and locations.
- q. Provide manufacturer's test kit for all circuit breaker types and functions used.

Design Standards - Electrical

- r. All circuit breakers larger than 200 amps shall be tested.
 - s. Main circuit breakers are to be sized according to the appropriate NEC section for any location. If a larger breaker is installed, then the appropriate trip plug must be installed. It is not permitted for the trip settings to be dialed down to meet the intent of this article.
 - t. Provide main lugs only when the switchboard is in the same room with their feeder breaker, otherwise, provide main circuit breaker.
 - u. Switchboards shall be provided with a main circuit breaker.
 - v. Switchboard and Distribution Panelboard (DP) requirements for Concession and *Tenant* spaces are as follows:
 - i. The power feed for the Concession spaces must originate at a switchboard dedicated to concessions. If there is no space or spare available in the Concession switchboards DOA shall be consulted so that a suitable alternative switchboard can be designated by the DOA.
 - ii. For large Concession spaces where the main disconnect size is 400 amps or above ground fault protection may be required at the discretion of the DOA.
 - iii. Verification of the actual load on the existing switchboard is the responsibility of Concession's DSP. Current load readings of the switchboard are required so that new loads can be added to the switchboard safely. See section titled "Circuit Load and Metering" and "Load Calculations".
 - iv. Power for the *Tenant* spaces shall originate at a CPTC house SB or DP with spare capacity to add load and not be dedicated to Concession spaces.
4. Motor Control Centers (MC)
- a. MCs shall be purchased with new Digital Smart Meters as described in section titled "Electric Metering and Power Monitoring System (EPMS)"
 - b. MCs which consist of multiple enclosed sections with motor starters, fuses or circuit breakers and power disconnects shall be shown on the power plan layout drawings.
 - c. MC details shown on one-line diagram shall include all loads, circuit numbering and spaces. KAIC ratings of all components shall be shown to match the electrical system.
 - d. Provide elevation (front views) showing all starter locations and circuit (compartment) number in a logical industry sequence.

Design Standards - Electrical

- e. Provide additional details such as schedules or other information on drawings as necessary for construction.
 - f. Locate indoors where possible; avoid outdoor locations.
 - g. Locate MCs in dedicated electrical rooms accessible only to qualified personnel.
 - h. Use front accessible where possible.
 - i. Use copper main bus; 100 percent full length capacity, minimum 600A.
 - j. Use copper neutral bus, if required; 100 percent capacity full length.
 - k. Use copper ground bus, full length.
 - l. Wire MCs for NEMA Class I, Type B.
 - m. Circuit protectors, contactors, overload blocks and all accessories shall be NEMA construction.
 - n. Motor starters shall include overload reset button, red and green, LED type pilot lights- red for "run" mode and green for "stop".
 - o. Provide (HAND-OFF-AUTO (HOA) in cover; minimum 2-normally open (N/O) and 2-normally closed (N/C) auxiliary contacts and individual control power transformer (CPT) if above 150V to ground. Provide fuses for transformers over current protection.
 - p. CPT, if required, shall be sized for 100 VA spare capacity and include 2 primary and 1-secondary fuses for 120V control.
 - q. Do not mount panelboards or associated transformers in MCs. In addition, transformers must not be installed above the ceilings.
 - r. Do not mount variable frequency drives (VFD) in MCs; VFD's shall be individually mounted at controlled motor.
 - s. Provide future bus extensions and dedicated space for at least one future vertical section.
 - t. Provide minimum 20 percent spare capacity.
 - u. Provide 10 percent spare cubicles for each size provided.
5. Panelboards
- a. All new Panelboards shall be purchased with new Digital Smart Meters as described in section titled "Electric Power Monitoring System (EPMS)".
 - b. Locate new and existing panelboards identified for a project on power layout and or

Design Standards - Electrical

enlarged layout floor plan drawings.

- c. Provide completed panelboard schedules on drawings. Schedules shall show voltages to match voltages on single line diagram. Each circuit on the panel schedule shall be described to reflect the function and location of each load (for example, lighting room xx apron level). Each circuit shall show a connected and demand or estimated load in KVA whether the circuit is new or existing.
- d. Locate indoors where possible, avoid rooftop locations.
- e. Locate in dedicated electrical rooms and where possible avoid user or passengers' spaces. Column type panelboard is not allowed unless approved by DOA electrical Assistant Director or designee.
- f. Flush-mounted in areas such as user hallways and office spaces. When flush-mounted, provide spare conduits, skirting or other provisions to facilitate future modifications.
- g. Surface-mount in all other areas including user storage, warehouses, equipment chases and electrical or mechanical rooms.
- h. Avoid sub feed or dual-feed lugs. Connecting more than one wire on or under a single lug or connection point in the industry is referred to as double lugging. This is only allowed if that terminal, lug or connection is specifically rated for more than one wire per NEC 110.14.
- i. All buses for panelboards shall be copper.
- j. Avoid individually mounted sub feed circuit breakers.
- k. Main circuit breakers are to be sized according to the appropriate NEC section for any location. If a larger breaker is installed, then the appropriate trip plug must be installed as well. It is not permitted for the trip settings to be dialed down to meet the intent of this Section.
- l. Provide Transient Voltage Surge Suppression (TVSS) for all panel boards serving electronic loads.
- m. Provide 200% panelboard feeder neutrals and 200% neutral bus when required per harmonic analysis and for all electronic loads to include IT equipment. The 200% panelboard feeder neutrals shall be located on the appropriate feeder schedule.
- n. Provide main lugs only when the panelboard is located in the same room with their feeder breaker otherwise, provide main circuit breaker.

Design Standards - Electrical

- o. Connected loads shall not exceed 80% of main circuit breaker rating.
 - p. Series rated circuit breakers are not acceptable.
 - q. Panelboards shall be provided with a main circuit breaker designated with the required KAIC ratings to match the electrical system.
6. Low Voltage Dry Type Transformers (TR)
- a. Low voltage dry type TRs shall be shown on the power plan layout drawings.
 - b. Project design specifications shall include requirements for the transformers to factory assembled, metal enclosed and provided complete with mounting brackets (as required) to make a complete operational system.
 - c. Provide elevation and/or mounting details as required for construction.
 - d. Energy efficient type: Shall meet NEMA TP-1.
 - e. Taps: Voltages shall be compatible with the application. Taps shall be provided two at plus 2-1/2 percent increments and two minus 2-1/2 percent increments from rated voltage
 - f. Windings: TRs shall be provided with copper windings; aluminum is not acceptable.
 - g. Rating: The sizing of step down or step up dry type TRs shall take into consideration the current or expected normal and harmonic loading. The decision to use "K" transformers will be based on harmonic analyses of the connected and forecast load and be in compliance with IEEE- 110 and defined by UL as K-factor.
 - h. Mounting: TRs shall be mounted where accessible. No units may be mounted behind partitions, above ceilings, etc. If transformer is floor mounted see section 4, titled "Floor Mounted Equipment" for details. See section C.7.c for additional transformant mounting details.
 - i. Dry type TRs shall be U.L. listed and certified to meet NEMA Standards.
 - j. Grounding and bonding for TRs shall be per NEC requirements.
7. Motors
- a. Motors shall be shown on the power plan layout drawings.
 - b. Motors that are controlled by across the line motor starters (contactor, motor circuit protector and overload relay) and are 25 HP or larger shall include power factor correction capacitors at the motor starter to achieve 95 percent power factor.
 - c. VFD controlled motors are excluded from the power factor correction requirement. Utilize VFD's with minimal harmonic distortion.

Design Standards - Electrical

- d. To ensure a minimum standard of quality, identify devices, fittings, fixtures, and equipment on equipment list drawings with their electrical sizes, ratings, manufacture and catalog number. This is not necessary for items such as panel boards where complete specifications are written.
 - e. Identify motor starters with sizes on the motor control schedule.
 - f. Identify all equipment by using standard symbols and equipment schedules. In addition to the items already mentioned, the schedule should include information to help the contractor obtain the equipment and materials intended by the design.
 - g. Specify nameplates on all control items used on the job. Specify each nameplate either on the motor schedule or on the equipment list. Each nameplate identifies the system and the function of that device to the system.
 - h. Motors shall comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
 - i. Code Letter Designation: Motors 15 HP and larger: NEMA starting Code F or Code G, Motors Smaller than 15 HP: Manufacturer's standard starting characteristic. See project specifications for specific common motor requirements.
 - j. When required, provide motor thermal overload (TOL) relays IAW NEC requirements which serves as a crucial protective device in electrical systems used primarily to safeguard motors from overheating.
8. Variable Frequency Drives (VFD)
- a. VFD's shall be shown on the power plan layout drawings, indoors where possible; avoid outdoor locations. Locations shall match the mechanical drawings therefore coordination is required.
 - b. Typically, VFD's will only be installed when requested by the Mechanical Engineer. Coordination with the mechanical project specifications is required for requirements.
 - c. Contrary to previous requirements, a manual bypass circuit is not typically required on a VFD. A bypass circuit should only be specified after discussing the requirements with the Mechanical Engineer.
 - d. Do not install VFD's closer than five feet to an FID cabinet.
 - e. VFD's should be located as near as practical to the motor it controls.
 - f. The VFD should never be located more than 50 feet from the controlled motor.

Design Standards - Electrical

- g. A disconnect switch with an auxiliary contactor shall be provided near the motor.

9. Busway Systems

- a. Type: The DOA preferred Busway shall be the “**Integra**” ground busway system where all or part of the housing are designed-built-in (not an add on) for grounding.
- b. Busway shall be copper with 100% neutral bus minimum. Other electrical characteristics such as voltage and phase, shall be specified on single line drawings.
- c. The Busway shall be totally enclosed in a non-ventilated aluminum housing and single-bolt joints.
- d. Use IP54 or greater for indoor installations and NEMA 3R for outdoor installations. Busway shall also comply with UL 857.
- e. The Busway shall be protected against overcurrent in accordance with the allowable current rating of the busway.
- f. Where busway is used as a feeder, the voltage drop should not exceed 3 percent.
- g. All busways shall be grounded as described in section titled “Building Grounding System Designs”
- h. Provide expansion fittings for all busways at building expansion joints.
- i. The entire busway run shall be shown on power plan layout drawings. Busway shall also be shown and designated on the single line diagrams
- j. Where busway penetrates walls and floors, seal all penetrations with the appropriate fire stopping material to maintain fire rating of walls and floors.
- k. Existing legacy Busway at the CPTC is “Siemens”. If existing sections of busway are to be replaced, the replacement should be “Siemens”, like-for-like. If a different manufacturer is selected due to busway being obsolete a busway “TAP” box may be required which is not the preferred method for DOA,

B. Lightning Protection System Designs

- 1. The Lightning protection systems shall conform to UL 96A and NFPA 780 requirements.
- 2. A Master Label Lightning Protection system (UL certified) is required for all new roof and/or modified roof renovations/extensions associated with DOA facilities located at HJAIA. In addition, all new and existing Lightning Protection Systems shall have a Master Label UL Certification and or a UL “Letter of Findings”. The scope of work associated with the “Letter of Findings” requires DOA electrical approval.

Design Standards - Electrical

3. The DSP shall place notes on contract drawings and specifications stating that a new Master Label UL Certification is required for any new roof structures.
4. A Master Label UL re-Certification or a "Letter of Findings" is required when any new lighting protection components are tied to an existing lightning protection system or when the existing lightning protection system is modified.
5. A UL Master Label and or a "Letter of Findings" is also required for structures with expired Master Label UL Certification or with structures having an undetermined certification.
6. The DSP shall submit a Master Label UL Certification or a UL "Letter of Findings" as a project deliverable.
7. The DSP shall show a lightning protection system with details on Lightning Protection and Counterpoise Composite Plan drawings. Details such as loop conductor, air terminals, down conductors, bonding, penetration sleeves and all other components required to make a complete and operational Lightning Protection System shall be identified.
8. The Lightning protection drawings shall be sealed and signed by a P.E. (Electrical) registered in Georgia and submitted to the DOA for review.
9. The lightning protection system shall be connected to the building counterpoise system.
10. The DSP shall develop a performance specification for a certified Lightning Protection system which complements the submitted lightning protection drawings.

C. Building Grounding System Designs

1. The Grounding system shall conform to IEEE 142-2007 "Grounding of Industrial and Commercial Power Systems", National Fire Protection Association (NFPA) and NEC Article 250 for all grounding requirements. IEEE 142, section 4.1.3 states "Resistances in the 1 ohm to 5-ohm range are required". DOA requires that the resistance to ground for individual equipment and systems shall not exceed 5 ohms. See AIS Infrastructure Standards (latest edition) for specific and independent telecommunication grounding and bonding system requirements).
2. The Grounding system shall be designed and illustrated on a stand-alone grounding layout plan drawing.
3. Associated grounding details shall be placed on electrical drawings.
4. A grounding one-line or /riser diagram shall be developed for each project.
5. Grounding drawing shall show interconnection of the following:
 - a. All metal systems of the building such as:

Design Standards - Electrical

- i. Interior and exterior water system.
 - ii. Metal ductwork.
 - iii. Building steel and HVAC roof top units (if applicable).
 - iv. Lightning protection system.
 - v. Made electrodes, etc.
 - vi. Building foundation rebar.
 - vii. Metal roof drains.
 - viii. Antennas and Apron light poles.
 - b. All busways shall be grounded in accordance with the NEC. See section titled "Busway Systems" for additional details.
 - c. Drawings shall indicate where bonding is required in the electrical system (that is, neutral or ground bushing on transformers).
 - d. Drawings shall indicate where any new electrode system (s) connects into the rest of the grounding system when applicable.
 - e. Drawings shall identify any special requirements for the building grounding system specifically for static or signal grounds.
 - f. The size of all required grounding conductors (grounding electrode conductor, equipment grounding conductors, main bounding jumpers, etc.).
6. The design shall consider the NEC as a minimum requirement and other factors need to be considered when designing the system, signal grounds, and lengths of grounding conductors to ground.
 7. All ground connections to ground rods, buses, panels, etc., shall be made with pressure type solderless lugs and ground clamps.
 8. Soldered or bolt and washer type connections are not acceptable, exothermic welds are the DOA's preferred method of connection to a ground rod.
 9. The grounding design must also be based on a soil's resistivity test and ground resistivity calculations. Below grade connections should be exothermically welded.
 10. A wall mounted copper ground bar shall be provided in each electrical room housing medium voltage switchgear or substations. It should be interconnected with the ground electrode and ground bus in the switchgear or switchboard
 11. Tests: After installing grounding system but before permanent electrical circuits have

been energized, test for compliance with requirements. Measure ground resistance no fewer than two full days after the last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by fall-of-potential method according to IEEE 81.

12. If resistance to ground exceeds acceptance criteria of IEEE, the Grounding system will be considered defective and corrective actions shall be performed to reduce the ground resistance and bringing into compliance. The electrical DOA Assistant Director (or designee) shall be notified of any deficiencies; however, the grounding system will not be accepted until the 5 ohms acceptance criteria is met.

8.0 Design Calculations

A. Calculation requirements

1. All electrical calculations to include any recommendations shall be sealed and signed by a P.E. (Electrical) registered in Georgia. The original stamped signed copy of the calculations shall be provided to DOA as part of the design submittal.
2. Present all electrical calculations using the guidelines provided in this section. Provide two 8-1/2- by 11-inch, 3-hole-bound reports that contain all electrical calculations, time coordination curves, and protective device settings.
3. Provide one-line diagrams (hard copy) and electronic files with all calculations. At the end of the project, update both reports and electronic files in the same manner as other As-Built drawings.
4. The DSP shall submit calculations to DOA using PMWeb which is a web-based Project Management software tool IAW, P&D Policies and Procedure 02-001 "Document Control".
5. The SKM System Analysis software tool (latest version) identified in this section, shall be used for all mid-to-large CPTC projects. For smaller non-CPTC projects, the DSP shall notify the DOA Assistant Director (or designee) of the analysis software tool being used and obtain approval.

B. Short Circuit, Circuit Breaker Coordination Study

1. The DSP shall prepare a complete set of short-circuit, circuit breaker coordination study calculations. The DSP may elect to sub-contract this work but must inform DOA in writing. The DSP shall submit the sub-consultant's experience and

Design Standards - Electrical

- qualifications to the DOA electrical Assistant Director (or designee) for approval and shall be responsible for any sub-contracted work to include technical and quality assurance reviews.
2. When both normal and standby primary feeders serve a facility, provide calculations for both. The calculation shall be performed utilizing the latest SKM System Analysis software tool.
 3. Calculations shall consider both three-phase and single-phase to ground fault current on secondary systems. State the base MVA/kVA on the calculations.
 4. Prepare protective device coordination graphs which demonstrate coordination of devices for interrupting faults. Prepare these graphs for all new or modified primary and secondary systems. Coordination curves shall be prepared along with the single line diagram indicating which devices are under review.
 5. Provide a flag on all coordination curves indicating the available short circuit current at each device. Curve plots from the software shall be used.
 6. The Electrical System shall be fully coordinated unless directed otherwise by the DOA Engineering Director. Coordination study shall be from the utility transformer to the main circuit breaker in the smallest panel.
 7. Indicate in the coordination sheet, short circuits (with flags), breaker type, settings and scales.
 8. Calculations shall include ATS in closed-transition mode unless directed otherwise by DOA Engineering. See Engine Generator/Transfer Switch Sizing Calculations for additional guidance.
 9. Present the manufacturer's catalog data for each protective device to show they have adequate fault current interrupting capacity for the available short circuit current
 10. The Short Circuit, Circuit Breaker Coordination calculation report shall include the following:
 - a. Summary
 - b. Assumptions (verified or unverified),
 - c. Available short-circuit current letter from utility company,
 - d. Tabulation of results of all scenarios,
 - e. Print out of all inputs from SKM System Analysis software,
 - f. Print out of all results from SKM System Analysis software,

Design Standards - Electrical

- g. Single Line Diagram from SKM System Analysis software, and
 - h. Single Line Diagram with available short-circuit current value on each bus.
11. One final hardcopy report shall be provided to the DOA in a 3" binder(s) and in an electronic SKM System Analysis file format. The DSP shall submit files to DOA using PMWeb IAW, P&D Policies and Procedure 02-001 "Document Control".
 12. See AC 150/5340-30J, section 13. "Short Circuit Analysis for airport airside projects."

C. Load Calculations

1. The DSP shall prepare and submit electrical normal load calculations early in the engineering process (schematic - design phases) to provide reasonable assurance that existing electrical equipment such as switchgear, switchboards (including main-tie-main configurations), panelboards and other equipment are adequately sized (with margin) to accommodate new load additions or if equipment concerns are preventing a code compliant design. The DSP shall analyze the Emergency Generator loads in parallel with the normal power loads.
2. The DSP shall follow steps outlined in section titled "Circuit Load calculation or Metering" for obtaining output load data used as input in the design basis load calculation(s).
3. The load calculation(s) shall provide an estimation of all newly added electrical loads along with existing for the system under review.
4. The units of electrical loads shall be kilovolt-amperes (kVA). The units of kilowatts (kW) shall be converted to kVA using a power factor (PF).
5. If an existing Panelboard illustrated on a contract drawing is used as the design basis for a load calculation the following is required:
 - a. The load calculation shall indicate load classifications (type such as lighting, heating, motor, HVAC, receptacles, miscellaneous equip, etc..), connected loads, demand factors and estimated demands.
 - b. The Panelboard "Totals" shall be identified for connected loads, estimated demands, existing connected current loads (A), estimated demand loads (A).

Design Standards - Electrical

- c. All verified or unverified assumptions shall be identified.
 6. The electrical load calculation results shall demonstrate that the existing equipment is sufficient to meet new added load demands (Pass) or is inadequate (Fail) with recommended corrective actions. A discussion with the DOA Assistant director (or designee) is required if code compliant issues are identified and resolutions are necessary to continue.
- D. Emergency Generator/Transfer Switch Sizing Calculations
1. For HJAIA CPTC: The HJAIA Resiliency Emergency Power program provided and installed emergency power generators for each individual concourse and main terminal at the CPTC which were sized to accommodate their individual concourse loads upon loss of normal power (resilient 100% back-up emergency power). When loads are added to the normal power source, the DSP shall analyze the associated generator load block (emergency generators) capacity and determine if the existing emergency generators are adequately sized to provide a resilient emergency power source. Load shedding to remain resilient is prohibited. Coordination with the DOA electrical Design Manager may be required to obtain the latest Peak demand load data from the utility.
 2. When loads are added/removed the emergency generator's capacity/margin shall be revised and documented in the analysis.
 3. For all HJAIA CPTC and DOA facilities, the emergency generator sizing calculations shall show the "sequence of operation" for the various loads that are served from the generator. Consideration that the voltage dip shall not exceed 35% for general loads and motors and 20% for critical and electronic loads.
 4. For HJAIA DOA facilities with generators, as new loads are added to an existing generator the analysis shall illustrate the generator's ability to handle new and existing loads along with identifying the reserve capacity remaining for the generator size.
 5. All loads used for this analysis shall be from a verifiable source with all verified or unverified assumptions identified and documented.
 6. Automatic Transfer Switch (ATS) sizes fed from the generator shall match the generator size.

Design Standards - Electrical

7. ATS's shall be closed transition as required by Georgia Power or unless otherwise directed by the DOA electrical engineering department. Noted exceptions: ATS's shall be open - transition for parking decks, parking lots, guard booths and escalator designs if required.

E. Arc Flash Calculations

1. Arc Flash calculations shall be in accordance with NFPA 70E and IEEE STD-1584. Provide complete electronic calculation in its original format (i.e. SKM System Analysis files).
2. For arc flash, provide calculations for each piece of electrical equipment and provide 3 samples of the arc flash warning signs to DOA for approval.
3. Based on the calculation output, Arc-flash warning signs shall be placed on electrical equipment in locations where arc-flash hazards exist IAW requirements of OSHA and NFPA 70E.
4. One final Arc Flash hardcopy report shall be provided to the DOA in a 3" binder(s) and in an electronic SKM System Analysis file format via. the PMWeb system, IAW P&D Policies and Procedure 02-001 "Document Control" (latest revision). For smaller non-CPTC projects, the DSP shall notify the DOA Assistant Director (or designee) of the software being used.
5. See AC 150-5370-10H for airport airside project arc flash requirements.

F. Harmonic Calculations

1. Electronic loads are generally nonlinear, and results in the generation of harmonic currents. These currents circulate within the AC distribution system, which supplies power to electronic loads. For each HJAIA - DOA facility, prepare a harmonic study calculations when significant harmonic (nonlinear) load is added to the distribution or building power system.
2. A harmonic study will also be required when the new load exceeds the recommended voltage or current distortion levels as allowed per by IEEE 519-2022, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems."
3. The results of the harmonic study will dictate when additional harmonic correction measures are required. Provide base line harmonic measures prior to adding new equipment that may introduce harmonics. Ensure that harmonics introduced due to the new equipment will not exceed the base line values.
4. One final Harmonic Analysis Calculation hardcopy report shall be provided to the

Design Standards - Electrical

DOA in a 3" binder(s) and in an electronic SKM System Analysis file format via. the PMWeb web-based Project Management software system, IAW P&D Policies and Procedure 02-001 "Document Control" (latest revision).

G. Voltage Drop Calculations

1. To mitigate voltage drop concerns during design, the electrical DSP shall take into account factors like cable length, gauge (size) of the conductors and the current load.
2. A maximum combined voltage drop of 5 % with feeders at 2% and branch circuits at 3% shall not be exceeded.
3. Sensitive circuits: Branch circuits supplying sensitive circuits shall be limited to a voltage drop, not exceeding **1.5 %** and the combined voltage drop of feeder and branch-circuit conductors shall not exceed **2.5 %** per NEC 647-4(D). For Cord-Connected equipment the voltage drop on branch circuits supplying receptacles shall not exceed 1% per NEC 647-4(D)(2).
4. Prepare voltage drop calculations IAW the National Electrical Code (when required) and place details on drawing(s) or in a stand-alone document and submit as a deliverable via. the PMWeb web-based Project Management software system, IAW P&D Policies and Procedure 02-001 "Document Control" (latest revision).
5. See AC 150-5340-30J, section 13.2.6.1.1 for airport airside control voltage drop requirements.

H. Lighting Calculations

1. Photometric calculations shall be in the point-to-point format. A Photometric calculation summary shall also be provided to describe the output details such as light loss factor used (LLF), the Average fc, Maximum (Max.) fc, Minimum (Min.) fc, Average/Min. fc, Max./Min. fc (maintain ratio between maxima and minimum).
2. Photometric calculation drawings shall be provided for building (interiors and exterior), parking lots, parking decks and other locations where applicable to illustrate the designed fc levels.
3. Provide individual photometric calculations for normal and emergency lighting.
4. Provide final As Built lighting calculations and photometrics drawings at the completion of each project via. the PMWeb web-based Project Management software system, IAW P&D Policies and Procedure 02-001 "Document Control" (latest revision).

9.0 Equipment Identification

A. Branch Circuit Panelboard Directories

1. Computer generated panelboard directories shall be created under the As-Built phase and placed under plastic jacket or protective cover for protection from damage or dirt. Handwritten directories are not allowed.
 - a. As a minimum provide the following details on directories:
 - i. Number each single pole space.
 - ii. Odd-numbered circuits on the left side starting at the top, even on right side starting from the top.
 - iii. Securely mount directories on inside face of panelboard door.
 - iv. Define briefly, but accurately, nature of connected load (i.e. lighting office number, receptacles, electrical room, etc..).
 - v. Provide CPTC official GIS room number locations for all loads and indicate panel name on schedule.
 - vi. Multi-pole circuits shall utilize all pole space numbers as its circuit identifier, i.e., a three-pole circuit will have three space numbers.

B. Identification Nameplate Labels

1. Equipment identification nameplate labels which are different from electrical manufacturers nameplates shall be provided for all electrical equipment located at HJAIA. For CPTC and DOA ancillary facilities, the unique electrical equipment nameplates shall be created using the methodology outlined in this standard and applied to all electrical equipment with the noted exception: Concession spaces shall have unique identification nameplates for all electrical equipment designed by the DSP using a systematic approach. The following is a minimum equipment list:
 - i. Normal and Emergency (Life Safety, Critical, Legally Required Standby, Optional Standby, and Uninterruptible Power Supply)
 - ii. Power electrical equipment including but not limited to, substations, switchgear, switchboards,
 - iii. Panel boards (power, lighting, receptacle),
 - iv. Motor control centers,
 - v. Non-fusible disconnect switches (including individually mounted circuit breakers),

Design Standards - Electrical

- vi. Fusible disconnect switches,
 - vii. Wire ways,
 - viii. Bus ducts and associate components when required,
 - ix. Cable trays,
 - x. Automatic transfer switches,
 - xi. Transformers,
 - xii. Uninterruptible power supplies,
 - xiii. Generators,
 - xiv. Miscellaneous electrical components, etc.
2. For new installations label cubicle/compartments/spaces for all Switchgear, Switchboards and MCCs. Label each disconnecting and overcurrent protective device, meter and control device mounted in compartment doors with a nameplate.
 3. Identify fuse type and size on the cover of fusible equipment
 4. Time Delay: Provide 1/8-inch lettering at the control location to identify a motor having a time delay relay – “Time Delay Start to limit System Inrush”.
 5. Identify soft start on motor starter.
 6. All nameplates shall be engraved.
 7. Securely attach engraved nameplates using epoxy adhesive.
 8. No temporary markings are permitted to remain on equipment.
 9. Coordination with the DOA “Assess Management” department is required to determine if specific asset tagging requirements are applicable to the scope of work.

C. Color Scheme for Engraved Electrical Nameplate Labels**Table 2 – Nameplate Voltage Color Identifier**

System	Label Background Color	Lettering Color
120/240 Volts, Single Phase – Normal	Black	White
208/120 Volts, Three Phase – Normal	Black	White
480/277 Volts, Three Phase – Normal	Black	White
120/240 Volts, Single*	Red	White
208/120 Volts, Three Phase*	Red	White
480/277 Volts, Three*	Red	White

* Connected to generator power source (Emergency, Legally Required Standby and Optional Standby).

D. Nameplates: Electrical Equipment Identification Methodology

1. All new electrical equipment shall have a unique identification number.
2. The identification number shall be annotated on three lines, centered within a nameplate with a minimum 1/2 inch margin maintained around the outer edges.
3. The methodology used to create an electrical equipment nameplate identification number is outlined in Table 3:

Table 3 – Nameplate Label Description

<p>Line One</p>	<p>Line one shall list the official H-JAIA GIS room number where equipment is located. Room numbers for existing spaces are located near each electrical room at the CPTC.</p> <p>For existing CPTC electrical rooms without GIS room number identification nameplates or for new proposed electrical rooms, the DSP shall contact the HJAIA DOA planning department to obtain the official GIS room number identification which is required to build unique identification labels.</p> <p>For CPTC electrical designs, which utilize existing open spaces, where electrical equipment will be or is located and a CPTC space number has not been assigned for this area, an identifier shall be developed by using the following method:</p> <ul style="list-style-type: none"> • step one) obtain the CPTC zone number for this area by contacting the H-JAIA DOA planning department. This designator will become the first identifier for line one, • step two) add the CPTC level. This designator will become the second identifier for line one, • step three) locate the closest vertical and horizontal column identifier which is typically a letter and number and add to line separated by a back slash. This designator will become the third identifier for line one. These key designators together and separated by a hyphen will become the new electrical equipment location name. <p><u>Example:</u> CPTC zone designator is AS17, CPTC level number designator is 1, and horizontal/vertical column number designators are A/16. Line one will now become AS17-1-A/16</p>
<p>Line Two</p>	<p>Line two shall include the Power Type - Voltage Type - Equipment type (plus sequential number) - Source identifier and CPTC concourse identifier. A hyphen shall be used to separate the categories identified. See Table 4, 5, 6, 7 and section 1.14 for type descriptions which shall be used when creating the identification number for line 2.</p>
<p>*Line Three</p>	<p>Line three shall include the word Concession in parentheses.</p>

*Applicable to concession distribution equipment only.

Design Standards - Electrical

Table 4 - POWER TYPE IDENTIFIER

N	Normal Power
E	Standby Power
R	Legally Required
S	Life Safety
U	Uninterruptible Power Supply (UPS) Power

Table 5 - VOLTAGE TYPE IDENTIFIER

M	Medium (above 480VAC)
H	277/480 VAC, 3 phase
L	120/208 VAC, 3 phase
B	120/240 VAC, 1 phase
O	Other (24VDC and below 120VAC)

Table 6 - EQUIPMENT TYPE IDENTIFIERS:

The below listed identifier abbreviations approved by the DOA Electrical Department shall be used. To use abbreviations not listed, submit a descriptive written request to the DOA Electrical Department for approval.

Identifier	Equipment Type
AT	Automatic Transfer Switch
BD	Bus Duct
BP	Bus Plug
BTB	Bus Tap Box
CB	Cable Bus
CT	Cable Tray
DF	Fusible disconnect Switch
DP	Distribution Panelboard
DS	Non-Fusible disconnect Switch
EG	Emergency Generator
FA	Fire Alarm Control Panel
IB	Individually mounted circuit breaker
LC	Lighting Control Panel
MC	Motor Control Center
M1	Meter (number denotes the meter type)
PP	Panel board (Power, Lighting, Receptacle)
SB	Switchboard
SG	Switchgear
TR	Transformer
TV	Transient Voltage Surge Suppressor
UP	Uninterruptible Power Supply (UPS)
UT	Utility Transformer or Bus
WW	Wire way

Table 7 – CPTC CONCOURSE IDENTIFIERS

A	Concourse A	E	Concourse E
B	Concourse B	F	Concourse F
C	Concourse C	M	Main Terminal including Atrium
D	Concourse D	T	Concourse T

E. Source Identifier Methodology

1. Any electrical distribution equipment connected directly to a utility bus (or utility transformer) will be considered a SOURCE.
2. The equipment type identifier shown in table 4 shall be used to identify the source.
3. Once the source equipment type identifier has been defined, a proxy shall be assigned using letter **S** (for source) followed by a numeric number and location. Locations are as follows:
 - a. Example: three Switchgear and two Switchboard's fed directly from the utility bus and all equipment located in the same CPTC electrical room with the official GIS room number **AS17-1- F1**: the identifications
 - i. Line One Line one shall list the official HJAIA GIS room number where equipment is physically located. **AS17-1-F1**
 - ii. Line Two Line two shall list the **Power** Type - **Voltage** Type - **Equipment** type (plus sequential number) - **Source** and Concourse Designator. A hyphen shall be used to separate the categories identified from Tables 4, 5, 6 and 7: **N – H – SG1 – UT – S1A**.
4. The designation **UT** will only be used in the equipment identification name at the Main SWGR or SWBD level. This **UT** identifier shall not appear in any downstream equipment identification numbers.
5. If any downstream equipment is fed from two upstream sources, then list both sources separated by a back slash, example **S1A/S2A**. See Figures 1, 2, 3 and 4 for examples.

10.0 Quality Assurance

A. Requirements

The DSP shall submit project deliverables reviewed under their approved Quality Assurance (QA) program.

B. Redi-Check Interdisciplinary Coordination Review

The DSP shall develop and implement a “Redi-Check Interdisciplinary Coordination” review methodology to document review results.

C. Quality Assurance (QA) Checklists

The DSP shall submit a draft QA checklist to the DOA Assistant Director Electrical (or designee) prior to all initial schematic 30% deliverable for “Capital Projects”. Once approved by DOA a completed QA checklist shall be submitted with each contract submittal to demonstrate compliance. The DSP will be notified by the DOA if the QA expectations are not met. An in-person meeting may be required to discuss the corrective actions.

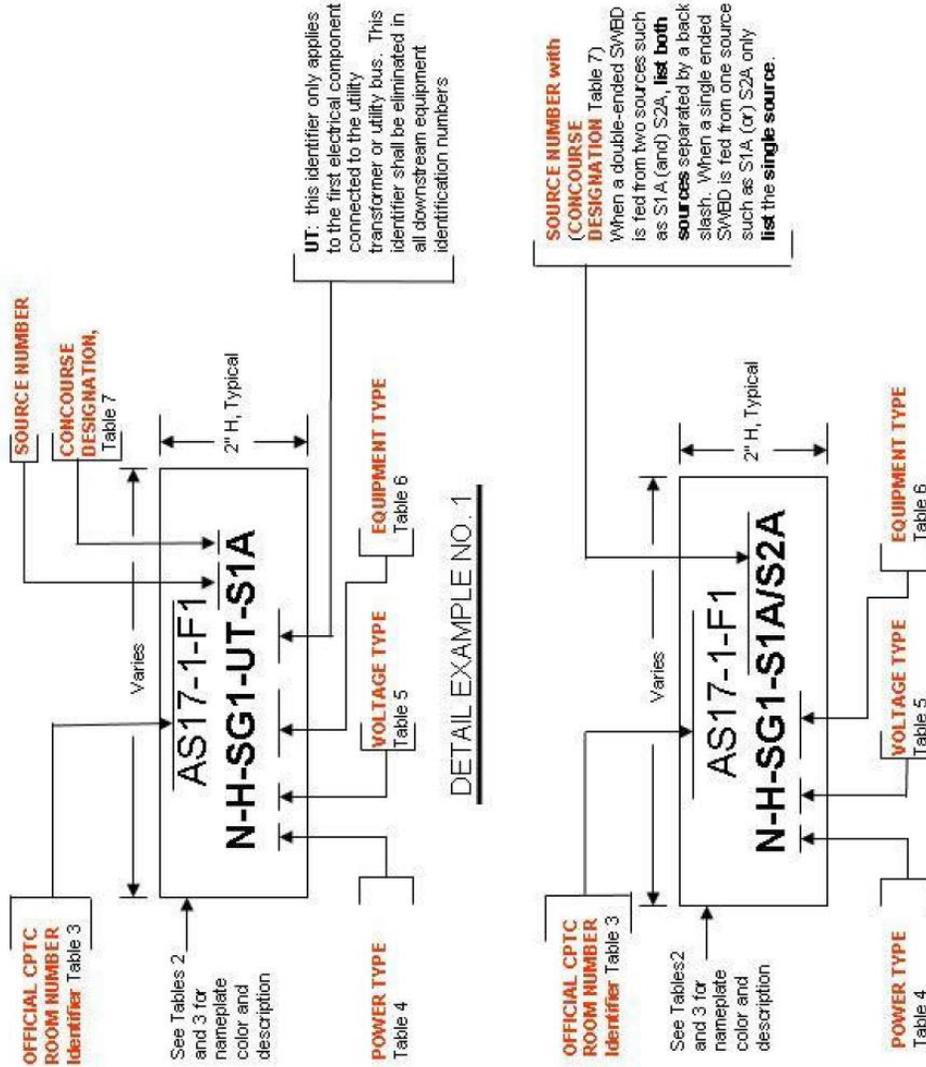
Figure Index:

Figure 1 - Equipment Nameplate Detail Examples

Figure 2 - Equipment Nameplate Detail Examples

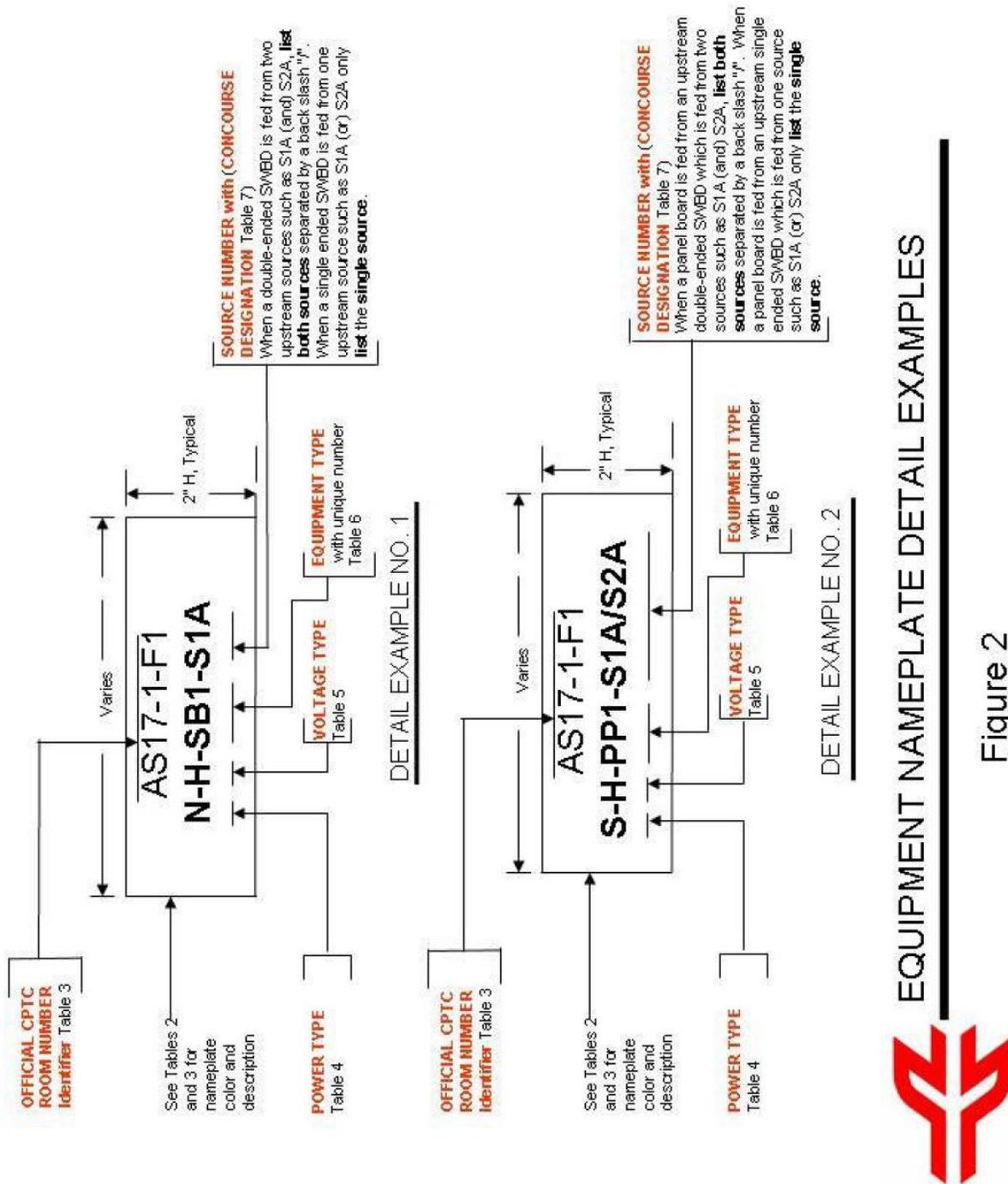
Figure 3 - Equipment Identification Riser Diagram

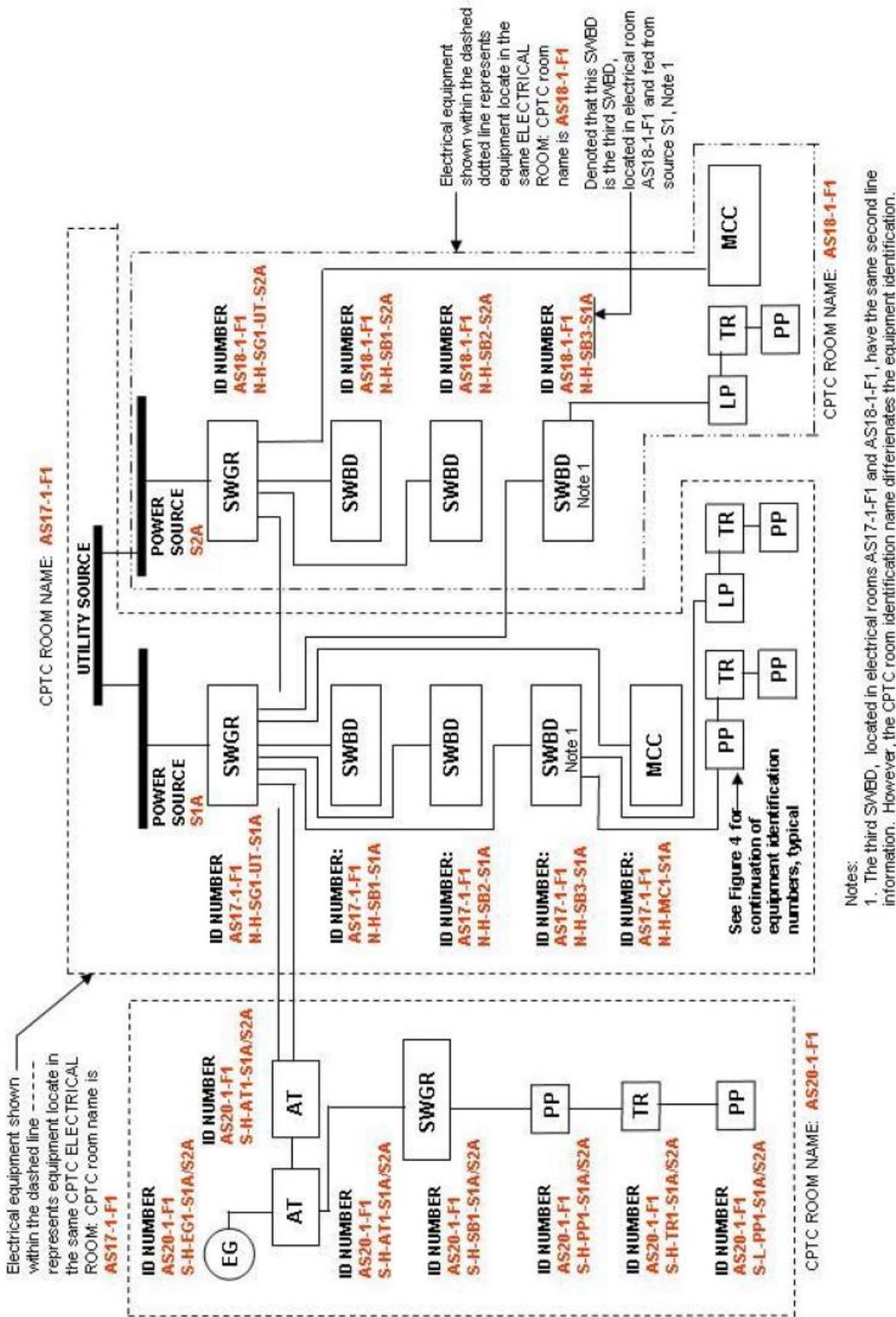
Figure 4 - Electrical Equipment Room Layout Riser Diagram



EQUIPMENT NAMEPLATE DETAIL EXAMPLES

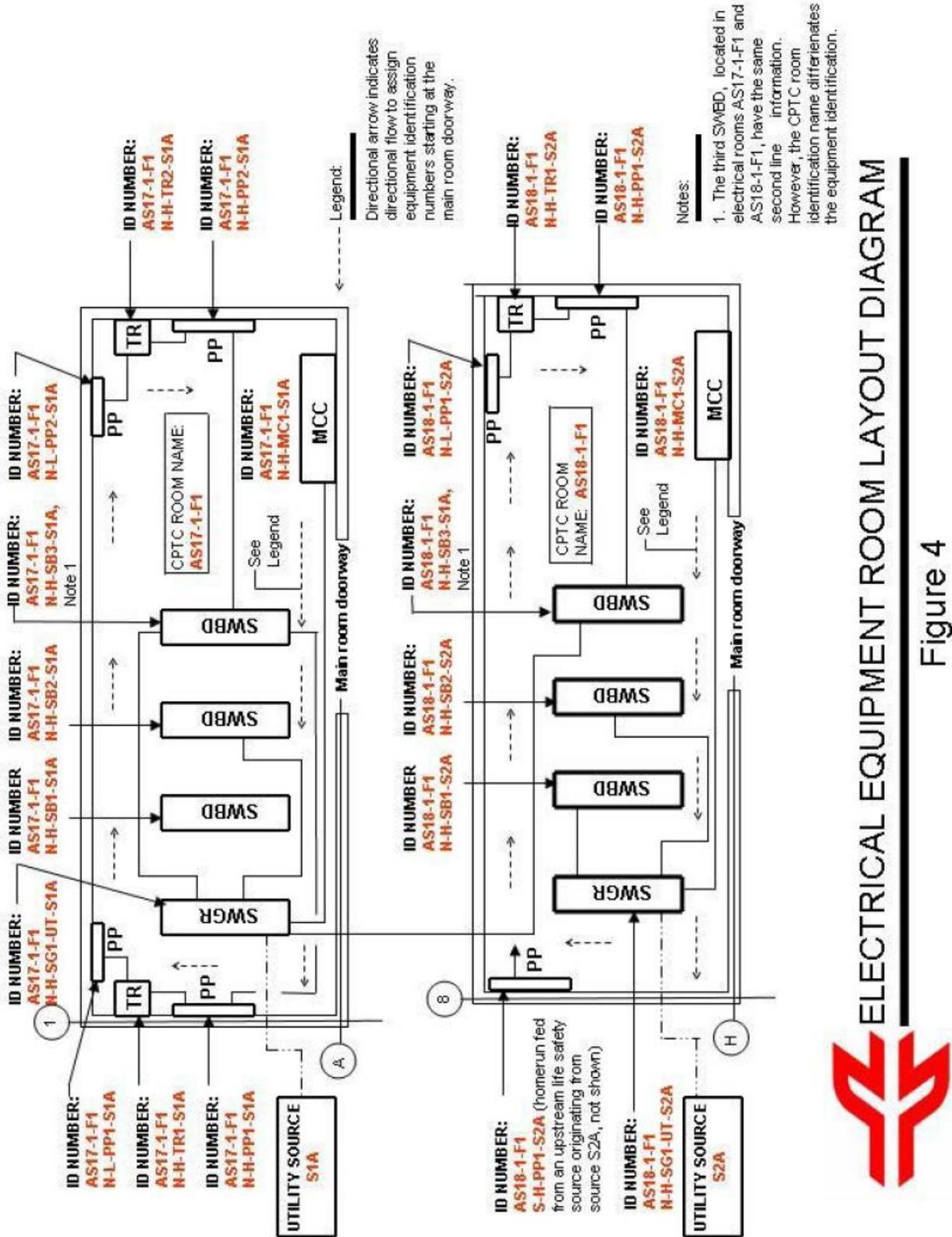
Figure 1





EQUIPMENT IDENTIFICATION RISER DIAGRAM

Figure 3



ELECTRICAL EQUIPMENT ROOM LAYOUT DIAGRAM

Figure 4

Revision Log

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

Concessions

**New Construction and
Modifications**

Design Standards

Temporary Kiosks

Table of Contents

Section	Page
1.0 Purpose	3
2.0 Scope	3
3.0 Responsibilities	3
4.0 Technical Requirements	3
A. Architectural	3
B. Signage	4
C. Electrical.....	4
D. Plumbing and Fire Protection.....	4
5.0 Building Permit	5
6.0 Construction	5

1.0 Purpose

- A. The purpose of these design standards is to provide Concessionaires/Designers of Record with the Department of Aviation (DOA), Planning & Development Bureau (P&D) minimum technical requirements for submitting a Temporary Kiosk project for review and approval.

2.0 Scope

- A. These design guidelines apply to all Concessionaires and their Designers of Record including Vendors, Contractors and Sub-Contractors.

3.0 General Requirements

- A. Temporary Kiosks are permitted for a period of Six (6) months maximum. Requests for extensions shall be submitted for review and approval.
- B. Temporary Kiosks shall be in an area that can be recessed and shall not encroach into the public circulation corridors. Recess shall include a minimum of 3 ft. for queuing.
- C. Submit the required documentation for the proposed Kiosk per the P&D Project Submittal & Review Standards (Section 1 of this Manual)
- D. Comply with the technical requirements of these standards.
- E. Construct/install the project in accordance with the P&D stamped/accepted drawings.
- F. Submit all revisions or modifications to the P&D stamped/accepted drawings for P&D review and approval.
- G. Obtain required building permits before start of any construction/installation work.

4.0 Technical Requirements

A. Architectural

The kiosk design, even though is temporary, should provide a sense of belonging within its surrounding environment.

1. Overall kiosk measurements shall not exceed 9'-0" in height by 3'-6" wide.
2. Materials for construction and finishes shall be selected based on their durability, low maintenance requirements, hazard free, and energy efficient.
3. Hinges are to be fully concealed from view when door is closed and shall permit 120- or 170-degree door swing. Hinge crank shall be heavy steel with a concealed, integral self-closing spring mechanism.
4. Concealed storage for personal items shall be provided.
5. DOA Concessions and P&D shall review and approve the kiosk concept design
6. Kiosk design shall comply with all ADA and Building Code Requirements.

B. Signage

1. Kiosk signage shall be integral to the unit.
2. Kiosks shall not have blade type signage.

3. Surface mounted box or cabinet type signs are permitted as part of the kiosk design.
 4. Signs shall be limited to trade name and logo/symbol only.
 5. Size of letters, logos and graphics shall be proportionate to the Kiosk design.
 6. Materials
 - a. Signs engraved or sandblasted in granite, marble or other stone are acceptable.
 - b. Sandblasted or etched signs on glass are acceptable.
 - c. Pin mounted letters shall not stand away from the background plane of the signage band more than two inches (2").
 - d. Formed plastic or injection molded signs, or vacuum formed letter signs are not permitted.
 - e. Signs fabricated from simulated materials such as plastic laminates are not permitted.
 - f. Hand lettered signs of any type are expressly prohibited.
 7. Lighting
 - a. No exposed raceways, ballast, transformers, or readily visible sign company names or labels are permitted.
 - b. Neon-formed letter tubing and/or neon tenant logos shall not be used.
 - c. Back lit, halo lit, front lit, rear-lit channel or halo-reverse-lit channel letters illuminated with neon with the rear face of each letter shall be no more than two inches (2") away from the background plane of the signage band.
 - d. Light sources shall be recessed or concealed.
 - e. All signs must be Underwriter Laboratory approved.
- C. Electrical
1. Provide One Line Diagram containing all electrical distribution equipment starting from the 480V Concessions Switchboard down to the 208/120V distribution panel powering the kiosk.
 2. Provide 208/120V panel schedule with load tabulation.
 3. Wiring
 - a. All wiring shall be in electrical metallic tubing, wire ways, approved raceways or cable trays. EMT may be used for concealed installations, but GRS should be used for exposed conduit. Only cast metal boxes should be used for exposed installation. EMT with compression fittings can be used in lieu of GRS with prior DOA approval and where the circuit is not subject to any mechanical damage. EMT with set screws is not allowed.

- b. Branch circuit conductors shall be minimum 12 AWG and shall be copper, type THHN/THWN unless otherwise noted. Minimum conduit size shall be $\frac{3}{4}$ ".
- c. No reduced sized neutrals will be allowed. Each single pole over current device shall have its own separate neutral conductor.
- d. Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.
- e. Power conductors shall be routed separately from all other conductor types.
- f. Include equipment grounding conductors sized per NEC with all power circuits
- g. Ensure feeders have amperage adequate for the loads to be served. Demand Factors are allowed in accordance with NEC

4. Circuiting

- a. Home runs for receptacle, power, and lighting shall be indicated with an arrowhead, panel/terminal cabinet number, and circuit/terminal block number
- b. Identify the conduit size and then number and type of conductors it contains.
- c. For typical circuits, this information may be listed by general note. For example, "All conductors are 12 AWG THHN/THWN in $\frac{3}{4}$ -inch conduit unless otherwise noted"
- d. Avoid shared neutral circuiting
- e. Group circuit homeruns where feasible and derate as required per NEC Table 310.15(B)(2)(a)
- f. Branch circuit design for general use power outlets shall be limited to no more than six receptacles per circuit. General use power outlets shall be NEMA 5-20R
- g. Except for life safety requirements, circuits shall not be connected to the emergency power
- h. Dedicated circuits shall be marked accordingly in the panel directory distinguishing them from the other circuits
- i. If any circuits from an existing panel are demolished first use these spare circuits for any new work before using existing spaces or spare circuit breakers.
- j. Include notes on the drawings to instruct the contractor to efficiently use wall space or electrical room space when installing new electrical equipment in order to maintain space for future work
- k. Provide list of demolished circuits and update circuit directories

A. Plumbing & Fire Protection

- 1. Concession/Designer/Contractor shall review existing sprinklers for clearance. If sprinkler heads are blocked, Concessionaire/Designer shall be responsible for relocating or adding new sprinkler heads per fire marshal standards. Drawings showing design intent shall be required.

2. If drainage is required, Concession/Designer/Contractor shall be responsible for routing waste to a DOA approved location. City of Atlanta Department of Watershed Management shall review and approve Grease Trap requirements. Any preparation or production sink shall require point of use Grease Trap with calculations.
3. If water is required for fire protection or domestic, Concession/Designer/Contractor shall be responsible for connecting to a DOA approved water line. An isolation valve for the concession that is accessible from the finish floor shall be required.
4. Concession/Designer/Contractor shall be responsible for replacing and/or repairing any surface/material that is affected/damaged by the Concession/Designer/Contractor's work.

5.0 Building Permit

- A. Concessionaire/Designer of Record shall submit the P&D/Atlanta Fire Department (AFD) stamped/accepted construction set of documents to the City of Atlanta, Office of Buildings (OOB) for review and issuance of a construction building permit.

OOB shall not review any submittal without the P&D/AFD seal of acceptance.

6.0 Construction

- A. All Concession projects shall be constructed in accordance with the P&D stamped/accepted documents.
- B. Any revisions or modifications to the Concessions P&D stamped/accepted documents shall be submitted to P&D for review and approval.
- C. Concessionaire/Designer/contractor shall be responsible for addressing/completing all "Conditionally Closed" comments as part of the construction work.

Hartsfield-Jackson Atlanta International Airport

City of Atlanta

Department of Aviation

Office of Infrastructure Planning & Development

Concessions

New Construction and Modifications

Design Standards

Construction

Construction Standards

Table of Contents

Section	Page
1.0 Purpose	3
2.0 Scope	3
3.0 General Conditions	4
A. Concessions Projects	4
B. Construction Oversight	4
C. Construction Coordination	4
D. Construction Standards	4
E. Security Requirements	4
F. Logistic Plan.....	4
G. Safety Plan.....	4
H. Pre-construction Conference	4
I. Notifications.....	5
J. Work Hours	5
K. Permits and Code Compliance	5
L. Insurance	5
M. Existing Conditions	5
N. Digging.....	5
O. Deliveries	5
4.0 Special Conditions	5
A. Construction Notice	5
B. Support Equipment.....	6
C. Height Restrictions.	6
D. Temporary Barriers	6
E. Construction Area Access	6
F. Tools	6
G. Debris	7
H. Waste Collection and Removal.....	7
I. Clean Site.....	7
J. Restoration	7
K. Temporary Construction Facility Privileges	7
L. Protection of Airport Operation Systems.....	7
M. Aircraft Ramp Work	7
N. Operating within Critical Areas.....	7

O. Technical Requirements 7

P. Abandoned Penetrations 7

Q. Access Control and Alarm Monitoring System (SACS/ACAMS) 8

R. Building Management System (BMS/Fire Suppression & Life Safety Systems) 8

S. Environmental Requirements 8

T. Sustainability Standards 8

Construction Standards

1.0 PURPOSE

The purpose of these Standards is to provide airport Concessionaires with specific Department of Aviation (DOA) requirements for performing any construction work at Hartsfield-Jackson Atlanta International Airport (ATL). Concessionaires shall furnish their contractors with these Standards during their pricing phase. It is the responsibility of the Concessionaire to ensure that their contractor and sub- contractors comply with these standards.

2.0 SCOPE

These Standards apply to all Airport Concessionaires (Leaseholders, Vendors, Contractors, and Sub- Contractors).

3.0 GENERAL CONDITIONS

- A. Concessions Projects: All Concessions projects shall be constructed in accordance with the DOA/P&D stamped accepted documents.
- B. Construction Oversight: DOA Concessions shall be responsible for construction oversight of all Concessions work. P&D's Facilities Construction Team ("FCT") may also conduct construction oversight in coordination with DOA Concessions.
- C. Construction Coordination: All planned and active construction activities shall be reported by the Concessionaire's Contractor on a weekly, bi-weekly or monthly basis coordination meeting to be established by DOA Concessions.
- D. Concessions Construction Standards: All Concessions construction projects shall comply with all the requirements of these Standards. Failure to comply may result in suspension of work by DOA Concessions, FCT, Office of Buildings, Atlanta Fire Department, Airport Security or Airport Police.
- E. Security Requirements: Concessionaire's contractors and sub-contractors shall conform to all DOA Airport Operation Requirements, including Security, Badging, OCIP Badge and Custom Seals (If required). Contact DOA Security Office at (404) 530-6667 for all Security information and requirements.
- F. Logistics Plan: Concessionaire's contractor shall develop and submit to DOA Concessions a Logistics Plan (as required) to include dumpster locations (dumpster cover required), staging area, ramp vehicle and equipment parking locations, limits of construction, location of temporary barriers and delivery access routes prior to commencement of any construction work.
- G. Safety Plan: Concessionaire's contractor shall submit a project specific Safety Plan to DOA Concessions. The plan shall be approved before any demolition/construction work begins. As part of the Safety Plan, the contractor shall include an emergency Contact List. The Emergency Contact List shall be updated with current information throughout the duration of the project.

- H. Pre-Construction Conference: A Pre-Construction conference scheduled by DOA Concessions shall be held at least seven (7) days prior to commencement of any construction work. No construction work shall commence without a Pre-Construction conference.

- I. Notifications: Concessionaire's contractors shall notify DOA Concessions and AATC at least seventy-two (72) hours prior to the start of any construction work and moving of personnel or material onto ATL property. DOA Concessions shall also notify the following entities:
 - 1. FCT@ (404)-382-5500 and Via Email: DOA.facilities@atl.com for all concessions projects.
 - 2. TBI @ (404) 530-2021 for projects in Concourses D South, E and F.
 - 3. DOA Landside Operations @ (404) 530- 2021 for projects in the Domestic Terminal and Concourses T, A, B, C, and D North.
 - 4. Airside Operations @ (404) 530-6620 for all airside ramp projects.
 - 5. AATC @ 404-530-2112 or www.aatc.org

- J. Work Hours: Standard DOA approved hours for all Concessions construction work shall be performed between 11:00 PM and 5:00 AM Sunday thru Thursday. Ramp construction work shall be performed between 11:00 PM and 5:00 AM daily. In case(s) of Irregular Operations (IROPS), the hours available to a contractor or sub-contractor shall be subject to change without prior notice. DOA Concessions in coordination with FCT can only authorize daytime work if work is contained inside the approved wall in the construction area/space and if it does not cause excessive noise, dust, use of volatile organic compounds or welding.

- K. Permits and Code Compliance: Concessionaire's contractor shall obtain all necessary federal, state, county and city permit and shall comply with all applicable laws, codes and regulations.

- L. Insurance: Concessionaire's contractor working on the Airport controlled facilities or property shall be duly licensed and shall provide proof of adequate insurances when requested.

- M. Existing Conditions: Concessionaire's contractor shall be responsible for site verification of all existing conditions and requesting as-built data from DOA Concessions. If any utility shall be disturbed or damaged during the construction work, the contractor shall notify DOA Concessions, Atlanta Airlines Terminal Corporation (AATC) and FCT immediately. Concessionaires shall be responsible for all costs associated with the repair or replacement of any damaged utility and affected property.

- N. Digging: Before any digging, cutting, drilling or coring is performed, the Concessionaire's contractor shall be responsible for the following:
 - 1. Contacting the Georgia Utilities Protection Center @ 1-800-282-7411 for notification to Owners of all buried utilities before digging.

2. Concessionaire's contractor and sub-contractors shall adhere to the rules, regulations and laws dictated by the Georgia Utilities Protection Center.
 3. Concessionaire's contractor and sub-contractors shall protect all utilities not designated for removal, relocation or replacement during the construction work.
 4. In case(s) of accidental disturbance of utilities, the Concessionaire's contractor/sub-contractor shall immediately notify the utility Owner and DOA Concessions, AATC and FTC.
 5. Responsible for coordinating the repair of the interrupted utility per the timeline and requirements indicated by DOA Concessions and any other matters where the proposed construction may present operational problems to ATL or its Tenants.
- O. Deliveries: Standard DOA approved delivery and debris removal shall only be between 11:30 PM and 5:00 AM

4.0 SPECIAL CONDITIONS

- A. Construction Notice: Concessionaire's contractor shall furnish and install a Document Display device outside the construction barrier wall or door providing the following information:
1. Concessionaire's Name & Contract Information
 2. Contractor's name & Contact Information
 3. DOA Approved Project Start Date
 4. DOA Approved Project Completion Date
 5. DOA Approved Hours of Operation
- B. Support Equipment: Concessionaire's contractor shall request permission and register all support vehicles (cars and trucks) and construction equipment (lifts, forklifts, work boxes, trash dumpsters, etc.) operating on the ATL premises during the construction of a project. The approved vehicles shall always display the operating certificates inside front window. Identification tags shall be always attached to the construction equipment. The operating certificates and identification tags shall be obtained from DOA Landside Operations at (404) 209-4142. Unapproved vehicles and equipment shall be subject to removal by the DOA at the expense of the Concessionaire/Contractor. Any vehicle or piece of equipment parked in a no parking zone, outside the limits of construction, outside previously approved parking locations, or considered a hazard shall be subject to removal by the DOA at the expense of the Concessionaire/Contractor and/or could result in the suspension of all construction work.
- C. Height Restrictions: FAA Regulations regarding the use of cranes and other equipment operating airside or extending above the roof of the building shall be strictly enforced. Concessionaire's contractor shall be responsible for submitting FAA Form 7460 to the DOA for review and approval (contact: hjaia.7460@atl.com).
- D. Temporary Barriers: Temporary interior and exterior construction wall and/or barrier shall be constructed per DOA/ATL requirements as follows:
1. No plastic "fillable" barriers shall be permitted on the Aircraft Operations Area (AOA).
 2. All interior construction requires a temporary barrier.

3. Temporary barriers shall create a dust barrier and meet one of three conditions: 1) Extend to ceiling/structure above, 2) Extend to a height that shall not allow visibility of work site, 3) Provide a top enclosure to isolate the work site.
 4. All barriers shall be constructed of a standard stud wall with finished drywall, painted, painted and/or graphics, cove base and trim.
 5. All barriers shall be maintained in good condition throughout the entire project.
 6. Barriers shall not expose non-construction personnel to pinch points, slips, trips, falls, or cut hazards.
 7. Barriers shall be installed on a plywood/hardboard base per DOA/ATL requirements to prevent floor damage.
 8. Access doors to the construction areas shall be self-closing, metal type and secured using a Best or equivalent seven-pin type cored locking device operator using green, orange, sand or other construction core as required by the DOA.
 9. Following the project completion, all finishes (project related or adjacent to the project) shall be restored to a DOA acceptable condition.
- E. Construction Area Access: Doors or openings through security barriers or partitions shall be maintain secured 24 hours a day. If the doors or openings are unlocked, properly badge or authorized contractor provided personnel shall maintain doors under continuous control observation.
- F. Tools: Concessionaire's contractor shall maintain a tool inventory list and be responsible for ensuring that all tools and construction materials are fully always secured to prevent passengers or unauthorized persons from gaining access to them beyond Security Check Points and Security Screening Areas or in the Terminal Buildings.
- G. Debris: All debris resulting from the construction work or incidental thereto shall be contained and promptly removed by the Concessionaire's contractor per ATL standards. Immediately upon completion of the construction work, Concessionaire's contractor shall dispose of all debris off ATL property.
- H. Waste Collection and Removal: Concessionaire's contractor and sub-contractors shall be responsible for the collection and removal of construction waste attributable to all Concessions construction projects per ATL Concessions Construction Waste Collection & Removal Standards. Dumpsters shall be labeled in large lettering with a 24-hour contact name and phone number to call in the event there is an issue with debris.
- I. Clean Site: Concessionaire's contractor shall be responsible for maintaining the work site safe, clean and orderly always. Failure to comply, DOA may accomplish the same at Concessionaire's contractor expense and/or suspend all construction until the situation is corrected.
- J. Restoration: Concessionaire's contractor shall be responsible for restoring contiguous areas affected by the construction work to its original condition.
- K. Temporary Construction Facility Privileges: Any temporary construction facility or trailer shall be approved by DOA Concessions before installation. The contractor shall be responsible for maintaining the grounds associated with this privilege. Noncompliance in

maintaining the grounds shall result in loss of this privilege. Approved facilities shall be removed at the completion of the construction project and the premises shall be restore to its original condition.

- L. Protection of Airport Operation Systems: If any portion of Airport operations systems is damage by the Concessionaire's contractor or sub-contractors, or anyone operating under their control or direction. The Concessionaire's contractor or sub-contractors shall immediately notify DOA Concessions and propose both temporary and permanent repairs to restore system functions and return the system to its original condition at no additional cost to the DOA.
- M. Aircraft Ramp Work: Airport Operations shall govern all ramp activities. Construction activities shall not supersede Airport Operations for any reason. When Concessions project construction requires work on the aircraft ramps, Concessionaire's contractor & sub-contractors shall comply with all DOA Specifications, Standards and Criteria.
- N. Operating within Critical Areas: When construction work requires the Concessionaire's contractor and sub-contractors to conduct its operations within areas adjacent to active aircraft gates, taxi lanes, and/or the apron. The work shall be coordinated with DOA Concessions in coordination with FCT. Concessionaire's contractor shall request authorization from DOA Concessions forty-eight (48) hours prior to any gate closure or interference with the Aircraft Operations.
- O. Technical Requirements: Concessionaire's contractor and sub-contractors shall be responsible for complying with the following ATL requirements:
 - 1. Electrical Power: Any unauthorized connection to an airport power source shall be disconnected/de-energized by the Concessionaire's contractor or sub-contractor per the DOA Concessions and FCT direction. Failure to comply, DOA shall disconnect or de-energize at Concessionaire's contractor/sub-contractor expense.
 - 2. Conduit: All conduits shall be concealed from public view.
 - 3. Floor Slab Penetrations: Concessionaire's contractor/sub-contractor shall be responsible for scanning (GPR or X-Ray) and providing DOA with the scan results which shall include a detailed drawing of the area to be core drilled. All floor slabs that require drilling, core drilling, embedding or demolition of any conduit and other utility lines, shall be constructed per the Architectural and Structural Design Standards, Sections 2 & 4 of this manual.
- P. Abandon Penetrations: Concession's contractor/sub-contractor shall be responsible for covering any new, existing or always abandon floor slab penetrations (Floor/Ceiling) during construction. All abandon penetrations shall be filled per the Architectural and Structural Design Standards, Sections 2 & 4 of this manual.
- Q. Access Control and Alarm Monitoring System (SACS/ACAMS)

When these systems are impacted or tie-ins are required by the Concessionaire's construction project, the Concessionaire's contractor/sub-contractor shall be responsible for restoring, maintaining the integrity and be compatible with the existing ATL SACS/ACAMS system. Concessionaire's contractor shall coordinate with and use the existing DOA Operations & Maintenance provider to accomplish this work. All work associated with these systems shall be coordinated through DOA Concessions

and shall be review and approved by DOA Security prior to start of any work. Notice shall be provided to DOA Concessions at least 48 hours prior to disturbing the existing SACS/ACAMS system.

R. Building Management System (BMS)/Fire Suppression and Life Safety Systems

When these systems are impacted or tie-ins are required by the Concessionaire's construction project, the Concessionaire's contractor/sub-contractor shall be responsible for restoring, maintaining the integrity and be compatible with the existing ATL BMS/Fire Suppression and Life Safety Systems. Concessionaire's contractor shall coordinate with and use the existing AATC Operations & Maintenance provider to accomplish this work. All work associated with these systems shall be coordinated through DOA Concessions and AATC prior to start of any work.

S. Environmental Requirements

When construction mitigation work is required, Concessionaire's contractor shall be responsible for complying with ATL Tenant Environmental Compliance Guide (contact DOA Environmental at 404-530-5500 for information). All required project specific mitigation, spill/emergency response and hazardous management plans shall be coordinated through DOA Concessions and shall be review and approve by DOA Environmental prior to start of any mitigation work.

T. Sustainability Standards

The ATL Planning and Development Bureau (P&D) has developed comprehensive Sustainable Construction Standards to apply to all DOA projects to meet City of Atlanta Ordinances, obtain certifications in industry leading Sustainability Rating Systems, and reach airport-wide sustainability goals. P&D requests that construction teams include these Standards in all construction projects where applicable, and to the highest extent possible. The implementation of these Standards is voluntary and in no way a contractual requirement. However, their maximum implementation, should be recognized as best practices, which can also contribute to the airport's overall sustainability goals of reducing energy and water consumption, waste generation, and greenhouse gas emissions.

The following are the P&D Sustainable Construction Standards for Reference only:

Construction Standards Sustainability

1.0 Purpose

The P&D Sustainable Construction Standards are General Requirements to be applied to all projects at ATL. These General Conditions are additional guidance to Division 1: Sustainable Requirements, which should be tailored project by project based on the Credits and Prerequisites the project is pursuing for the specified Sustainability Certification.

A. PART 1 – GENERAL

1. SUMMARY

- a. Includes general requirements and procedures for compliance with Sustainable Construction Standards.
- b. The Contractor shall adhere to all Sustainable Construction Standards in addition to project specific sustainability requirements included in Section 018111 to meet the intended Sustainability Certification Standard (LEED®, Parksmart®, SITES®, Envision®, etc.).
 - i. Sustainable Construction Progress Reports: Concurrent with each Application for Payment, contractor should, where applicable, submit reports comparing actual construction and purchasing activities with sustainable reports.
 - ii. Contractor shall submit all Project Close-out documentation upon completion of this project to the ATL P&D Sustainability Team Project Manager.
- c. Sustainable Construction Standards Submittal Checklist and Supplemental Documents will be available digitally through the ATL P&D Sustainability Team Project Manager.

2. SUBMITTALS

- a. General: Sustainable Construction Standards submittals are in addition to the other required project submittals.
 - i. All Sustainable Construction Standards submittals shall be submitted by the Contractor Sustainability Coordinator to the ATL P&D Sustainability Team Project Manager for approval in coordination with all documentation specified in SECTION 018111

B. DEFINITIONS

1. HJAIA P&D Sustainability Project Manager: Department of Aviation Planning and Development Department Sustainability Program Team member responsible for managing, implementing and enforcing the P&D Sustainability Program through all project phases and coordinating documentation collection for all Submittals found in the HJAIA Sustainable Construction Standards.

2. Contractor Sustainability Coordinator: An approved member of the Construction Team responsible for all Submittals found in the HJAIA Sustainable Construction Standards and all sustainability Submittals included in SECTION 018111.
3. Sustainable Construction Standards Submittal Checklist: A checklist of all Submittals found in the HJAIA Sustainable Construction Standards.

2.0 CONSTRUCTION TEAM

A. SUSTAINABLE CONSTRUCTION TRADES TRAINING

1. Schedule sustainability training with HJAIA P&D Sustainability Team Project Manager for all key construction team members prior to commencement of the construction phase that includes the following concepts:
 - a. Project-specific Sustainability Certification Standards (LEED®, Parksmart®, SITES®, or Envision®) compliance requirements in SECTION 018111.
 - b. Sustainable Construction Standards: provide digital access to all attendees.
 - c. Proactive sustainability: Examples of actions workers can take to be more sustainable while on site, included, but not limited to:
 - i. Energy and Water efficient practices.
 - ii. Recycling and proper use of single stream dumpsters (if in use).

2. SUBMITTALS

- a. Agenda for Sustainable Construction Trades Training
- b. Attendee List

B. CONTRACTOR SUSTAINABILITY COORDINATOR

1. The Contractor shall designate a Sustainability Project Coordinator to manage all Sustainable Construction Standards requirements for this project. The Sustainability Coordinator may be either an employee of contractor or consultant hired for this project.
 - a. The Contractor Sustainability Coordinator shall have a LEED Accredited Professional credential or equivalent green professional credential.
 - b. The designated Contractor Sustainability Coordinator shall be approved by the P&D Sustainability Team Project Manager.
 - c. The Contractor Sustainability Coordinator will be responsible for compiling and submitting all sustainability Submittals and required documentation.
 - d. The Contractor Sustainability Coordinator will submit all submittals and required documentation to the ATL P&D Sustainability Team Project Manager for approval. Sustainability Coordinator to use the provided templates and specified formatting.

- e. The Contractor Sustainability Coordinator will submit required Submittals and documentation concurrent with each Application of Payment.
- f. Reduction of pay application will be equivalent to the value of work not produced and/or completed based on submittal and documentation verification by the ATL P&D Sustainability Team Project Manager.

2. SUBMITTALS

- a. Provide proof of LEED Accredited Professional credential or equivalent credential.
- b. Provide proof of Sustainability Contractor experience on LEED or equivalent Sustainability Project experience.

3.0 SITE ENVIRONMENTAL MANAGEMENT

A. NON-TOXIC LANDSCAPE MAINTENANCE DURING CONSTRUCTION

- 1. If pesticides are used during construction, only use pesticides with a hazard tier ranking of 3 (least hazardous) as per The City of San Francisco Department of the Environment's (SFE) Hazard Tier Review Process.

B. SUBMITTALS

- 1. Manufacturer Documentation and MSDS Sheets on all pesticides and fertilizers used on-site.

4.0 RESOURCE SELECTION AND PRESERVATION

A. CONSTRUCTION TEMPORARY LIGHTING ENERGY EFFICIENCY

- 1. Reduce temporary lighting energy consumption using energy efficient lighting and operation protocol.
 - a. Use LED lighting for all temporary construction lighting.
 - b. Comply with minimum lighting requirements as defined in OSHA Standard 1926.56.
 - c. Establish a schedule for when lighting is required and develop a policy to reduce lighting when not needed.
 - d. Coordinate site walk during each phase of construction for P&D Sustainability Team Project Manager.

2. SUBMITTALS

- a. Provide bulb wattage for all temporary lighting used throughout construction

B. POTABLE WATER USE DURING CONSTRUCTION

1. Develop a Construction Water Use and Monitoring Plan to minimize potable water use during construction.
 - a. Identify and list all on-site water uses during construction.
 - b. Identify which uses can be performed utilizing non-potable or reused water.
 - c. Identify possible sources of non-potable water within the HJAIA Campus.
 - d. Monitor and report all potable and non-potable water use on site throughout the duration of the project.

 2. SUBMITTALS
 - a. Construction Water Use and Re-Use Log Template to be provided electronically.
- C. CONSTRUCTION AND DEMOLITION WASTE DIVERSION
1. Divert a minimum of 90% of construction and demolition waste from landfills.
 - a. Establish waste diversion goals for the project by identifying at least five materials (both structural and nonstructural) targeted for diversion. Approximate a percentage of the overall project waste that these materials represent.
 - b. Specify that at least 5 material waste streams will be collected and diverted separately
 - c. Reuse material on site whenever possible.
 - d. Work with project manager to enter waste diversion information into a waste tracking platform such as RE-TRAC CONNECT®.
 - e. Follow LEED Reference Manual for Building Design and Construction version 4: Construction and Demolition Waste Management credit language, regardless of project type.

 2. SUBMITTALS
 - a. Waste Tickets from haulers and waste management companies
 - b. Calculations on reuse in accordance with LEED Reference Manual for Building Design and Construction version 4: Construction and Demolition Waste Management Credit.
 - c. LEED Reference Manual for Building Design and Construction version 4: Construction and Demolition Waste Management Credit Required Documentation.

5.0 CONSTRUCTION VEHICLES AND EQUIPMENT

A. CONSTRUCTION VEHICLES AND EQUIPMENT GENERAL REQUIREMENTS

1. Construction shall not proceed until the contractor submits a list of all diesel on-road vehicles, non-road construction equipment, and generators to be used on-site to be confirmed by the P&D Sustainability Program Implementation Team. The list shall include the following:
 - a. Contractor and subcontractor name and address, including a contact person responsible for vehicles and/or equipment.
 - b. Equipment type, equipment manufacturer, equipment serial number, engine manufacturer, engine model year, engine certification (Environmental Protection Agency (EPA) Tier Emission rating), horsepower, engine family number, engine serial number, and expected fuel usage and hours of operation.
 - c. For any emission control technology installed: technology type, serial number, make, model, manufacturer, EPA/ California Air Resources Board (CARB) verification number, Tier level, installation date and hour-meter reading on installation date.
2. If the contractor subsequently needs to bring equipment on-site not on the list approved by the P&D Sustainability Team, the contractor shall submit written notification within 24 hours that attests the equipment complies with all contract conditions and provide information requested in 5A1
3. All diesel equipment shall comply with the pertinent local, state, and federal regulations relative to exhaust emission controls safety, or the requirements of this document, whichever is more stringent at the time of construction.
4. The contractor shall establish generator sites and truck-staging zones for vehicles waiting to load or unload materials on-site, when possible. Such zones shall be located where exhausted air pollutants have least impact on adjacent properties, the public, and surrounding structures' air intake systems.

B. CONSTRUCTION VEHICLE AND EQUIPMENT MAINTENANCE

1. Contractor shall designate an area for vehicle maintenance. Do not perform construction vehicle and equipment maintenance and repairs outside of designated areas.
 - a. When possible, conduct maintenance activities under cover.
 - b. Maintain a log of all vehicle repairs and maintenance.
 - c. Ensure that hazardous wastes are recycled and/or disposed safely per local, state and federal regulations.
 - d. Create a Spill Response Plan for cleanup of chemical, fuel or oil spills.
 - e. When available, use environmentally friendly chemicals and processes.

2. SUBMITTALS

- a. Prior to construction, submit The Spill Response Plan.
- b. At the end of the project or upon request, submit a log of maintenance and repairs conducted on construction vehicles used during construction.

C. ROADWAY PRESERVATION DURING CONSTRUCTION

1. Ensure all surrounding roadways used by the project site are not damaged by construction activity.
 - a. Any existing road weight limit restrictions limit must be followed by construction-related vehicles operating on airport and public roadways.
 - b. Equipment with tractor treads is prohibited on public roadways.
 - c. Immediately report all Incidents and Accidents to ensure roadway is preserved, and if damaged, is repaired within a reasonable timeframe.

2. SUBMITTALS

- a. Prior to construction, submit a list of construction vehicles operating on public roadways and the maximum load it could possibly transport.
- b. Prior to construction, submit a written policy that will be used to communicate that equipment with tractor treads shall not be driven on airport or public roadways.
- c. Immediately submit Accident and Incident reports (if applicable).

D. CONSTRUCTION VEHICLE IDLING PLAN

1. Implement a Vehicle Idling Inspection Program and document findings or results.
 - a. During periods of inactivity, idling of diesel on-road vehicles and non-road equipment shall be minimized and shall not exceed fifteen consecutive minutes.
 - b. Post signage for no vehicle idling in sensitive areas, such as areas within 100 feet of building air-intake systems.

2. SUBMITTALS

- a. Prior to construction, submit an inventory of vehicles using alternative idle reduction technologies.
- b. At the end of the project and upon request, vehicle Anti Idling Program inspection logs.
- c. Prior to construction, submit a site plan that identifies areas where signage will be installed communicating idling expectations.
- d. Prior to construction, provide a sample of Anti-Idling signage detail to be used in sensitive areas.

3. EXEMPTIONS

- a. See: Part 5 EXEMPTIONS D - I

E. LOW EMISSION ON-ROAD CONSTRUCTION VEHICLES

1. All on-road construction vehicles on site for more than 10 total days must have either engines that meet EPA 2010 on-road emission standards (TIER 4) or (2) emission control technology verified by the EPA or the CARB to meet the EPA 2010 on-road emission standards (TIER 4), such as Selective Catalytic Reduction (SCR) systems, to reduce Nitrogen Oxide (NOx) emissions.
 - a. Develop an inventory of construction vehicles, which includes vehicle type, horsepower rating, fuel type, and overall fuel usage during each phase of construction. In addition, on- road vehicle records should show official registrations, manufacturer, model and model-year.
 - b. The contractor is encouraged to use alternative fuels to further reduce NOx emissions including zero NOx technology (i.e., Electric) or near zero NOx technology (i.e., natural gas or propane) when reasonably available.
2. Upon confirming that the diesel on-road construction vehicle meets one of the criteria in 5.5: A., ATL will issue a compliance sticker.
 - a. All equipment on site shall display the compliance sticker in a visible, external location as designated by ATL.
3. SUBMITTALS
 - a. Prior to construction, submit an inventory of vehicles that will be used for each phase of construction. Submit updates as needed.
 - i. All information included in 5.5 A.: Data for on-road construction vehicles
 - ii. Written confirmation from the contractor that only on-road construction vehicles meeting EPA TIER 4 NOx emission levels will be used for the construction project unless otherwise exempt.
4. EXEMPTIONS
 - a. See: PART 5 EXEMPTIONS A-C

F. LOW EMISSION NON-ROAD CONSTRUCTION EQUIPMENT

1. All non-road construction equipment on-site for more than 10 total days must have either engines meeting EPA Tier 3 non-road emission standards or (2) repowered engines meeting EPA Tier 3 non-road emission standards or (3) emission control technology verified by EPA of CARB for use with non-road engines to reduce NOx emissions.
 - a. Develop an inventory of non-road construction equipment include type, horsepower rating, fuel type, fuel usage and hours of operation during each phase of construction. The contractor shall maintain records of manufacturer, model and model-year of equipment.
 - b. The contractor is encouraged to use alternative fuels to further reduce NOx emissions including zero NOx technology (i.e., Electric) or near zero NOx technology (i.e., natural gas or propane) when reasonably available.

2. Upon confirming that the diesel non-road construction equipment has met one of the criteria in 5.6: A, ATL will issue a compliance sticker.
 - a. All equipment on site shall display the compliance sticker in a visible, external location as designated by ATL.

3. SUBMITTALS

- a. Prior to construction, submit an inventory of non-road construction equipment that will be used for each phase of construction. Submit updates as needed.
 - i. All information included in 5.6 A.: Data for non-road construction equipment.
 - ii. Written confirmation from the contractor that only non-road construction equipment meeting at least EPA TIER 3 NOx emission levels will be used for the construction project unless otherwise exempt.
- b. At the end of the project and upon request, submit a log of maintenance and repairs conducted on all construction equipment used during construction.

4. EXEMPTIONS

- a. See: PART 5 EXEMPTIONS A-C

G. LOW EMISSION PORTABLE DIESEL GENERATORS

1. All portable diesel generators on site for more than 10 total days must have either (1) engines meeting at least the EPA Tier 2 non-road emission standards or (2) repowered engines meeting EPA Tier 2 non-road emission standards or (3) emission control technology verified by EPA or CARB for use with non-road engines to reduce NOx emissions.
 - a. Develop an inventory of portable diesel generators, which includes type, horsepower rating, fuel type, fuel usage and hours of operation during each phase of construction. The contractor shall maintain records of manufacturer, model and model-year of equipment.
 - b. The contractor is encouraged to use electricity from the power grid as an alternative to portable diesel generators when reasonably available to further reduce localized NOx emissions.

2. SUBMITTALS

- a. Prior to construction, submit an inventory of all portable diesel generators that will be used during construction and a plan that identifies portions of the project that may be reasonably completed using the electric grid power as an alternative to diesel generators. Submit updates as needed.
 - i. All information included in 5-G-1.: Data for portable diesel generators
 - ii. Written confirmation from the contractor that only diesel generators meeting at least EPA TIER 2 NOx emission levels will be used for the construction project unless otherwise exempt.

3. EXEMPTIONS

- a. See 6.0 EXEMPTIONS A - C

6.0 EXEMPTIONS

A. APPLIES TO: 5E, 5F, and 5G

If the contractor can prove to ATL's satisfaction that for a particular class of on-road diesel vehicle, diesel non-road construction equipment, or diesel generator, that (1) no alternative equipment with the specified TIER level is available, (2) it is not technically feasible to meet the control level specified above with a verified device, or (3) installing the control device would create a safety hazard or impair visibility for the operator, then the contractor may, with ATL's written approval, drop down to a lower level of Tier rating. For any approved lower level-Tier equipment, the contractor shall provide a plan describing step to minimize NOx emissions whenever a forecast projects the Air Quality Index will exceeding 100 for Atlanta. <https://airgeorgia.org>

B. APPLIES TO: 5E, 5F, and 5G

ATL may create an exemption when there is a compelling emergency need to use diesel vehicles or engines that do not meet the contract conditions for emissions controls. An example would be the need to rescue vehicles or other equipment to prevent or remedy harm to human beings or nearby property. Meeting contract deadlines, failure to rent equipment in a timely manner, planned unavailability, or lack of advance planning are not considered compelling emergencies.

C. APPLIES TO: 5E, 5F, and 5G

ATL may provide an exemption lasting no more than 30 days to a contractor, if the contractor can prove with valid documentation and to ATL's satisfaction that the appropriate emission control equipment has been ordered in a timely manner after the bid was awarded but has yet to be installed due to delays attributable to the equipment manufacturer and beyond control of the contractor. The contractor must install the retrofit as soon as practicable once it has been delivered and shall submit proof thereof when installation is complete. Provided, however, that such exemption shall not be available to a contractor who already owns an equivalent piece of equipment that meets the engine requirements for the project, as the contractor may use that piece of equipment.

D. APPLIES TO: 5D

When an on-road diesel vehicle or non-road construction equipment is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control.

E. APPLIES TO: 5D

To bring the on-road diesel vehicle, non-road construction equipment, or generator to the manufacturer's recommended operating temperature.

F. APPLIES TO: 5D

When there are regulations requiring temperature control for driver or passenger comfort and there are no auxiliary power sources available to provide temperature control.

G. APPLIES TO: 5D

When it is necessary to operate auxiliary equipment located in or on the diesel vehicle or construction equipment, to accomplish the intended use of the vehicle or equipment (for example, cranes and cement mixers).

H. APPLIES TO: 5D

When the on-road diesel vehicle, non-road construction equipment, or generator is being repaired, if idling is necessary for such a repair.

I. APPLIES TO: 5D

When the on-road diesel vehicle, non-road construction equipment, or generator is queued for inspection, if idling is necessary for such inspection.

Atlanta Fire Rescue Department Plan Review Requirements

I. FIRE SITE REVIEW REQUIREMENTS

Site and Utility Plans to include:

- Fire Department site access.
- *Roadway width(s)
 - ✓ 20 ft. minimum and 13ft. 6 in. vertical clearance.
 - ✓ 26 ft. minimum for buildings 30ft or higher.
- *Turning radius:
 - ✓ Structure with 3 stories or less – inside radius - 28ft. and outside radius - 48 ft.
 - ✓ Structure more than 3 stories – inside radius - 35ft. and outside radius - 50ft. ***Note: ARFF (Aircraft Rescue Fire Fighting) apparatus radius shall be verified.**
- Show overhead power lines within 20ft. of fire access road.
- *Gates – (specify mode of operation).
- *Knox Box(s) equipment location(s) i.e. breezeways, gates, entrances.
- *Location of all fire hydrants located within proximity of proposed project. *100ft. from FDC (Fire Department Connection(s)).
- *FDC (Fire Department Connection(s), standpipe connection, sprinkler test headers, PIV (Post Indicator Valves) locations.
- *Exit discharge from the proposed structure(s).
- *Transformer(s) location(s).
- Parking decks.
- *Generators.
- *ASTs/USTs. (Aboveground Storage Tanks/Underground Storage Tanks) - ***Note: Must be shown on both Site and Utility Plans.**

II. FIRE REVIEW FOR NEW/RELOCATION/REMOVAL OF ABOVE OR BELOW GROUND TANK OR FUEL DISPENSING UNIT

General Information:

Applicable codes:

- ✓ NFPA 30 Flammable and Combustible Liquids Code.
- ✓ NFPA 30A Automotive and Marine Service Station Code.
- ✓ NFPA 37 Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines.
- ✓ NFPA 70 National Electrical Code.

***Note: Most current code edition shall apply**

Site Plan to include:

- Location of tank, drawn to scale.
- Distance from buildings, observation wells, vents, hazardous features such as electrical equipment and incinerators.
- Distance from property lines, parking and drives.

Structural Plans to include:

- Identify type of liquid being stored.
- Identify type of storage: above ground, underground, container or portable tank.
- Specify volume of each tank in gallons.
- Section to scale through above ground tank and containment showing dimensions, calculation of containment volume, shape, dimensions, and construction of containment, tank base, fireproofing for metal tank supports, anchorage and venting.
- Section through underground tank(s) and excavation showing depths, physical dimension of tanks, backfill, anchorage (if required), venting and cathodic protection.
- Details for fuel dispensing units designating solenoid valves, shear valves, hose breakaway valves and emergency power shut-off switch.
- Manufacturers cut sheets – describe tank and all appurtenances indicated above and specify applicable UL listing information (e.g. UL 142 or UL 2085 tanks).
- Location and type of fire extinguishers.
- Description of vapor recovery system.

III. FIRE ASSEMBLY REVIEW REQUIREMENTS

- ✓ Seating layout or floor plan if no seating is required.
- ✓ Full set of architectural plans.

Life Safety Plan to include:

- Occupant load, Egress capacities and Exit Remoteness calculations.
- Travel distances, Common Path Travel and Dead-End limitations.
- Exit discharge termination at a public way.
- Exit signs, emergency lighting and pull Station locations
- Fire extinguisher locations and type.
- Fire rated walls.
- Furniture/Fixture/Equipment layouts.
- Symbols legend.
- Room identifications.
- Fire protection (sprinklered or non-sprinklered).
- P/H (Panic hardware).

***Note: Seated capacity must be noted on plans.**

IV. APPROVED QUALIFIED CONTRACTORS for IFC 510 and EMERGENCY RESPONDER RADIO COVERAGE TESTING

The following structures are not required to comply with the requirements of IFC Section 510:

- ✓ Buildings with no more than two occupiable stories, no more than 12,000 total square feet, and no floors below grade.
- ✓ Temporary buildings including tents when permitted by the Fire Marshal. For additions to buildings, unless the exceptions above are met for the area of the addition, the entire building being expanded must meet IFC 510 requirements.

V. FIRE ALARM REVIEW ITEMS FOR APPROVAL

- Riser Diagram "Point to Point" diagram and wire legend.
- Battery Calculations and Voltage Drop Calculations.
- Accurate Legend of Symbols for All Fire Alarm Devices Being Installed.
- Identification of Type of Wiring Used, Including Gauge and Wire Counts.
- The Matrix of Sequence of Operation/Events When Alarm System Is Activated.
- Stamp and Signature of the Designer in Responsible Charge of the Project.
- Location of FACP (Fire Alarm Control Panel), Annunciators, DACT's (Digital Alarm Communicator Transmitter), Power Extenders and Command Centers.
- Speaker wattages and decibel ratings for both horn alarm and voice evacuation system.
 - ✓ Components.
- The candela rating shown for drawing for each strobe device and each illuminated emergency.
 - ✓ Exit sign.
- Fire Alarm Systems with more than 6 devices and no new control panel installation or major
 - ✓ Modification to the system.

***Note – Fire alarm plan is a separate review and shall be submitted by the contractor elected to install.**