

**DOCUMENT 00 00 11**

**ADDENDUM NO. 1**

**June 2, 2025**

**Taxiway A Reconstruction – Phase 6 and Midfield Ramp Repair – Phase 3**

**Duluth International Airport  
Duluth Airport Authority  
AIP No. 3-27-0024-080-2024  
SP No. A6901-220, A6901-222  
City of Duluth No. 25-4406  
SEH No. DULAI 179719 & 180793**

From: Short Elliott Hendrickson Inc.  
3535 Vadnais Center Drive  
St. Paul, MN 55110-3507  
651.490.2000

To: Document Holders

DOCUMENT HOLDERS on the above-named project are hereby notified that this document shall be appended to, take precedence over and become part of the original bidding documents dated May 13, 2025 for this work. Bids submitted for the construction of this work shall conform to this document.

This addendum consists of the attached Pre-Bid Meeting Minutes, revisions to the specifications, and revisions to drawings.

**Changes to Bidding Requirements:**

1. Document 00 21 13 Instructions to Bidders: Section 24.01 is updated to reflect that DBE requirements for Federally-Funded Contracts apply for the construction reflected in Plan Set A. DELETE in its entirety and REPLACE with the attached revised specification section.

**Changes to Specifications:**

2. Specification P-501 Cement Concrete Pavement: Section 501-6.5 is updated to reflect concrete beam testing requirements for Phase 6A-1 concrete paving inside of the designated runway safety area. DELETE in its entirety and REPLACE with the attached revised specification section.

**Changes to Drawings:**

3. Plan Set A - Drawing G5.03 Statement of Estimated Quantities: Updated to reflect revised quantities for select bid items with a unit of "ACRE". SEQ note for bid item P-101 Remove Bituminous Pavement (Full Depth) is updated to reference existing pavement observations reflected in Appendix A – Geotechnical Reports. DELETE in its entirety and REPLACE with the attached revised drawing.
4. Plan Set A - Drawing G5.04 Statement of Estimated Quantities: Updated to reflect revised quantities for select bid items with a unit of "ACRE". SEQ note for bid item P-101 Remove Bituminous Pavement (Full Depth) is updated to reference existing pavement observations reflected in Appendix A – Geotechnical Reports. DELETE in its entirety and REPLACE with the attached revised drawing.
5. Plan Set A – Drawing C2.01 Plan & Profile Grade – Txy A: Updated to reflect note in profile view addressing anticipated slightly lower existing grade through this corridor resulting from embankment surcharge that was performed as part of preceding construction project. DELETE in its entirety and REPLACE with the attached revised drawing.

6. Plan Set A – Drawing C2.02 Plan & Profile Grade – Txy A: Updated to reflect note in profile view addressing anticipated slightly lower existing grade through this corridor resulting from embankment surcharge that was performed as part of preceding construction project. DELETE in its entirety and REPLACE with the attached revised drawing.
7. Plan Set A – Drawing C5.05 Storm Sewer – Electrical Duct Bank Plan and Profile: Updated to reflect plan and profile views for electrical duct bank construction. DELETE in its entirety and REPLACE with the attached revised drawing.
8. Plan Set A – Drawing C5.06 Storm Sewer Schedule: Updated to reflect revised values for Inner Structure Diameter, Invert Elevation (Pipe In), and incorporation of values for Pipe Pay Length. DELETE in its entirety and REPLACE with the attached revised drawing.
9. Plan Set A – Drawing C6.05 Drain Tile Schedule: Updated to reflect revised values for drain tile structure Description and Casting. DELETE in its entirety and REPLACE with the attached revised drawing.
10. Plan Set A – Drawing C6.06 Drain Tile Schedule: Updated to reflect revised values for drain tile pipe Name, Start Structure, End Structure, and incorporation of values for Pipe Pay Length. DELETE in its entirety and REPLACE with the attached revised drawing.
11. Plan Set A – Drawing C6.07 Drain Tile Schedule (Alt Bid): Updated to reflect revised values for drain tile structure Description, Invert Elevation (Pipe out), Casting, and incorporation of values for Pipe Pay Length. DELETE in its entirety and REPLACE with the attached revised drawing.

Attachments:

Pre-Bid Meeting Minutes  
Updated Specifications  
Updated Drawings

Note: Receipt of this Addendum No.1, dated June 2, 2025 shall be acknowledged on [BidExpress](#). Failure to do so will not allow Bidder to submit Bid.

**END OF ADDENDUM**



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## PRE-BID MEETING MINUTES

**RE:** Taxiway A Reconstruction Phase 6 and Midfield  
Ramp Repair Phase 3  
Duluth International Airport (DLH)

**Date of Meeting:** Wednesday, May 21, 2025

**Project Manager:** Jarrod Nelson

**Time of Meeting:** 10:30 a.m.

**SEH No.:** DULAI 179719, 180793 16.00

**Location of Meeting:** Virtual MS Teams / Airport  
Conference Room

**Attendees:** Attendance list [is attached](#) with issue of meeting minutes

The following items [were](#) discussed at the above referenced meeting:

### I. Project Representatives

#### A. Owner Representatives – Duluth Airport Authority

1. Mark Papko – DAA, Director of Operations
2. Ryan Welch – DAA, Interim Director of Operations & Airside Manager
3. Matt Snell – DAA, Public Safety Manager
4. Paul Sinnot – DAA, Interim Airside Manager

#### B. Engineer Representative – Short Elliott Hendrickson, Inc.

1. Shawn McMahon, PE (MN, WI, IA, SD) – SEH, Project Principal, 651.925.7541
2. Jarrod Nelson, PE (MN, IA, ND, SD) – SEH, Project Manager, 651.325.8161
3. Allison Andrashko, PE (MN) – SEH, Project Manager, 507.261.7617
4. Adinda Van Espen, PE (MN, ....) – SEH, Project Manager, 320.428.3654
5. Mark Giddings, PE – Burns & McDonnell, Electrical Project Manager
6. Derek Bruemmer, EIT – Burns & McDonnell

### II. Project Information

- A. Please submit all bidding questions via email to [jnelson@sehinc.com](mailto:jnelson@sehinc.com), copying [aandrashko@sehinc.com](mailto:aandrashko@sehinc.com)
- B. Project Documents: Bidding Documents are available to view and download at no cost as [www.bidexpress.com](http://www.bidexpress.com). Bidders must create a free account with Bid Express®; and login to search for city projects (search by “City of Duluth” or bid number). Bids will only be received electronically through Bid Express®.
- C. Project Award: Project award will be based upon overall lowest base bid cost and available funding at the time of bid opening.

Engineers | Architects | Planners | Scientists

Short Elliott Hendrickson Inc., 3535 Vadnais Center Drive, St. Paul, MN 55110-3507

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- D. Please review **Article 3 – Qualifications of Bidders** included in Instructions to Bidders of the Project Manual for required documents to be submitted during the bid
1. Bid Security (5%, sent separately via email prior to bid opening), Byrd Anti-Lobbying Amendment Certification, Bid Item Prices, Acknowledgement of Addenda, Declaration of Non-Collusion, Responsible Contractor Verification & Cert. of Compliance, First Tier Subcontractor List, and DBE certification reflecting intended DBE utilization percentage.
  2. Items to be submitted within 72 hours after bid include: Signed Bid Form (00 41 00), List of Proposed Suppliers (00 43 37), Certificate of Compliance with Minnesota Statutes 363A.36 (00 45 47), Buy American Certification (00 45 48), required supporting DBE documentation.
- E. Major Items of Work Include:
- Schedule A – Taxiway A Reconstruction – Phase 6 (Base Bid): 29,560 SY 13-inch P-501 PCC, 12,550 tons bituminous pavement (State Spec., P-401, and P-403 mixes), 58,700 CY excavation, 8,710 CY P-209 crushed aggregate base, 23,300 CY P-154 granular borrow, pavement markings, turf restoration, conduit, airfield lighting and signage, 1,890 LF storm sewer pipe with storm structures, and 7,120 LF of drain tile pipe with structures.
- Schedule B – Taxiway A Reconstruction – Phase 6 (Alternate Bid): 7,230 SY 13-inch P-501 PCC, 4,530 tons bituminous pavement (State Spec., P-401, and P-403 mixes), 12,000 CY excavation, 2,750 CY P-209 crushed aggregate base, 6,690 CY P-154 granular borrow, pavement markings, turf restoration, conduit, airfield lighting and signage, and 1,930 LF of drain tile pipe with structures.
- Schedule C – Midfield Ramp Repair – Phase 3 (Base Bid): 3,800 SY 12-inch P-501 PCC, 3,000 CY excavation, 1,200 CY P-209 crushed aggregate base, 1,200 CY P-154 granular borrow, pavement markings, turf restoration, and 800 LF of drain tile pipe with structures.
- Schedule D – Midfield Ramp Repair – Phase 3 (Base Bid): contaminated soils and piping removals and disposal.
- F. Anticipated Project Schedule:
1. Receive Bids: June 10, 2025
  2. Anticipated Contract Award: July 2025
  3. Anticipated Start of Construction: May 18, 2026 (125 Calendar Days)
  4. No Construction or Contractor Access during DLH Airshow: July 8 – July 13, 2026
  5. Alternate Bid Area (if selected) and Midfield Ramp Repair – Phase 3 Can Commence on July 14, 2026 after Contractor regains access to airfield.
  6. Anticipated Substantial Completion: September 19, 2026 (Taxiway A – Phase 6) and September 22, 2026 (Midfield Ramp – Phase 3)
- G. Phasing (See Construction Safety Plan Sheet):
1. Taxiway A Reconstruction, Phase 6
    - a. Phase 6A-0 shall be complete in 5 calendar days, starting on May 18, 2026.
    - b. Phase 6A, Phase 6A-1, and Phase 6B work shall be complete in 125 calendar days, substantially complete by September 19, 2026.
      - (1) Phase 6A-1 construction requires that Runway 9/27 shall be closed for two coordinated 60-hour continuous weekend periods and an additional 3 period of weekday nighttime work. These work periods will all be coordinated and approved by DAA.

- (a) Anticipated that the first 60-hour closure would be used for removals and prep and the second 60-hour closure would be used for concrete paving.
    - (b) The 60-hour closures do not need to be back to back.
  - c. Phase 6B cannot commence before July 14, 2026. No additional calendar days will be given if this alternate is selected, so substantially complete by September 19, 2026.
  - d.
- 2. Midfield Ramp Repair, Phase 3 cannot commence before July 14, 2026 and work shall be complete in 70 calendar days, substantially complete by September 22, 2026.
  - a. Concrete paving operations shall not commence for Midfield Ramp Repair construction until after Taxiway A reconstruction concrete paving operations have been completed.

H. Airport Security:

- 1. Bidders must thoroughly examine Project Documents for security related requirements.
- 2. Airport shall remain in full operation during construction except where required for project specific closures
- 3. Airfield Safety and Security Training will be held at scheduled times, where the following topics will be discussed:
  - a. Project Signage for Haul Routes and Site Access
  - b. Procedure for Receipt of Deliveries
  - c. Airfield and Site Security
  - d. Badging Requirements
- 4. Failure to comply with safety and phasing plans that results in a runway incursion or vehicle deviation will result in a penalty of \$1,000. Security violations could result in a penalty of up to \$10,000 per occurrence.
- 5. Contractor is required to hire a third-party Professional Security Firm, for which DAA approval of security firm is required prior to contract award.
- 6. If individuals are on-site for more than 5 days, they do need to be badged.
- 7. All badges for security firms expire at the end of the year.

I. Access and Haul Routes

- 1. Radio escort required across Midfield Ramp to control traffic. No additional compensation will be made for hauling delays due to aircraft traffic.

J. Staging and Storage

- 1. Contractor can pre-position equipment for project start. No contractor presence at airport allowed during DLH Airshow.
- 2. Batch plant is semi-secure, all other areas are NOT secure.

K. Quality Control Plan Required

III. **Contract Requirements**

A. Construction Staking – Contractor’s Responsibility

B. Quantity surveys are required to be submitted for payment. As-built survey data to be collected and forwarded to Engineer. See Field Engineering in project manual.

C. Disadvantaged Business Enterprise – DBE Goal of 8.0%

- 1. Only applies to construction of Plan Set A.

D. Wage Rates

1. Equal Employment Opportunity (EEO)
2. State and Federal prevailing wage rate requirements

E. Buy American Certification

F. Permits

1. City of Duluth Stormwater permit
  - a. Paid for by the contractor.
2. NPDES permit
  - a. Paid for by the contractor.
3. City of Duluth Haul Route Application
  - a. Paid for by the contractor.
4. City of Duluth Grading Permit
  - a. Paid for by the contractor.

IV. **Project Work**

A. General Scope

1. Batch Plant Setup – Mobilization Limited to 10% of total cost
2. Installation of Traffic Control Devices/Signage and Barricades
3. Covering of existing airfield taxiway and runway signs
4. Erosion Control BMP installation

B. Civil Scope

1. Concrete and Asphalt Pavement, Earthwork and Storm Sewer System Removals
2. Storm Sewer/Drain Tile Construction, and Storm Sewer Structure Construction
3. Pavement Construction
4. Pavement Markings
5. Seeding and Hydromulching
6. Disposal of Contaminated Soils and Materials at Abandoned Military Fuel Piping
7. Regulated Asbestos Removal at Abandoned Military Fuel Piping

C. Electrical Scope

1. Removal of existing taxiway edge lighting and signage
2. Existing utilities – locate, flag, and protect existing utilities. Pull back, protect, and reconnect existing cable. Reconstruction required for designated utilities.
3. Installation of new lighting, signage, and circuitry.
4. Routing of new circuit homerun duct banks and installation of new handholes adjacent to existing circuit homerun duct bank. Temporary jumpers required for construction phasing are considered incidental to mobilization. Existing circuit homerun duct bank to be demolished upon cutover of new homerun circuitry.
5. Detailed Schedule and Phasing Submittal Required
6. Existing “temporary” taxiway edge lighting and signage conversion to permanent taxiway edge lighting and signage at Taxiway R2 pavement
7. [Electrical vault work including removal of old regulators](#)

D. Restoration

1. Locations: disturbed areas, storage areas, haul roads
2. Restored to equal or better conditions

V. **Addendum**

VI. **Questions**

- A. Question: Is the size and material for the gas line called out on the plans? Answer: Yes, it is.
- B. Contractor cannot schedule runway closures on drill weekends. Drill weekends are anticipated to occur approximately one weekend per month. Dates will be finalized closer to construction.
- C. Question: Why is it that the concrete paving for Taxiway A must occur before the concrete paving for Midfield Ramp? Answer: Opening Taxiway A is a higher priority than opening Midfield Ramp.
- D. Per Instructions to Bidders, contractor questions received less than 4 days prior to bid opening may not be answered.

**PRE-BID MEETING ATTENDANCE - TAXIWAY A RECONSTRUCTION - PHASE 6**

Name	Email
Mark Papko	mpapko@duluthairport.com
Ryan Welch	Rwelch@duluthairport.com
Matt Snell	msnell@duluthairport.com
Dan Taylor	dtaylor@duluthairport.com
Brady Leiser	intern@duluthairport.com
Jarrod Nelson	jnelson@sehinc.com
Adinda Van Espen	avanespen@sehinc.com
Allison Andrashko	aandrashko@sehinc.com
Aaron Tast	atast@braunintertec.com
Mark Giddings	mgiddings@burnsmcd.com
Sam Yunker	sayunker@burnsmcd.com
Brad Mattson	bmattson@shafercontracting.com
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Robby Meseroll	rmeseroll@Ulland.com
Heath Line	heath@kgmcontractors.com
Aaron Brockman	aaron.brockman@northlandconstructors.us
Eric Hiti	eric.hiti@northlandconstructors.us
Nicholas Lynn	

**INSTRUCTIONS TO BIDDERS**

**ARTICLE 1 – DEFINED TERMS**

- 1.01 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office* - The office from which the Bidding Documents are to be issued.
  - B. *Bidder or Responsible Bidder* – Terms used in these Bidding Documents that mean a ‘responsible contractor’ meeting the minimum criteria as defined in Minnesota Statutes, section 16C.285, subdivision 3.

**ARTICLE 2 – COPIES OF BIDDING DOCUMENTS**

- 2.01 Authorized sets of the Bidding Documents may be obtained digitally or by paper copy as directed in the Advertisement for Bids.
- 2.02 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete or unauthorized sets of Bidding Documents.
- 2.03 Owner and Engineer in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

**ARTICLE 3 – QUALIFICATIONS OF BIDDERS**

- 3.01 To demonstrate Bidder’s qualifications to perform the Work, Bidder must submit with its Bid in the **Bid Express** Online solicitation:
- A. Byrd Anti-Lobbying Amendment Certification
  - B. Bid Form Item Prices
  - C. Acknowledgement of Addenda
  - D. Declaration of Non-Collusion (**Bid Express**)
  - E. Responsible Contractor Verification & Certificate of Compliance (**Bid Express**)
  - F. First Tier Subcontractor List (**Bid Express**)
  - G. Disadvantaged Business Enterprise (DBE) Certification reflecting intended DBE utilization percentage.
- 3.02 To remain in consideration for project award, the following documents shall be submitted by email to [jnelson@sehinc.com](mailto:jnelson@sehinc.com) within 72 hours after bid opening:
- A. Signed Document 00 41 00, Bid Form
  - B. Document 00 43 37, List of Proposed Suppliers
  - C. Document 00 45 47, Certificate of Compliance with Minnesota Statutes 363A.36
  - D. Document 00 45 48, Buy American Certification
  - E. Required DBE documentation in accordance with Article 24 and Document 00 73 30, Additional Special Provisions for Federally-Funded Contracts.

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- 3.03 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.04 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.05 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

**ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE**

4.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 *Existing Site Conditions*

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:
  - (a) those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
  - (b) those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
  - (c) reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
  - (d) Technical Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
4. Geotechnical Evaluation Report: The Bidding Documents contain a Geotechnical Evaluation Report (GER). The GER describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations ("Baseline Conditions"). The GER is a Contract Document.

The Baseline Conditions in the GER are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on the Baseline Conditions. Bids should be based on a comprehensive approach that includes an independent review and analysis of the GER, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.

Nothing in the GER is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the

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responsibility to select and be responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.

B. Underground Facilities

1. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

C. Adequacy of Data:

1. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. On request, and to the extent Owner has control over the Site, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.
- B. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- C. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavations and utility locates.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

**ARTICLE 5 – BIDDER'S REPRESENTATIONS**

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding documents, including Addenda;

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- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all federal, state, and local Laws and Regulations that may affect cost, progress, or performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder; information commonly known to Contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;
- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

**ARTICLE 6 – PRE-BID CONFERENCE**

- 6.01 A pre-Bid conference will be held at the time and location stated in the Advertisement for Bids. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

**ARTICLE 7 – INTERPRETATIONS AND ADDENDA**

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than 4 days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

### **ARTICLE 8 – BID SECURITY**

- 8.01 Bidders must submit copies of paper bid bonds via email to [purchasing@duluthmn.gov](mailto:purchasing@duluthmn.gov), but must be sent, received, and verified prior to the bid opening date and time. Bidders are responsible for ensuring their bonds have been received and are acceptable by the Purchasing Office.
- 8.02 No other options (certified check and bank money order) are allowable for submitting Bid Security.
- 8.03 **Bid Security must be payable to the Duluth Airport Authority (Owner).**
- 8.04 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner’s exclusive remedy if Bidder defaults.
- 8.05 The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.06 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

### **ARTICLE 9 – CONTRACT TIMES**

- 9.01 The number of days within which, or the dates by which milestones are to be achieved and the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

### **ARTICLE 10 – LIQUIDATED DAMAGES**

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

### **ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS**

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

### **ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS**

- 12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. Subcontractors must comply with MN Statute 16C.285 to do work under this project. It is the prospective Bidder’s responsibility to verify its proposed subcontractors compliances with the statutes. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

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12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

12.03 All bidders shall within 72 hours of the bid opening submit by email to [jnelson@sehinc.com](mailto:jnelson@sehinc.com), a list of the proposed Suppliers to remain in consideration for the project award.

If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

### ARTICLE 13 – PREPARATION OF BID

13.01 All blanks on the Bid Form shall be completed. A Bid Price shall be indicated for each section, Bid Item and unit price item listed therein.

13.02 The Bid Form is available in **Bid Express** Online and must be submitted electronically.

13.03 The Bid must be executed as directed by the City of Duluth Purchasing website <https://www.duluthmn.gov/purchasing/bids-request-for-proposals/> and by **Bid Express**.

13.04 The Bid shall contain an acknowledgment of receipt of all Addenda.

13.05 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

13.06 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach covenant to the Bid. The Bidder shall be either organized under Minnesota Law or have a Certificate of Authority from the Minnesota Secretary of State to do business in Minnesota, in accordance with the requirements of M.S. 303.03.

### ARTICLE 14 – BASIS OF BID; EVALUATION OF BIDS

14.01 *Base Bid with Alternates*

A. Bidders shall submit a Bid on a unit price basis for the base Bid and include a separate price for each alternate described in the Bidding Documents as provided for in the Bid Form. The price for each alternate will be the amount added to **OR** deleted from the base Bid if Owner selects the alternate.

B. In the comparison of Bids, alternates will be applied in the same order as listed in the Bid Form.

14.02 *Unit Price*

A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.

B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form)

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for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

**ARTICLE 15 – SUBMITTAL OF BID**

- 15.01 The Bid Form is to be completed and submitted in compliance with directions given on Bid Express.
- 15.02 The Bid shall be submitted no later than the date and time prescribed as indicated in the Advertisement for Bids, unless altered in an issued addendum.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner will not be accepted nor opened.
- 15.04 The submitted Bid Security may be emailed, as directed in the Advertisement for Bid. Request of actual copy upon award may be requested.

**ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID**

- 16.01 If your bid was submitted in error, or if you wish to withdraw your bid, follow these steps: (before the solicitation closes)

Select your bid on the Bids tab.

Click Withdraw Bid.

Click OK in the confirmation window.

After you have withdrawn your bid, an email confirmation will be sent to all users associated with your business. The email confirms that the bid has been withdrawn on this solicitation at a specific date and time.

- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

**ARTICLE 17 – OPENING OF BIDS**

- 17.01 Bids will be opened at the time and place indicated in the Advertisement for Bids and, unless obviously non-responsive, read aloud publicly.

**ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE**

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

**ARTICLE 19 – AWARD OF CONTRACT**

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, non-responsive, unbalanced, or conditional bids. Owner will reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive. Owner

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also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

- 19.02 If Owner awards the Contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid. Owner may also reject the Bid of any bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder.
- 19.03 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.
- 19.04 *Evaluation of Bids*
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- B. For determination of the apparent low Bidder(s) when sectional bids are submitted, Bids will be compared on the basis of the aggregate of the Bids for separate sections and the Bids for combined sections that result in the lowest total amount for all of the Work.
- 19.05 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Bidding Documents.
- 19.06 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the Work in accordance with the Contract Documents.

**ARTICLE 20 – BONDS AND INSURANCE**

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

**ARTICLE 21 – SIGNING OF AGREEMENT**

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within 10 days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

**ARTICLE 22 – BUY AMERICAN CERTIFICATION**

- 22.01 Contract requirements for Buy American Certification shall be in accordance with Document 00 45 48.
- 22.02 Within 3 business days following the opening of the bids and prior to the award of the Contract, the responsible low Bidder will be required to submit the Document 00 45 48 Buy American Certificate for Construction Project.
- A. If requesting a Buy American Waiver for this Project, the required documentation is provided in Document 00 45 48.
- B. If submitting a formal waiver request, the responsible low Bidder shall submit to the Owner within 15 calendar days after the Bid opening.

**ARTICLE 23 – RETAINAGE**

23.01 Provisions concerning Contractor's rights to deposit securities in lieu of retainage are set forth in the Agreement.

**ARTICLE 24 – UTILIZATION OF DISADVANTAGED BUSINESS ENTERPRISES**

24.01 Contract requirements for DBEs shall be in accordance with Document 00 73 30, Additional Special Provisions for Federally-Funded Contracts. **These DBE requirements for Federally-Funded Contracts apply to the construction reflected in Plan Set A.**

24.02 The DBE goal for this project is 8.0%.

24.03 Form Exhibit B (dated 3/27/17) of Appendix H is required to be submitted via email within 72 hours after bid opening.

24.04 Intended DBE utilization percentage shall be entered with the Disadvantaged Business Enterprise (DBE) Certification in the **Bid Express** solicitation.

**ARTICLE 25 – CERTIFICATION OF NON-SEGREGATED FACILITIES**

25.01 Notice to Prospective Federally-Assisted Construction Contractors

A. A Certification of Non-segregated Facilities shall be submitted prior to the award of a federally-assisted construction contract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity Clause.

B. Contractors receiving federally-assisted construction contract awards exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of the following notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed \$10,000 and are not exempt from the provisions of the Equal Opportunity Clause. NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

25.02 Notice to Prospective Subcontractors of Requirements for Certification of Non-Segregated Facilities

A. A Certification of Non-segregated Facilities shall be submitted prior to the award of a subcontract exceeding \$10,000, which is not exempt from the provisions of the Equal Opportunity Clause.

25.03 Contractors receiving subcontract awards exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of this notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed \$10,000 and are not exempt from the provisions of the Equal Opportunity Clause. NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

25.04 Certification of Non-Segregated Facilities Form can be provided, if requested.

**ARTICLE 26 – ELECTRONIC PAYMENT REQUIREMENTS**

26.01 All payments to the successful bidder are required to be via Automated Clearing House (ACH). Refer to **Appendix I** for forms.

26.02 Successful Contractor shall submit the documents in **Appendix I** to the Sponsor two weeks prior to the request of first payment. Payments will not be made by any other means.

26.03 Failure of the successful bidder to set of ACH in a timely manner may delay payment.

**END OF DOCUMENT**



## Item P-501 Cement Concrete Pavement

### DESCRIPTION

**501-1.1** This work shall consist of pavement composed of cement concrete with **and** without reinforcement constructed on a prepared underlying surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

### MATERIALS

#### 501-2.1 Aggregates.

**a. Reactivity.** Fine and Coarse aggregates to be used in PCC on this project shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Tests must be representative of aggregate sources which will be providing material for production. ASTM C1260 and ASTM C1567 tests may be run concurrently.

(1) Coarse aggregate and fine aggregate shall be tested separately in accordance with ASTM C1260, however, the length of test shall be extended to 28 days (30 days from casting). Tests must have been completed within 6 months of the date of the concrete mix submittal.

(2) The combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

(3) If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662 in lieu of ASTM C1567. If lithium nitrate admixture is used, it shall be nominal 30%  $\pm$ 0.5% weight lithium nitrate in water. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

**b. Fine aggregate.** Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and the parameters identified in the fine aggregate material requirements below. Fine aggregate material requirements and deleterious limits are shown in the table below.

<b>Fine Aggregate Material Requirements</b>		
Soundness of Aggregates by Use of Sodium Sulfate <b>or</b> Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	45 minimum	ASTM D2419
Fineness Modulus (FM)	$2.50 \leq FM \leq 3.40$	ASTM C136
<b>Limits for Deleterious Substances in Fine Aggregate for Concrete</b>		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

**c. Coarse aggregate.** The maximum size coarse aggregate shall be **1-½ inch**.

Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. The aggregates shall have no known history of detrimental pavement staining. Steel blast furnace slag shall not be permitted. Coarse aggregate material requirements and deleterious limits are shown in the table below; washing may be required to meet aggregate requirements.

#### Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate <b>or</b> Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 (9.5 mm) sieve <sup>1</sup>	ASTM D4791
Bulk density of slag <sup>2</sup>	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29
D-cracking (Freeze-Thaw) <sup>3</sup>	Durability factor $\geq 95$	ASTM C666

<sup>1</sup> A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

<sup>2</sup> Only required if slag is specified.

<sup>3</sup> Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one (1) year old or which are for different gradations will not be accepted.

The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

#### Limits for Deleterious Substances in Coarse Aggregate

Deleterious material	ASTM	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (75 µm)	ASTM C117	1.0 <sup>1</sup>
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert <sup>2</sup> (less than 2.40 Sp Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	0.1 <sup>3</sup>
Total of all deleterious Material		3.0 <sup>1</sup>

<sup>1</sup> The limit for material finer than 75-µm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale. Test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete mix. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis. The total of all deleterious materials increases up to 3.5%.

<sup>2</sup> Chert and aggregates with less than 2.4 specific gravity.

<sup>3</sup> The limit for chert may be limited to 0.1 percent by mass in areas subject to severe freeze and thaw.

**d. Combined aggregate gradation.** This specification is targeted for a combined aggregate gradation developed following the guidance presented in United States Air Force Engineering Technical Letter (ETL) 97-5: Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements. Base the aggregate grading upon a combination of all the aggregates (coarse and fine) to be used for the mixture proportioning. Three aggregate sizes may be required to achieve an optimized combined gradation that will produce a workable concrete mixture for its intended use. Use aggregate gradations that produce concrete mixtures with well-graded or optimized aggregate combinations. The Contractor shall submit complete mixture information necessary to calculate the volumetric components of the mixture. The combined aggregate grading shall meet the following requirements:

(1) The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in paragraph 501-2.1d(4) below, the point thus determined shall fall within the parallelogram described therein.

(2) The CF shall be determined from the following equation:

$$CF = \frac{\text{(cumulative percent retained on the } 3/8 \text{ in. (9.5 mm) sieve)}(100)}{\text{(cumulative percent retained on the No. 8 (2.36 mm) sieve)}}$$

(3) The WF is defined as the percent passing the No. 8 (2.36 mm) sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds (42 kg) of cementitious material per cubic meter yard greater than 564 pounds per cubic yard (335 kg per cubic meter).

(4) A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary. The point determined by the plotting of

the CF and WF may be adjusted during production  $\pm 3$  WF and  $\pm 5$  CF. Adjustments to gradation may not take the point outside of the parallelogram.

**e. Contractors combined aggregate gradation.** The Contractor shall submit their combined aggregate gradation using the following format:

**Contractor's Combined Aggregate Gradation**

Sieve Size	Contractor's Concrete mix Gradation (Percent passing by weight)
2 inch (50 mm)	*
1-1/2 inch (37.5 mm)	*
1 inch (25.0 mm)	*
3/4 inch (19.0 mm)	*
1/2 inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (600 $\mu$ m)	*
No. 50 (300 $\mu$ m)	*
No. 100 (150 $\mu$ m)	*

**501-2.2 Cement.** Cement shall conform to the requirements of

**ASTM C150 - Type I, II, or V.**

**ASTM C595 - Type IP, IS, IL.**

**ASTM C1157 – Types GU, HS, MH.**

**501-2.3 Cementitious materials.**

**a. Fly ash.** Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total alkali content less than 3% per ASTM C311. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Resident Project Representative (RPR).

**b. Slag cement (ground granulated blast furnace (GGBF)).** Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

**c. Raw or calcined natural pozzolan.** Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6%. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content less than 3%.

**d. Ultrafine fly ash and ultrafine pozzolan.** UltraFine Fly Ash (UFFA) and UltraFine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

- (1) The strength activity index at 28 days of age shall be at least 95% of the control specimens.
- (2) The average particle size shall not exceed 6 microns.

**501-2.4 Joint seal.** The joint seal for the joints in the concrete pavement shall meet the requirements of Item P-604 or Item P-605 and shall be of the type specified in the plans.

**501-2.5 Isolation joint filler.** Premolded joint filler for isolation joints shall conform to the requirements of ASTM D1751 or ASTM D1752 and shall be where shown 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 RPR. When the use of more than one piece is required 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 RPR.

**501-2.6 Steel reinforcement.** Reinforcing shall consist of welded wire reinforcement conforming to the requirements of ASTM A1064.

**501-2.7 Dowel and tie bars.** Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete.

**a. Dowel Bars.** Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078, Type 1, with a coating thickness after curing greater than 10 mils. Patched ends are not required for Type 1 coated dowels. The dowels shall be coated with a bond-breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

**b. Tie Bars.** Tie bars shall be deformed steel bars and conform to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

**501-2.8 Water.** Water used in mixing or curing shall be potable. If water is taken from other sources considered non-potable, it shall meet the requirements of ASTM C1602.

**501-2.9 Material for curing concrete.** Curing materials shall conform to one of the following specifications:

**a.** Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A, or Class B.

**b.** White polyethylene film for curing concrete shall conform to the requirements of ASTM C171.

**c.** White burlap-polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C171.

**d.** Waterproof paper for curing concrete shall conform to the requirements of ASTM C171.

**501-2.10 Admixtures.** Admixtures shall conform to the following specifications:

**a. Air-entraining admixtures.** Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining agent and any water reducer admixture shall be compatible.

**b. Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D.

**c. Other admixtures.** The use of set retarding and set-accelerating admixtures shall be approved by the RPR prior to developing the concrete mix. Retarding admixtures shall meet the requirements of

ASTM C494, Type A, B, or D and set-accelerating admixtures shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

**d. Lithium Nitrate.** The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:

#### Lithium Admixture

Constituent	Limit (Percent by Mass)
LiNO <sub>3</sub> (Lithium Nitrate)	30 ±0.5
SO <sub>4</sub> (Sulfate Ion)	0.1 (max)
Cl (Chloride Ion)	0.2 (max)
Na (Sodium Ion)	0.1 (max)
K (Potassium Ion)	0.1 (max)

The lithium nitrate admixture dispensing and mixing operations shall be verified and certified by the lithium manufacturer's representative.

**501-2.11 Epoxy-resin.** All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

- a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.
- b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.
- c. Material for use for injecting cracks shall be Type IV, Grade 1.
- d. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

**501-2.12 Bond Breaker.** Liquid membrane forming compound shall be in accordance with paragraph 501-2.9.

### CONCRETE MIX

**501-3.1 General.** No concrete shall be placed until an acceptable concrete mix has been submitted to the RPR for review and the RPR has taken appropriate action. The RPR's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

**501-3.2 Concrete Mix Laboratory.** The laboratory used to develop the concrete mix shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix must be included in the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the RPR prior to start of construction.

**501-3.3 Concrete Mix Proportions.** Develop the mix using the procedures contained in Portland Cement Association (PCA) publication, "Design and Control of Concrete Mixtures." Concrete shall be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained in paragraph 501-6.6 for a flexural strength of **650** psi per ASTM C78.

The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be **517** pounds per cubic yard. The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall be between 0.38 – 0.45 by weight.

Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. At the start of the project, the Contractor shall determine an allowable slump as determined by ASTM C143 not to exceed 2 inches (50 mm) for slip-form placement. For fixed-form placement, the slump shall not exceed 3 inches (75 mm). For hand placement, the slump shall not exceed 4 inches (100 mm).

The results of the concrete mix shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard (meter) basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

If a change in source(s) is made, or admixtures added or deleted from the mix, a new concrete mix must be submitted to the RPR for approval.

The RPR may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

**501-3.4 Concrete Mix submittal.** The concrete mix shall be submitted to the RPR at least 30 days prior to the start of operations. The submitted concrete mix shall not be more than 180 days old and must use the materials to be used for production for the project. Production shall not begin until the concrete mix is approved in writing by the RPR.

Each of the submitted concrete mixes (i.e., slip form, side form machine finish and side form hand finish) shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items and quantities as a minimum:

- Certified material test reports for aggregate in accordance with paragraph 501-2.1. Certified reports must include all tests required; reporting each test, test method, test result, and requirement specified (criteria).
- Combined aggregate gradations and analysis; and including plots of the fine aggregate fineness modulus.
- Reactivity Test Results.
- Coarse aggregate quality test results, including deleterious materials.
- Fine aggregate quality test results, including deleterious materials.
- Mill certificates for cement and supplemental cementitious materials.
- Certified test results for all admixtures, including Lithium Nitrate if applicable.
- Specified flexural strength, slump, and air content.
- Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.
- Flexural and compressive strength summaries and plots, including all individual beam and cylinder breaks.
- Correlation ratios for acceptance testing and Contractor QC testing, when applicable.
- Historical record of test results documenting production standard deviation, when applicable.

### 501-3.5 Cementitious materials.

**a. Fly ash.** When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

**b. Slag cement (ground granulated blast furnace (GGBF)).** Slag cement may be used. The slag cement, or slag cement plus fly ash if both are used, may constitute between 25 to 55% of the total cementitious material by weight.

**c. Raw or calcined natural pozzolan.** Natural pozzolan may be used in the concrete mix. When pozzolan is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If pozzolan is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

**d. Ultrafine fly ash (UFFA) and ultrafine pozzolan (UFP).** UFFA and UFP may be used in the concrete mix with the RPR's approval. When UFFA and UFP is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 7% and 16% by weight of the total cementitious material.

### 501-3.6 Admixtures.

**a. Air-entraining admixtures.** Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be **5.5%**. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

**b. Water-reducing admixtures.** Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

**c. Other admixtures.** Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

**d. Lithium nitrate.** Lithium nitrate shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements in accordance with paragraph 501-2.10d.

## CONSTRUCTION METHODS

**501-4.1 Control Strip.** The control strip(s) shall be to the next planned joint after the initial 250 feet (75 m) of each type of pavement construction (slip-form pilot lane, slip-form fill-in lane, or fixed form). The Contractor shall demonstrate, in the presence of the RPR, that the materials, concrete mix, equipment, construction processes, and quality control processes meet the requirements of the specifications. The concrete mixture shall be extruded from the paver meeting the edge slump tolerance and with little or no finishing. Pilot, fill-in, and fixed-form control strips will be accepted separately. Minor adjustments to the mix design may be required to place an acceptable control strip. The production mix will be the adjusted mix design used to place the acceptable control strip. Upon acceptance of the control strip by the

RPR, the Contractor must use the same equipment, materials, and construction methods for the remainder of concrete paving. Any adjustments to processes or materials must be approved in advance by the RPR. The acceptable control strip shall be paid for in accordance with paragraph 501-6.6.

**501-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification.

**a. Plant and equipment.** The plant and mixing equipment shall conform to the requirements of ASTM C94 and/or ASTM C685. Each truck mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. The truck mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch (19 mm) or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

Equipment for transferring and spreading concrete from the transporting equipment to the paving lane in front of the finishing equipment shall be provided. The equipment shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

**b. Finishing equipment.**

**(1) Slip-form.** The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine so that the end result is a dense and homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements.

**(2) Fixed-form.** On projects requiring less than 10,000 cubic yards of concrete pavement or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with equipment specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the RPR. Hand screeding and float finishing may only be used on small irregular areas as allowed by the RPR.

**c. Vibrators.** Vibrator shall be the internal type. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation or voids. The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of American Concrete Institute (ACI) 309R, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the RPR.

Hand held vibrators may only be used in irregular areas and shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete.

**d. Concrete saws.** The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.

**e. Fixed forms.** Straight side fixed forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) in length. 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. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the RPR. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the RPR. The forms shall extend the full depth of the pavement section.

**501-4.3 Form setting.** Forms shall be set to line and grade as shown on the plans, sufficiently in advance of the concrete placement, to ensure continuous paving operation. Forms shall be set to withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the concrete placement.

**501-4.4 Base surface preparation prior to placement.** Any damage to the prepared base, subbase, and subgrade shall be corrected full depth by the Contractor prior to concrete placement. The underlying surface shall be entirely free of frost when concrete is placed. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. Bond breaker shall be applied in accordance with 501-2.12.

**501-4.5 Handling, measuring, and batching material.** Aggregate stockpiles shall be constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. 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. Store and maintain all aggregates at a uniform moisture content prior to use. A continuous supply of materials shall be provided to the work to ensure continuous placement.

**501-4.6 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 are placed into the drum until the drum is emptied into the truck. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94 or ASTM C685.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is discharged from the truck should not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. In no case shall the temperature of the concrete when placed exceed 90°F (32°C). Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified is not exceeded.

**501-4.7 Weather Limitations on mixing and placing.** No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

**a. Cold weather.** Unless authorized in writing by the RPR, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F (4°C) and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F (2°C).

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F (10°C) at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F (66°C). The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

Curing during cold weather shall be in accordance with paragraph 501-4.13d.

**b. Hot weather.** During periods of hot weather when the maximum daily air temperature exceeds 85°F (30°C), the following precautions shall be taken.

The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F (32°C). The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The concrete placement shall be protected from exceeding an evaporation rate of 0.2 psf (0.98 kg/m<sup>2</sup> per hour) per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. If the Contractor's measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

Curing during hot weather shall be in accordance with paragraph 501-4.13e.

**c. Temperature management program.** Prior to the start of paving operation for each day of paving, the Contractor shall provide the RPR with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. (Federal Highway Administration HIPERPAV 3 is one example of a temperature management program.) As a minimum, the program shall address the following items:

- (1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.
- (2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 19-9, PCA, Design and Control of Concrete Mixtures.
- (3) Anticipated timing of initial sawing of joint.
- (4) Anticipated number and type of saws to be used.

**d. Rain.** The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

**501-4.8 Concrete Placement.** At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet (1 m). The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on

adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 450 psi, based on the average of four field cured specimens per 2,000 cubic yards (1,530 cubic meters) of concrete placed. The Contractor must determine that the above minimum strengths are adequate to protect the pavement from overloads due to the construction equipment proposed for the project.

**The Contractor shall have available materials for the protection of the concrete during cold, hot and/or inclement weather in accordance with paragraph 501-4.7.**

**a. Slip-form construction.** The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 inches (23 cm) for slipform and at the end of the dowels for the fill-in lanes. The spacing of internal units shall be uniform and shall not exceed 18 inches (0.5 m).

The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or vibrator trails and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one foot (30 cm). The frequency of vibration or amplitude should be adjusted proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Not more than 15% of the total free edge of each 500-foot (150 m) segment of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch (6 mm), and none of the free edge of the pavement shall have an edge slump exceeding 3/8 inch (9 mm). (The total free edge of 500 feet (150 m) of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet (150 m) of paving lane originally constructed as a separate lane will have 1,000 feet (300 m) of free edge, 500 feet (150 m) of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches (0.5 m) from the edge.

When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump will be removed the full width of the slip form lane and replaced at the expense of the Contractor as directed by the RPR.

**b. Fixed-form construction.** Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars / dowel bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and coated with a release agent each time they are used and before concrete is placed against them.

Concrete shall be spread, screed, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. The equipment must be specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the RPR.

Concrete for the full paving width shall be effectively consolidated by internal vibrators. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or leaving vibrator trails.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

**c. Consolidation.** Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches (50 mm). Vibrators shall not be used to transport or spread the concrete. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) or over-consolidation (vibrator trails, segregation, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the RPR.

If a lack of consolidation of the hardened concrete is suspected by the RPR, referee testing may be required. Referee testing of hardened concrete will be performed by the RPR by cutting cores from the finished pavement after a minimum of 24 hours curing. The RPR shall visually examine the cores for evidence of lack of consolidation. Density determinations will be made by the RPR based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for each 500 cubic yards (382 m<sup>2</sup>) of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original concrete mix density, with no cores having a density of less than 96% of the original concrete mix density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

**501-4.9 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 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 reinforcing steel 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 screed. If any portion of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it 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.

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. 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 ASTM specification requirements.

**501-4.10 Joints.** Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2-inch (12 mm) from their designated position and shall be true to line with not more than 1/4-inch (6 mm) variation in 10 feet (3 m). The surface across the joints shall be tested with a 12-foot (3 m) straightedge as the joints are finished and any irregularities in excess of 1/4 inch (6 mm) shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.

**a. Construction.** Longitudinal construction joints shall be slip-formed or formed against side forms as shown in the plans.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

**b. Contraction.** Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required 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. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the plans.

**c. Isolation (expansion).** Isolation joints shall be installed as shown on the plans. The premolded filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint. The filler shall be fastened uniformly along the hardened joint face with no buckling or debris between the filler and the concrete interface, including a temporary filler for the sealant reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the concrete is still plastic

**d. Dowels and Tie Bars for Joints**

**(1) Tie bars.** Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals

shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth and within the tolerances in paragraph 501-4.10(f.). When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

**(2) Dowel bars.** Dowel bars shall be placed across joints in the proper horizontal and vertical alignment as shown on the plans. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by the RPR. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

**(3) Placing dowels and tie bars.** Horizontal spacing of dowels shall be within a tolerance of  $\pm 3/4$  inch (19 mm). The vertical location on the face of the slab shall be within a tolerance of  $\pm 1/2$  inch (12 mm). The method used to install dowels shall ensure that the horizontal and vertical alignment will not be greater than 1/4 inch per foot (6 mm per 0.3 m), except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

**(a) Contraction joints.** Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

At the Contractor's option, dowels and tie bars in contraction joints may be installed by insertion into the plastic concrete using approved equipment and procedures per the paver manufacturer's design. Approval of installation methods will be based on the results of the control strip showing that the dowels and tie bars are installed within specified tolerances as verified by cores or non-destructive rebar location devices approved by the RPR.

**(b) Construction joints.** Install dowels and tie bars by the cast-in-place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms.

**(c) Joints in hardened concrete.** Install dowels in hardened concrete by bonding the dowels into holes drilled into the concrete. The concrete shall have cured for seven (7) days or reached a minimum flexural strength of 450 psi (3.1 MPa) before drilling begins. Holes 1/8 inch (3 mm) greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur. Spalling beyond the limits of the grout retention ring will require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of  $\pm 1/2$  inch (12 mm) of the dimension shown on the drawings. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole by means of a suitable metal or plastic grout retention ring fitted around the dowel.

**e. Sawing of joints.** Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have

been sawn. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial saw-cut and maintained for the remaining cure period.

Joints shall be cut in locations as shown on the plans. The initial joint cut shall be a minimum 1/8 inch (3 mm) wide and to the depth shown on the plans. Prior to placement of joint sealant or seals, the top of the joint shall be widened by sawing as shown on the plans.

**501-4.11 Finishing.** Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, edging of joints, and then texturing. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Equipment, mixture, and/or procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to prevent plastic shrinkage cracking, approved by the RPR, may be used in accordance with the manufacturers requirements.

**a. Machine finishing with slipform pavers.** The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. Equipment, mixture, and/or procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Remove excessive slurry from the surface with a cutting straightedge and wipe off the edge. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

**b. Machine finishing with fixed forms.** The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

**c. Other types of finishing equipment.** Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the RPR's approval.

Bridge deck finishers shall have a minimum operating weight of 7500 pounds (3400 kg) and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

**d.** : (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical.

**e. Straightedge testing and surface correction.** After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a 12-foot (3.7-m) finishing straightedge swung from handles capable of spanning at least 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 excess water and laitance in excess of 1/8 inch (3 mm) thick shall be removed from the surface of the pavement and wasted. 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 smoothness requirements. Straightedge testing and surface corrections 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. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

**501-4.12 Surface texture.** The surface of the pavement shall be finished as designated below for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. The texture shall be uniform in appearance and approximately 1/16 inch (2 mm) in depth. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the RPR.

**a. Brush or broom finish.** Shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface.

**b. Burlap drag finish.** Burlap, at least 15 ounces per square yard (555 grams per square meter), will typically produce acceptable texture. To obtain a textured surface, the transverse threads of the burlap shall be removed approximately one foot (30 cm) from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface.

**c. Artificial turf finish.** Shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf. The leading transverse edge of the artificial turf drag will be securely fastened to a lightweight pole on a traveling bridge. At least 2 feet (60 cm) of the artificial turf shall be in contact with the concrete surface during dragging operations. Approval of the artificial turf will be done only after it has been demonstrated by the Contractor to provide a satisfactory texture. One type that has provided satisfactory texture consists of 7,200 approximately 0.85-inch-long polyethylene turf blades per square foot.

**501-4.13 Curing.** Immediately after finishing operations are completed and bleed water is gone from the surface, all exposed surfaces of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. 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 during the curing period.

When a two-saw-cut method is used to construct the contraction joint, the curing compound shall be applied to the saw-cut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

**a. Impervious membrane method.** Curing with liquid membrane compounds should not occur until bleed and surface moisture has evaporated. All exposed surfaces 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 one gallon (4 liters) to not more than 150 square feet (14 sq m). 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 mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the RPR, a double application rate shall be used to ensure coverage. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. 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.

**b. White burlap-polyethylene sheets.** The surface of the pavement shall be entirely covered with the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted to remain in contact with the surface covered, and the covering shall be maintained fully saturated and in position for seven (7) days after the concrete has been placed.

**c. Water method.** The entire area shall be covered with burlap or other water absorbing material. The material shall be of sufficient thickness to retain water for adequate curing without excessive runoff. The material shall be kept wet at all times and maintained for seven (7) days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

**d. Concrete protection for cold weather.** Maintain the concrete at a temperature of at least 50°F (10°C) for a period of 72 hours after placing and at a temperature above freezing for the remainder of the 7-day curing period. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

**e. Concrete protection for hot weather.** Concrete should be continuous moisture cured for the entire curing period and shall commence as soon as the surfaces are finished and continue for at least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete surface shall be protected from drying with application of a liquid membrane-forming curing compound while the surfaces are still damp. Other curing methods may be approved by the RPR.

**501-4.14 Removing forms.** Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured in accordance with paragraph 501-4.13.

If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation methods must be reviewed and appropriate adjustments made to assure adequate consolidation at the edges of future concrete placements. Honeycombed areas that extend into the slab less than approximately 1 inch (25 mm), shall be repaired with an approved grout, as directed by the RPR. Honeycombed areas that extend into the slab greater than a depth of 1 inch (25 mm) shall be considered as defective work and shall be removed and replaced in accordance with paragraph 501-4.19.

**501-4.15 Saw-cut grooving.** If shown on the plans, grooved surfaces shall be provided in accordance with the requirements of Item P-621.

**501-4.16 Sealing joints.** The joints in the pavement shall be sealed in accordance with Item P-604 or P-605.

**501-4.17 Protection of pavement.** The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the RPR. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the RPR.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days, the joints are protected, the concrete has attained a minimum field cured flexural strength of 450 psi (3100 kPa), and the slab edge is protected.

All new and existing pavement carrying construction traffic or equipment shall be kept clean and spillage of concrete and other materials shall be cleaned up immediately.

Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

**501-4.18 Opening to construction traffic.** The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 450 pounds per square inch (3100 kPa) when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

**501-4.19 Repair, removal, or replacement of slabs.** New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable as defined by acceptance criteria in paragraph 501-6.6 shall be removed and replaced or repaired, as directed by the RPR, at the Contractor's expense. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The RPR will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall have a diameter of 2 inches (50 mm) to 4 inches (100 mm), shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. Repair of cracks as described in this section shall not be allowed if in the opinion of the RPR the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/8 inch (3 mm) of the pavement surface.

**a. Shrinkage cracks.** Shrinkage cracks which do not exceed one-third of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) pressure injected using procedures recommended by the manufacturer and approved by the RPR. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the RPR. Shrinkage cracks which exceed one-third the pavement depth shall be treated as full depth cracks in accordance with paragraphs 501-4.19b and 501-19c.

**b. Slabs with cracks through interior areas.** Interior area is defined as that area more than 6 inches (150 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than one-third the pavement depth, that extend into the interior area.

**c. Cracks close to and parallel to joints.** All full-depth cracks within 6 inches (150 mm) either side of the joint and essentially parallel to the original joints, shall be treated as follows.

**(1) Full depth cracks and original joint not cracked.** The full-depth crack shall be treated as the new joint and the original joint filled with an epoxy resin.

**i. Full-depth crack.** The joint sealant reservoir for the crack shall be formed by sawing to a depth of 3/4 inches (19 mm),  $\pm 1/16$  inch (2 mm), and to a width of 5/8 inch (16 mm),  $\pm 1/8$  inch (3 mm). The crack shall be sawed with equipment specially designed to follow random cracks. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent raveling or spalling. The joint shall be sealed with sealant in accordance with P-605 or as directed by the RPR.

**ii. Original joint.** If the original joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.

If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.

Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

**(2) Full depth cracks and original joint cracked.** If there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced.

**d. Removal and replacement of full slabs.** Make a full depth cut perpendicular to the slab surface along all edges of the slab with a concrete saw cutting any dowels or tie-bars. Remove damaged slab protecting adjacent pavement from damage. Damage to adjacent slabs may result in removal of additional slabs as directed by the RPR at the Contractor's expense.

The underlying material shall be repaired, re-compacted and shaped to grade.

Dowels of the size and spacing specified for other joints in similar pavement on the project shall be installed along all four (4) edges of the new slab in accordance with paragraph 501-4.10d.

Placement of concrete shall be as specified for original construction. The joints around the new slab shall be prepared and sealed as specified for original construction.

**e. Spalls along joints.**

**(1)** Spalls less than one inch wide and less than the depth of the joint sealant reservoir, shall be filled with joint sealant material.

**(2)** Spalls larger than one inch and/or deeper than the joint reservoir, but less than 1/2 the slab depth, and less than 25% of the length of the adjacent joint shall be repaired as follows:

**i.** Make a vertical saw cut at least one inch (25 mm) outside the spalled area and to a depth of at least 2 inches (50 mm). Saw cuts shall be straight lines forming rectangular areas surrounding the spalled area.

**ii.** Remove unsound concrete and at least 1/2 inch (12 mm) of visually sound concrete between the saw cut and the joint or crack with a light chipping hammer.

iii. Clean cavity with high-pressure water jets supplemented with compressed air as needed to remove all loose material.

iv. Apply a prime coat of epoxy resin, Type III, Grade I, to the dry, cleaned surface of all sides and bottom of the cavity, except any joint face.

v. Fill the cavity with low slump concrete or mortar or with epoxy resin concrete or mortar.

vi. An insert or other bond-breaking medium shall be used to prevent bond at all joint faces.

vii. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints.

(3) Spalls deeper than 1/2 of the slab depth or spalls longer than 25% of the adjacent joint require replacement of the entire slab.

**f. Diamond grinding of Concrete surfaces.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding of the hardened concrete should not be performed until the concrete is at least 14 days old and has achieved full minimum strength. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The depth of diamond grinding shall not exceed 1/2 inch (13 mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified.

Diamond grinding shall be performed with a machine specifically designed for diamond grinding capable of cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm) wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than the bottom of the grinding cut. The Contractor shall determine the number and type of blades based on the hardness of the aggregate. Contractor shall demonstrate to the RPR that the grinding equipment will produce satisfactory results prior to making corrections to surfaces.

Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. All grinding shall be at the expense of the Contractor.

### CONTRACTOR QUALITY CONTROL (CQC)

**501-5.1 Quality control program.** The Contractor shall develop a Quality Control Program in accordance with Item C-100. No partial payment will be made for materials that are subject to specific quality control requirements without an approved quality control program.

**501-5.2 Contractor Quality Control (CQC).** The Contractor shall provide or contract for testing facilities in accordance with Item C-100. The RPR shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The RPR will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

**501-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to this specification and as set forth in the CQCP. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the RPR as part of the CQCP.

The RPR may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the RPR, and if it can be demonstrated in the laboratory, in the presence of the RPR, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

**a. Fine aggregate.**

**(1) Gradation.** A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

**(2) Moisture content.** If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

**(3) Deleterious substances.** Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete as specified in paragraph 501-2.1b, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

**b. Coarse Aggregate.**

**(1) Gradation.** A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

**(2) Moisture content.** If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

**(3) Deleterious substances.** Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete as specified in paragraph 501-2.1c, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

**c. Slump.** One test shall be made for each subplot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

**d. Air content.** One test shall be made for each subplot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

**e. Unit weight and Yield.** One test shall be made for each subplot. Unit weight and yield tests shall be in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

**f. Temperatures.** Temperatures shall be checked at least four times per lot at the job site in accordance with ASTM C1064.

**g. Smoothness for Contractor Quality Control.**

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet,

identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12-foot (3.7 m) straightedge or a rolling inclinometer meeting the requirements of ASTM E2133. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer is used, the data may be evaluated using the FAA profile program, ProFAA, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

**(1) Transverse measurements.** Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

**(2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 501-4.19f or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 501-6.6.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

**h. Grade.** Grade will be evaluated prior to and after placement of the concrete surface.

Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the RPR within 48 hours.

Areas with humps or depression that that exceed grade or smoothness and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans. If these areas cannot be corrected with grinding then the slabs that are retaining water must be removed and replaced in accordance with paragraph 501-4.19d. Grinding shall be in accordance with paragraph 501-4.19f. All corrections will be at the Contractors expense.

**501-5.4 Control charts.** The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, and air content. The Contractor shall also maintain a control chart plotting the

coarseness factor/workability factor from the combined gradations in accordance with paragraph 501-2.1d.

Control charts shall be posted in a location satisfactory to the RPR and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the RPR may halt production or acceptance of the material.

**a. Fine and coarse aggregate gradation.** The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Superimposed on the control charts shall be the action and suspension limits. Gradation tests shall be performed by the Contractor per ASTM C136. The Contractor shall take at least two samples per lot to check the final gradation. Sampling shall be per ASTM D75 from the flowing aggregate stream or conveyor belt.

**b. Slump and air content.** The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

**c. Combined gradation.** The Contractor shall maintain a control chart plotting the coarseness factor and workability factor on a chart in accordance with paragraph 501-2.1d.

#### Control Chart Limits<sup>1</sup>

Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Gradation <sup>2</sup>	*3	*3
Coarseness Factor (CF)	±3.5	±5
Workability Factor (WF)	±2	±3
Slump	+0.5 to -1 inch (+13 to -25 mm)	+1 to -1.5 inch (+25 to -38 mm)
Air Content	±1.5%	±2.0%

<sup>1</sup> Control charts shall be developed and maintained for each control parameter indicated.

<sup>2</sup> Control charts shall be developed and maintained for each sieve size.

<sup>3</sup> Action and suspension limits shall be determined by the Contractor.

**501-5.5 Corrective action at Suspension Limit.** The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of control. The CQCP shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

**a. Fine and coarse aggregate gradation.** When two consecutive averages of five tests are outside of the suspension limits, immediate steps, including a halt to production, shall be taken to correct the grading.

**b. Coarseness and Workability factor.** When the CF or WF reaches the applicable suspension limits, the Contractor, immediate steps, including a halt to production, shall be taken to correct the CF and WF.

c. Fine and coarse aggregate moisture content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

d. Slump. The Contractor shall halt production and make appropriate adjustments whenever:

(1) (one point falls outside the Suspension Limit line for individual measurements

OR

(2) two points in a row fall outside the Action Limit line for individual measurements.

e. Air content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

(1) one point falls outside the Suspension Limit line for individual measurements

OR

(2) two points in a row fall outside the Action Limit line for individual measurements.

## MATERIAL ACCEPTANCE

**501-6.1 Quality Assurance (QA) Acceptance sampling and testing.** All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section, with the exception of coring for thickness determination, will be performed by the RPR. The Contractor shall provide adequate facilities for the initial curing of beams. The Contractor shall bear the cost of providing initial curing facilities and coring and filling operations, per paragraph 501-6.5b(1).

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

**501-6.2 Quality Assurance (QA) testing laboratory.** Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with ASTM C1077. The quality assurance laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods will be submitted to the RPR prior to start of construction.

**501-6.3 Lot size.** Concrete will be accepted for strength and thickness on a lot basis. A lot will consist of a day's production not to exceed 2,000 cubic yards (1530 cubic meters). Each lot will be divided into approximately equal sublots with individual sublots between 400 to 600 cubic yards. Where three sublots are produced, they will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or next lot. Where more than one plant is simultaneously producing concrete for the job, the lot sizes will apply separately for each plant.

**501-6.4 Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is, n=5 or n=6.

### 501-6.5 Acceptance Sampling and Testing.

#### a. Strength.

(1) **Sampling.** One sample will be taken for each subplot from the concrete delivered to the job site. Sampling locations will be determined by the RPR in accordance with random sampling procedures contained in ASTM D3665. The concrete will be sampled in accordance with ASTM C172.

(2) **Test Specimens.** The RPR will be responsible for the casting, initial curing, transportation, and curing of specimens in accordance with ASTM C31. Two (2) specimens will be made from each sample and slump, air content, unit weight, and temperature tests will be conducted for each set of strength specimens. Within 24 to 48 hours, the samples will be transported from the field to the laboratory while in the molds. Samples will be cured in saturated lime water.

The strength of each specimen will be determined in accordance with ASTM C78. The strength for each subplot will be computed by averaging the results of the two test specimens representing that subplot.

For the Phase 6A-1 concrete pavement to be installed inside of the designated Runway Safety Area, additional strength samples will be required for 3, 7, 14, and 28 days for each subplot. These additional specimens will be tested using the same methods as noted above.

(3) **Acceptance.** Acceptance of pavement for strength will be determined by the RPR in accordance with paragraph 501-6.6b(1). All individual strength tests within a lot will be checked for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded and the remaining test values will be used to determine acceptance in accordance with paragraph 501-6.5b.

#### b. Pavement thickness.

(1) **Sampling.** One core will be taken by the Contractor for each subplot in the presence of the RPR. Sampling locations will be determined by the RPR in accordance with random sampling procedures contained in ASTM D3665. Areas, such as thickened edges, with planned variable thickness, will be excluded from sample locations.

Cores shall be a minimum 4 inch (100 mm) in diameter neatly cut with a core drill. The Contractor will furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes will be filled by the Contractor with a non-shrink grout approved by the RPR within one day after sampling.

(2) **Testing.** The thickness of the cores will be determined by the RPR by the average caliper measurement in accordance with ASTM C174. Each core shall be photographed and the photograph included with the test report.

(3) **Acceptance.** Acceptance of pavement for thickness will be determined by the RPR in accordance with paragraph 501-6.6.

### 501-6.6 Acceptance criteria.

a. **General.** Acceptance will be based on the following characteristics of the completed pavement discussed in paragraph 501-6.5b:

- (1) Strength
- (2) Thickness
- (3) Grade
- (4) Profilograph smoothness – Not used.
- (5) Adjustments for repairs

Acceptance for strength, thickness, and grade, will be based on the criteria contained in accordance with paragraph 501-6.6b(1), 501-6.6b(2), and 501-6.6b(3), respectively. Production quality must achieve 90 PWL or higher to receive full payment.

Strength and thickness will be evaluated for acceptance on a lot basis using the method of estimating PWL. Production quality must achieve 90 PWL or higher to receive full pavement. The PWL will be determined in accordance with procedures specified in Item C-110.

The lower specification tolerance limit (L) for strength and thickness will be:

#### Lower Specification Tolerance Limit (L)

<b>Strength</b>	0.93 × strength specified in paragraph 501-3.3
<b>Thickness</b>	Lot Plan Thickness in inches, - 0.50 in

#### b. Acceptance criteria.

**(1) Strength.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1.

**(2) Thickness.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1.

**(3) Grade.** The final finished surface of the pavement of the completed project will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically or 0.1 feet laterally. The documentation, stamped and signed by a licensed surveyor shall be in accordance with paragraph 501-5.3h. Payment for sublots that do not meet grade for over 25% of the sublot shall be reduced by 5% and not be more than 95%.

**(4) Profilograph roughness for QA Acceptance.** Not used.

**(5) Adjustments for repair.** Sublots with spall repairs, crack repairs, or partial panel replacement, will be limited to no more than 95% payment.

**(6) Adjustment for grinding.** For sublots with grinding over 25% of a sublot, payment will be reduced 5%.

### METHOD OF MEASUREMENT

**501-7.1** Concrete pavement shall be measured by the number of square yards of plain **or** reinforced pavement as specified in-place, completed and accepted.

### BASIS OF PAYMENT

**501-8.1 Payment.** Payment for concrete pavement meeting all acceptance criteria as specified in paragraph 501-6.6. Acceptance Criteria shall be based on results of strength and thickness tests. Payment for acceptable lots of concrete pavement shall be adjusted in accordance with paragraph 501-8.1a for strength and thickness; 501-8.1b for repairs; 501-8.1c for grinding; and 501-8.1d for smoothness, subject to the limitation that:

The total project payment for concrete pavement shall not exceed **100** percent of the product of the contract unit price and the total number of square yards of concrete pavement used in the accepted work (See Note 1 under the Price Adjustment Schedule table below).

Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

**a. Basis of adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with the Price Adjustment Schedule table below. A pay factor shall be calculated for both strength and thickness. The lot pay factor shall be the higher of the two values when calculations for both strength and thickness are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either strength or thickness is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both strength and thickness are less than 100%.

**Price Adjustment Schedule<sup>1</sup>**

<b>Percentage of Materials Within Specification Limits (PWL)</b>	<b>Lot Pay Factor (Percent of Contract Unit Price)</b>
96 – 100	106
90 – 95	PWL + 10
75 – 90	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject <sup>2</sup>

<sup>1</sup> Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment in excess of 100% shall be subject to the total project payment limitation specified in paragraph 501-8.1.

<sup>2</sup> The lot shall be removed and replaced unless, after receipt of FAA concurrence, the Owner and Contractor agree in writing that the lot will remain; the lot paid at 50% of the contract unit price; and the total project payment limitation reduced by the amount withheld for that lot.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 501-8.1. Payment in excess of 100% for accepted lots of concrete pavement shall be used to offset payment for accepted lots of concrete pavement that achieve a lot pay factor less than 100%; except for rejected lots which remain in place and/or sublots with adjustments for repairs.

**b. Adjusted payment for repairs.** The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots which contain repairs in accordance with paragraph 501-4.19 on more than 20% of the slabs within the subplot. Payment factors greater than 100 percent for the strength and thickness cannot be used to offset adjustments for repairs.

**c. Adjusted payment for grinding.** The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots with grinding over 25% of a subplot.

**d. Profilograph Roughness.** Not used.

Payment. Payment shall be made under:

Item P-501	Cement Concrete Pavement, 12" – per square yard
Item P-501	Cement Concrete Pavement, Reinforced 12" – per square yard
Item P-501	Cement Concrete Pavement, 13" – per square yard
Item P-501	Cement Concrete Pavement, Reinforced 13" – per square yard

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1035	Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1078	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C70	Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C117	Standard Test Method for Materials Finer than 75- $\mu\text{m}$ (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123	Standard Test Method for Lightweight Particles in Aggregate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295	Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing

ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface
American Concrete Institute (ACI)	
ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting

ACI 309R                      Guide for Consolidation of Concrete  
Advisory Circulars (AC)  
AC 150/5320-6              Airport Pavement Design and Evaluation  
Federal Highway Administration (FHWA)  
HIPERPAV 3, version 3.2  
Portland Concrete Association (PCA)  
PCA                          Design and Control of Concrete Mixtures, 16<sup>th</sup> Edition  
U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD)  
CRD C662                      Determining the Potential Alkali-Silica Reactivity of Combinations of  
Cementitious Materials, Lithium Nitrate Admixture and Aggregate  
(Accelerated Mortar-Bar Method)  
United States Air Force Engineering Technical Letter (ETL)  
ETL 97-5                      Proportioning Concrete Mixtures with Graded Aggregates for Rigid  
Airfield Pavements

**END ITEM P-501**

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STATEMENT OF ESTIMATED QUANTITIES									
LINE NO.	ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY			FINAL QUANTITY		
				AIP ELIGIBLE FUNDING	AIP INELIGIBLE FUNDING	TOTAL	AIP ELIGIBLE FUNDING	AIP INELIGIBLE FUNDING	TOTAL
<b>SCHEDULE A - TAXIWAY A RECONSTRUCTION, PHASE 6 (BASE BID)</b>									
1	40-05	MAINTENANCE & RESTORATION OF HAUL ROADS	LS	1	0	1			
2	40-08	RESTORATION OF BATCH PLANT AND CONTRACTOR STORAGE AREA	LS	1	0	1			
3	50-07	CONSTRUCTION LAYOUT & STAKING	LS	1	0	1			
4	60-05	FIELD OFFICE	LS	1	0	1			
5	70-08	TRAFFIC PROVISIONS/AIRPORT SECURITY & DEVICES/PHASING	LS	1	0	1			
6	70-10	ORANGE CONSTRUCTION FENCE	LF	3,300	0	3,300			
7	02 41 35	REMOVE PAVEMENT MARKING BY WATER BLASTING	SF	6,140	0	6,140			
8	32 12 16	PLANT-MIXED ASPHALT PAVEMENT	TON	5,390	3,290	8,680			
9	C-100	CONTRACTOR QUALITY CONTROL PROGRAM (CQCP)	LS	1	0	1			
10	C-102	ROCK CONSTRUCTION ENTRANCE (INCLUDES MAINTENANCE AND REPAIR)	EA	2	2	4			
11	C-102	SILT FENCE, TYPE PREASSEMBLED (INCLUDES MAINTENANCE AND REPAIR)	LF	20,000	0	20,000			
12	C-102	FILTER LOG, TYPE WOOD FIBER BIOROLL (INCLUDES MAINTENANCE AND REPAIR)	LF	1,640	0	1,640			
13	C-102	INLET PROTECTION, TYPE B (INCLUDES MAINTENANCE AND REMOVAL)	EA	20	0	20			
14	C-105	MOBILIZATION	LS	1	0	1			
15	D-701	REINFORCED CONCRETE PIPE (RCP), 24" CLASS III	LF	75	0	75			
16	D-701	REINFORCED CONCRETE PIPE (RCP), 30" CLASS III	LF	338	0	338			
17	D-701	REINFORCED CONCRETE PIPE (RCP), 36" CLASS III	LF	453	0	453			
18	D-701	REINFORCED CONCRETE PIPE (RCP), 48" CLASS III	LF	975	0	975			
19	D-701	SUPPORT NATURAL GAS LINE OVER STORM SEWER PIPE	LS	1	0	1			
20	D-705	DRAIN TILE (6" PERFORATED, INCLUDING TRENCH, BACKFILL, FABRIC)	LF	6,040	0	6,040			
21	D-705	DRAIN TILE (6" SOLID SDR PVC PIPE, INCLUDING TRENCH, BACKFILL)	LF	1,080	0	1,080			
22	D-751	DRAIN TILE ACCESS/INSPECTION PIT	EA	30	0	30			
23	D-751	MANHOLE / CATCH BASIN 5' DIA.	EA	1	0	1			
24	D-751	MANHOLE / CATCH BASIN 6' DIA.	EA	1	0	1			
25	D-751	MANHOLE / CATCH BASIN 7' DIA.	EA	1	0	1			
26	D-751	MANHOLE / CATCH BASIN 8' DIA.	EA	3	0	3			
27	D-751	ADJUST MANHOLE / CATCH BASIN CASTING	EA	1	0	1			
28	L-108	NO. 8 AWG, 5 KV, L-824, TYPE C CABLE, INSTALLED IN DUCT BANK OR	LF	45,000	0	45,000			
29	L-108	NO. 6 AWG, SOLID, BARE COUNTERPOISE WIRE, INSTALLED IN TRENCH	LF	10,800	0	10,800			
30	L-108	2-#8 AWG AND 1-#8 GND, XHHW, INSTALLED IN TRENCH OR CONDUIT	LF	6,500	0	6,500			
31	L-108	1/C #4 5KV UNSHIELDED XLP MV-90 CABLE, INSTALLED IN DUCT BANK	LF	6,500	0	6,500			
32	L-108	NO. 8 AWG, 5 KV, L-824, TYPE C CABLE, USED FOR TEMPORARY JUMPS	LS	1	0	1			
33	L-110	NON-ENCASED ELECTRICAL CONDUIT, 1-WAY 2-INCH, PVC SCHEDULE 40	LF	7,000	0	7,000			
34	L-110	CONCRETE ENCASED ELECTRICAL CONDUIT, 2-WAY 2-INCH, PVC SCHEDULE 40	LF	800	0	800			
35	L-110	CONCRETE ENCASED ELECTRICAL CONDUIT, 4-WAY 4-INCH, PVC SCHEDULE 40	LF	3,000	0	3,000			
36	L-110	DRAIN LINE CONNECTION TO STORM STRUCTURE	EA	17	0	17			
37	L-125	REMOVAL OF EXISTING AIRFIELD ELECTRICAL	LS	1	0	1			
38	L-125	L-861(L) MEDIUM INTENSITY TAXIWAY EDGE LIGHT (WITHOUT ARCTIC KIT)	EA	70	0	70			
39	L-125	L-861(L) MEDIUM INTENSITY TAXIWAY EDGE LIGHT (WITHOUT ARCTIC KIT)	EA	8	0	8			
40	L-125	EXISTING L-861(L) MEDIUM INTENSITY TAXIWAY EDGE LIGHT REMOVE	EA	15	0	15			
41	L-125	L-858(L) GUIDANCE SIGN, SIZE 2, INCLUDING FOUNDATION, ISOLATION	EA	13	0	13			
42	L-125	L-829 4KW CONSTANT CURRENT REGULATOR	EA	1	0	1			
43	L-125	PRECAST AIRCRAFT-RATED ELECTRICAL HANDHOLE	EA	17	0	17			
44	L-125	REMOVE EXISTING RUNWAY LIGHT FIXTURE, BASE CAN, CABLE, CONDUIT	EA	1	0	1			
45	L-125	EXISTING L-852D RUNWAY LIGHT FIXTURE (WITHOUT ARCTIC KIT), WHITE	EA	1	0	1			
46	L-125	L-862 RUNWAY LIGHT FIXTURE (WITHOUT ARCTIC KIT), WHITE/WHITE	EA	1	0	1			
47	L-125	NEW L-852T(L) SEMIFLUSH TAXIWAY EDGE LIGHT (WITHOUT ARCTIC KIT)	EA	1	0	1			
48	P-101	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	LF	1,060	0	1,060			
49	P-101	REMOVE BITUMINOUS PAVEMENT (FULL DEPTH)	SY	17,660	0	17,660			
50	P-101	MILL BITUMINOUS PAVEMENT (VARIABLE DEPTH)	SY	690	0	690			
51	P-101	SAWING CONCRETE PAVEMENT (FULL DEPTH)	LF	390	0	390			
52	P-101	REMOVE CONCRETE PAVEMENT (FULL DEPTH)	SY	40	0	40			
53	P-101	REMOVE STORM PIPE	LF	1,810	0	1,810			
54	P-101	REMOVE STORM STRUCTURE	EA	4	0	4			
55	P-101	REMOVE DRAIN TILE CLEANOUT	EA	10	0	10			
56	P-101	REMOVE DRAIN TILE	LF	4,000	0	4,000			
57	P-151	CLEARING AND GRUBBING (AT EXPANDED CONTRACTOR STORAGE AREA)	ACRE	0.72	0.00	0.72			
58	P-152	COMMON EXCAVATION (EV)	CY	46,400	7,400	53,800			
59	P-152	UNCLASSIFIED OVER-EXCAVATION (EV) (INCLUDES REMOVAL AND REPLACEMENT OF EXCAVATED MATERIAL WITH SUITABLE GRANULAR MATERIAL)	CY	1,000	0	1,000			
60	P-152	MUCK EXCAVATION (EV) (INCLUDES REMOVAL AND REPLACEMENT OF EXCAVATED MATERIAL WITH SUITABLE GRANULAR MATERIAL)	CY	3,850	0	3,850			
61	P-152	SUBGRADE PREPARATION (INCLUDES SUBGRADE PROOF ROLLING)	SY	34,500	14,300	48,800			
62	P-152	ROCK EXCAVATION	CY	50	0	50			
63	P-154	SELECT GRANULAR BORROW / SUBBASE COURSE (CV)	CY	16,900	6,400	23,300			
64	P-154	GEOTEXTILE FABRIC, TYPE 7	SY	34,500	14,300	48,800			
65	P-209	CRUSHED AGGREGATE BASE COURSE (CV)	CY	6,200	2,510	8,710			
66	P-401	ASPHALT SURFACE COURSE	TON	80	150	230			
67	P-403	ASPHALT MIXTURE SURFACE COURSE	TON	1,480	340	1,820			
68	P-403	ASPHALT MIXTURE BASE COURSE	TON	1,480	340	1,820			
69	P-501	CEMENT CONCRETE PAVEMENT, 13"	SY	18,100	7,550	25,650			
70	P-501	CEMENT CONCRETE PAVEMENT, REINFORCED 13"	SY	3,910	0	3,910			
71	P-603	EMULSIFIED ASPHALT TACK COAT	GAL	1,680	720	2,400			
72	P-604	COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS	LF	21,590	13,870	35,460			
73	P-605	JOINT SEALING FILLER	LF	6,440	0	6,440			
74	P-620	REMOVE RUNWAY & TAXIWAY PAVEMENT MARKING USING BLACK PAINT	SF	7,230	0	7,230			
75	P-620	RUNWAY & TAXIWAY PAVEMENT MARKING (PERMANENT RATE)	SF	40,740	0	40,740			
76	P-620	RUNWAY & TAXIWAY PAVEMENT MARKING (TEMPORARY RATE)	SF	42,180	0	42,180			
77	P-620	REFLECTIVE MEDIA	LB	1,810	0	1,810			
78	T-901	SEEDING (INCLUDING FERTILIZER)	ACRE	14.50	0.00	14.50			
79	T-905	SELECT TOPSOIL BORROW (IMPORT) (CV)	CY	300	0	300			
80	T-908	HYDROMULCHING	ACRE	14.50	0.00	14.50			

### SEQ NOTES

GENERAL: TEMPORARY SANITARY FACILITIES, WATER FOR DUST CONTROL, AND TEMPORARY WATER SUPPLY FOR CONSTRUCTION OPERATIONS ARE CONSIDERED INCIDENTAL TO OTHER ITEMS OF PROJECT WORK.

40-05: PAID FOR BASED ON PERCENT COMPLETE.

40-08: RESTORATION INCLUDES GRADING, TURF ESTABLISHMENT, SOIL RIPPING/SCARIFICATION TO A DEPTH OF 6-INCHES, AND ANY OTHER MEASURES REQUIRED TO RETURN THE AREA TO PRE-CONSTRUCTION CONDITIONS OR BETTER, AS APPROVED BY ENGINEER. PAID FOR BASED ON PERCENT COMPLETE.

50-07: PAID FOR BASED ON PERCENT COMPLETE.

60-05: PAID ON A MONTHLY BASIS (LS\*MONTHS WORKED/TOTAL ANTICIPATED MONTHS OF WORK).

70-08: INCLUDES ALL TRAFFIC CONTROL SIGNAGE, BARRICADES, TEMPORARY FENCING, TRAFFIC CONTROL DEVICES, AND ALL ITEMS PERTAINING TO SECURITY, AND PHASING. PAID FOR BASED ON PERCENT COMPLETE.

C-100: PAID FOR BASED ON PERCENT COMPLETE.

C-105: MOBILIZATION SHALL BE LIMITED TO 10-PERCENT OF THE TOTAL PROJECT COST. FURNISHING, INSTALLING, AND REMOVAL OF ELECTRICAL JUMPERS REQUIRED FOR TEMPORARY ELECTRICAL CONSTRUCTION IS CONSIDERED INCIDENTAL TO THE WORK OF MOBILIZATION.

D-701: CONNECTIONS TO EXISTING STORM DRAIN PIPE, STRUCTURE, DRAIN TILE, INSPECTION PIT, AND CLEANOUT ARE ALL INCIDENTAL TO THESE PAY ITEMS.

D-705: CONNECTIONS TO EXISTING STORM DRAIN PIPE, STRUCTURE, DRAIN TILE, INSPECTION PIT, AND CLEANOUT ARE ALL INCIDENTAL TO THESE PAY ITEMS. ALL ITEMS REQUIRED FOR DRAIN TILE (TRENCHING, FILTER MATERIAL, FABRIC, CONNECTIONS, BACKFILLING, AND ASSOCIATED COMPACTION) ARE INCIDENTAL TO ITEM.

D-751: CONNECTIONS TO EXISTING STORM DRAIN PIPE, STRUCTURE, DRAIN TILE, INSPECTION PIT, AND CLEANOUT ARE ALL INCIDENTAL TO THESE PAY ITEMS.

D-751: WORK INCLUDES ADJUSTMENT OF EXISTING STRUCTURE CASTING TO FINISHED GRADE, INCLUDING ANY REQUIRED MODIFICATIONS TO EXISTING STRUCTURE AND INSTALLATION OF NEW CASTING.

L-108, L-110, L-125: NO PRICE ADJUSTMENT WILL BE MADE BASED ON PERCENTAGE OF QUANTITY USED. THE ENGINEER WILL PROVIDE A NOTICE TO PROCEED SPECIFICALLY FOR WIRE & CABLE ITEMS PRIOR TO ORDERING TO ENSURE THE CORRECT AMOUNT IS OBTAINED.

P-101 REMOVE BITUMINOUS PAVEMENT ITEM: WORK INCLUDES REMOVAL OF BITUMINOUS PAVEMENT AND ANY UNDERLYING CONCRETE PAVEMENT LAYERS, REGARDLESS OF ACTUAL PAVEMENT THICKNESS ENCOUNTERED. PER APPENDIX A - GEOTECHNICAL REPORTS OF THE PROJECT MANUAL, THERE IS NO INDICATION OF UNDERLYING CONCRETE PAVEMENT LAYERS UNDER EXISTING BITUMINOUS PAVEMENT SURFACES AT THE LOCATIONS OF THE PROJECT PAVEMENT CORES.

P-101 REMOVE CONCRETE PAVEMENT ITEM: WORK INCLUDES REMOVAL OF CONCRETE PAVEMENT AND ANY UNDERLYING BITUMINOUS PAVEMENT LAYERS, REGARDLESS OF ACTUAL PAVEMENT THICKNESS ENCOUNTERED.

P-101 PIPE REMOVAL (ALL): REQUIRED PIPE/STRUCTURE BULKHEADS ARE INCIDENTAL TO PIPE REMOVAL.

P-152: SEE EARTHWORK SUMMARY ON SHEET G5.05.

P-152: SEE EARTHWORK SUMMARY ON SHEET G5.05. ITEM INCLUDES MATERIAL EXCAVATED BELOW THE TYPICAL SECTION, AS DIRECTED BY ENGINEER. EXCAVATED MATERIAL TO BECOME PROPERTY OF CONTRACTOR, REPLACEMENT OF EXCAVATED MATERIAL WITH SUITABLE GRANULAR MATERIAL WILL BE INCIDENTAL TO THE UNCLASSIFIED OVER EXCAVATION.

P-152: SEE EARTHWORK SUMMARY ON SHEET G5.05.

P-152: ALL ON-SITE STRIPPING, SALVAGING, STOCKPILING, REPLACING AND SPREADING QUANTITY WILL BE PAID FOR UNDER COMMON EXCAVATION PRIOR TO THE PLACEMENT OF TOPSOIL BORROW (OBTAINED OFF-SITE) BY CONTRACTOR.

P-209: CONTRACTOR MAY SUBSTITUTE P-219 FOR P-209 WITH NO ADJUSTMENT TO UNIT PRICE.

SEH Project	DLH 179719	#	Rev.#	Plan Revision Issue Description	Date	Rev.#	Rev.#	Sheet Revision Issue Description	Date
Drawn By	SWB	#	1	ADDENDUM 1	06-02-25	#	#		#
Designed By	JN	#	#		#	#	#		#
Checked By	AVE	#	#		#	#	#		#

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MN.

*Jarrod R. Nelson*  
 JARROD R. NELSON, PE  
 DATE: 05-29-25 LICENSE NO. 26794

**TAXIWAY A RECONSTRUCTION - PHASE 6**

DULUTH, MINNESOTA

**STATEMENT OF ESTIMATED QUANTITIES**

G5.03

STATEMENT OF ESTIMATED QUANTITIES									
LINE NO.	ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY			FINAL QUANTITY		
				AIP ELIGIBLE FUNDING	AIP INELIGIBLE FUNDING	TOTAL	AIP ELIGIBLE FUNDING	AIP INELIGIBLE FUNDING	TOTAL
<b>SCHEDULE B - TAXIWAY A RECONSTRUCTION, PHASE 6 (ALTERNATE BID)</b>									
81	50-07	CONSTRUCTION LAYOUT & STAKING	LS	1	0	1			
82	60-05	FIELD OFFICE	LS	1	0	1			
83	70-08	TRAFFIC PROVISIONS/AIRPORT SECURITY & DEVICES/PHASING	LS	1	0	1			
84	70-10	ORANGE CONSTRUCTION FENCE	LF	1,940	0	1,940			
85	32 12 16	PLANT-MIXED ASPHALT PAVEMENT	TON	1,440	700	2,140			
86	C-102	SILT FENCE, TYPE PREASSEMBLED (INCLUDES MAINTENANCE AND REMOVAL)	EA	970	0	970			
87	C-102	INLET PROTECTION, TYPE B (INCLUDES MAINTENANCE AND REMOVAL)	EA	4	0	4			
88	C-105	MOBILIZATION	LS	1	0	1			
89	D-705	DRAIN TILE (6" PERFORATED, INCLUDING TRENCH, BACKFILL, FABRIC)	LF	1,820	0	1,820			
90	D-705	DRAIN TILE (6" SOLID SDR35 PVC PIPE, INCLUDING TRENCH, BACKFILL)	LF	110	0	110			
91	D-751	DRAIN TILE ACCESS/INSPECTION PIT	EA	6	0	6			
92	L-108	NO. 8 AWG, 5 KV, L-824, TYPE C CABLE, INSTALLED IN DUCT BANK OR	LF	3,800	0	3,800			
93	L-108	NO. 6 AWG, SOLID, BARE COUNTERPOISE WIRE, INSTALLED IN TRENCH	LF	3,360	0	3,360			
94	L-110	NON-ENCASED ELECTRICAL CONDUIT, 1-WAY 2-INCH, PVC SCHEDULE	LF	2,900	0	2,900			
95	L-110	CONCRETE ENCASED ELECTRICAL CONDUIT, 2-WAY 2-INCH, PVC SCHEDULE	LF	460	0	460			
96	L-125	L-861T(L) MEDIUM INTENSITY TAXIWAY EDGE LIGHT (WITHOUT ARCTIC)	EA	17	0	17			
97	L-125	L-858(L) GUIDANCE SIGN, SIZE 2, INCLUDING FOUNDATION, ISOLATION	EA	1	0	1			
98	P-101	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	LF	240	0	240			
99	P-101	REMOVE BITUMINOUS PAVEMENT (FULL DEPTH)	SY	9,700	0	9,700			
100	P-101	REMOVE STORM PIPE	LF	100	0	100			
101	P-101	REMOVE STORM STRUCTURE	EA	3	0	3			
102	P-101	REMOVE DRAIN TILE CLEANOUT	EA	5	0	5			
103	P-101	REMOVE DRAIN TILE	LF	1,820	0	1,820			
104	P-152	COMMON EXCAVATION (EV)	CY	8,200	3,400	11,600			
105	P-152	UNCLASSIFIED OVER EXCAVATION (EV) (INCLUDES REMOVAL AND RE	CY	250	0	250			
106	P-152	MUCK EXCAVATION (EV)	CY	100	0	100			
107	P-152	SUBGRADE PREPARATION (INCLUDES SUBGRADE PROOF ROLLING)	SY	11,220	2,630	13,850			
108	P-152	ROCK EXCAVATION	CY	50	0	50			
109	P-154	SELECT GRANULAR BORROW / SUBBASE COURSE (CV)	CY	5,550	1,140	6,690			
110	P-154	GEOTEXTILE FABRIC, TYPE 7	SY	11,220	2,630	13,850			
111	P-154	GEOGRID	SY	3,310	0	3,310			
112	P-209	CRUSHED AGGREGATE BASE COURSE (CV)	CY	2,320	430	2,750			
113	P-401	ASPHALT SURFACE COURSE	TON	660	90	750			
114	P-401	ASPHALT BASE COURSE	TON	960	0	960			
115	P-403	ASPHALT MIXTURE SURFACE COURSE	TON	270	70	340			
116	P-403	ASPHALT MIXTURE BASE COURSE	TON	270	70	340			
117	P-501	CEMENT CONCRETE PAVEMENT, 13"	SY	4,820	2,410	7,230			
118	P-603	EMULSIFIED ASPHALT TACK COAT	GAL	930	100	1,030			
119	P-604	COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS	LF	5,490	3,180	8,670			
120	P-605	JOINT SEALING FILLER	LF	1,880	0	1,880			
121	P-620	RUNWAY & TAXIWAY PAVEMENT MARKING (PERMANENT RATE)	SF	7,050	0	7,050			
122	P-620	RUNWAY & TAXIWAY PAVEMENT MARKING (TEMPORARY RATE)	SF	7,050	0	7,050			
123	P-620	REFLECTIVE MEDIA	LB	300	0	300			
124	T-901	SEEDING (INCLUDING FERTILIZER)	ACRE	2.40	0.00	2.40			
125	T-905	SELECT TOPSOIL BORROW (IMPORT) (CV)	CY	100	0	100			
126	T-908	HYDROMULCHING	ACRE	2.40	0.00	2.40			

### SEQ NOTES

- GENERAL: TEMPORARY SANITARY FACILITIES, WATER FOR DUST CONTROL, AND TEMPORARY WATER SUPPLY FOR CONSTRUCTION OPERATIONS ARE CONSIDERED INCIDENTAL TO OTHER ITEMS OF PROJECT WORK.
- 50-07: PAID FOR BASED ON PERCENT COMPLETE.
- 60-05: PAID ON A MONTHLY BASIS (LS\*MONTHS WORKED/TOTAL ANTICIPATED MONTHS OF WORK).
- 70-08: INCLUDES ALL TRAFFIC CONTROL SIGNAGE, BARRICADES, TEMPORARY FENCING, TRAFFIC CONTROL DEVICES, AND ALL ITEMS PERTAINING TO SECURITY, AND PHASING. PAID FOR BASED ON PERCENT COMPLETE.
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- P-209: CONTRACTOR MAY SUBSTITUTE P-219 FOR P-209 WITH NO ADJUSTMENT TO UNIT PRICE.

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SEH Project	DLH 179719	# Rev.#	Plan Revision Issue	Date	Rev.#	Sheet Revision Issue	Date
Drawn By	SWB	# 1	ADDENDUM 1	06-02-25	# #	Description	# #
Designed By	JN	# #		# #	# #		# #
Checked By	AVE	# #		# #	# #		# #

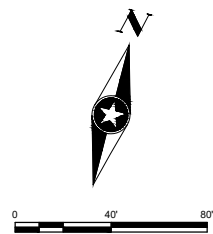
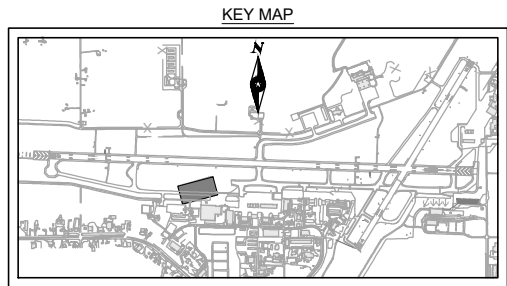
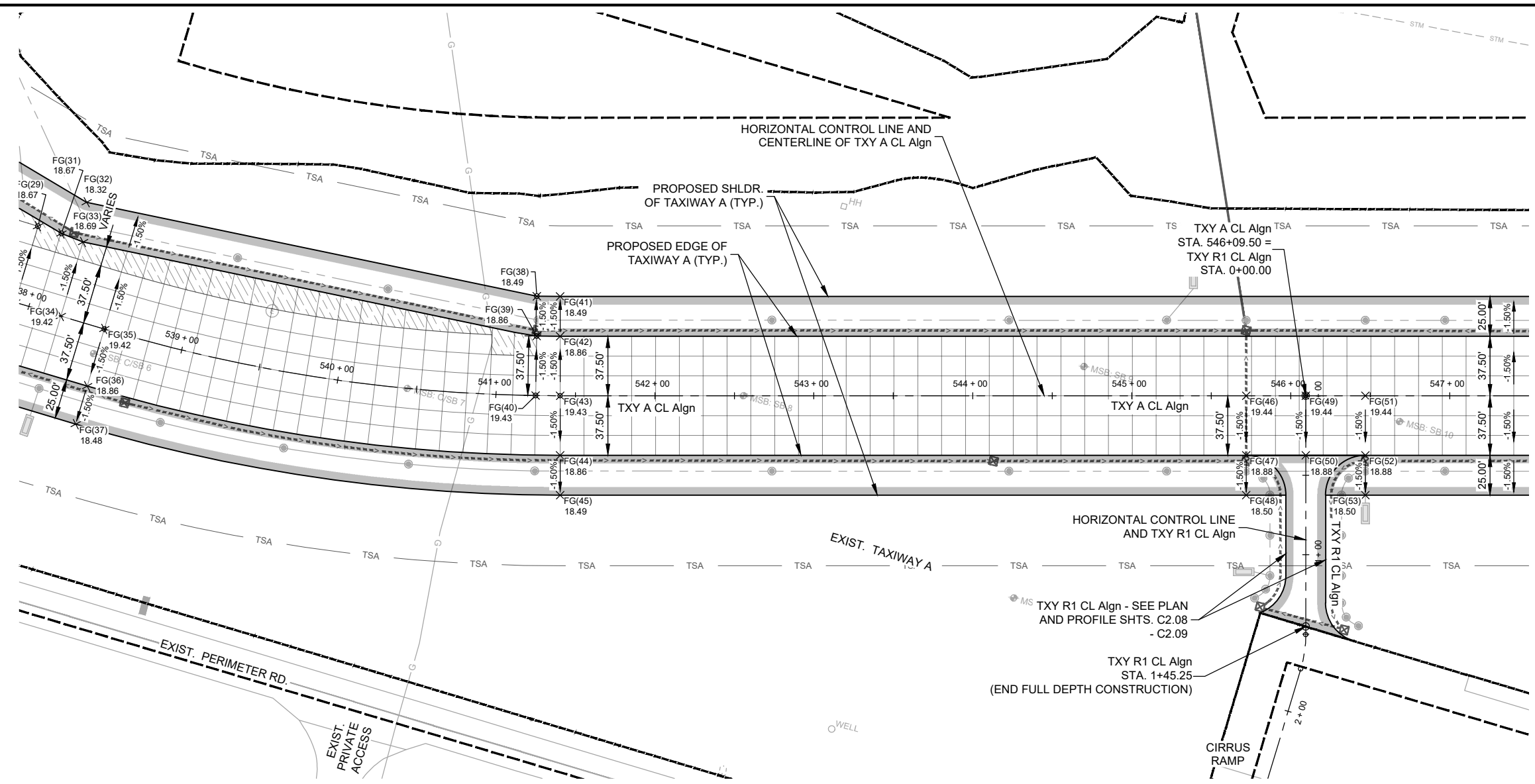
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**Jarrod R. Nelson**  
 JARROD R. NELSON, PE  
 DATE: 05-29-25 LICENSE NO. 26794

**TAXIWAY A RECONSTRUCTION - PHASE 6**  
 DULUTH, MINNESOTA

**STATEMENT OF ESTIMATED QUANTITIES** G5.04

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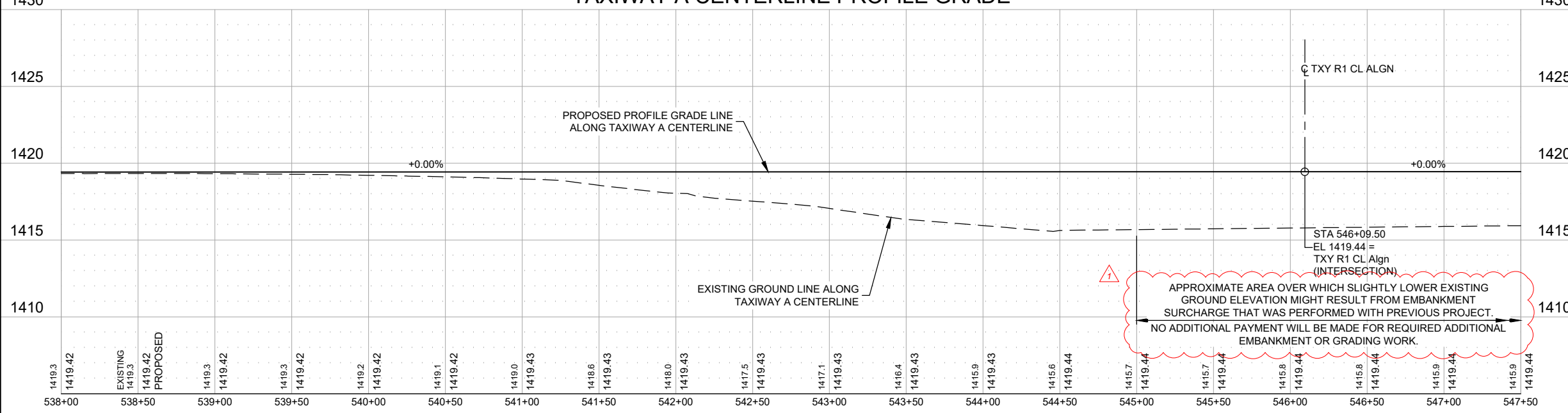
**NOTES:**

- 1) SEE SHEET C2.03 FOR FINISHED GRADE POINTS TABLE.

**GEOMETRIC CONTROL NOTES:**

- 1. COORDINATES SHOWN ARE BASED ON THE ST. LOUIS COUNTY SOUTH COORDINATE SYSTEM. PACS/SACS CONTROL INFORMATION AT THE AIRPORT WILL BE PROVIDED TO THE CONTRACTOR TO SET PROJECT CONTROL SHOWN ON SHEET C0.30.
- 2. CONTRACTOR SHALL FIELD VERIFY ALL ELEVATIONS FOR TIE IN OF PROPOSED PAVEMENT TO EXISTING PAVEMENT.

**TAXIWAY A CENTERLINE PROFILE GRADE**



**LEGEND**

- RSA RUNWAY SAFETY AREA
- TSA TAXIWAY SAFETY AREA
- PROPOSED GRADING LIMIT
- PROPOSED CONSTRUCTION LIMIT
- P-BUR EXISTING BURIED POWER
- COM EXISTING BURIED PHONE
- PROPOSED STORM PIPE
- CB PROPOSED STORM CATCH BASIN
- ST PROPOSED STORM MANHOLE
- EXISTING PAVEMENT EDGE
- STM EXISTING STORM PIPE
- FM EXISTING SANITARY PIPE
- EXISTING STORM CATCH BASIN
- EXISTING STORM MANHOLE
- EXISTING TAXIWAY LIGHT
- EXISTING RUNWAY LIGHT
- EXISTING BORING
- EXISTING ELECTRICAL MANHOLE
- EXISTING LIGHTED SIGN
- EXISTING INSPECTION PIT

SEH Project DLH 179719  
 Drawn By SWB  
 Designed By JN  
 Checked By AVE

Rev.#	Plan Revision Issue Description	Date	Rev.#	Sheet Revision Issue Description	Date
1	ADDENDUM 1	06-02-2025	#	#	#
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DATE 05-29-25 LICENSE NO. 26794

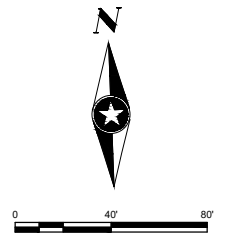
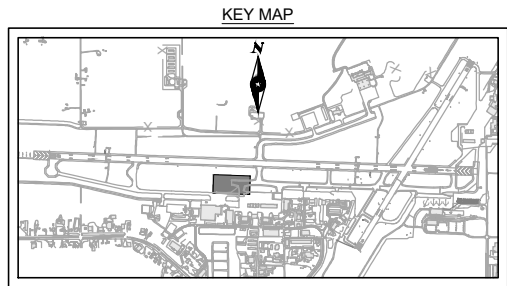
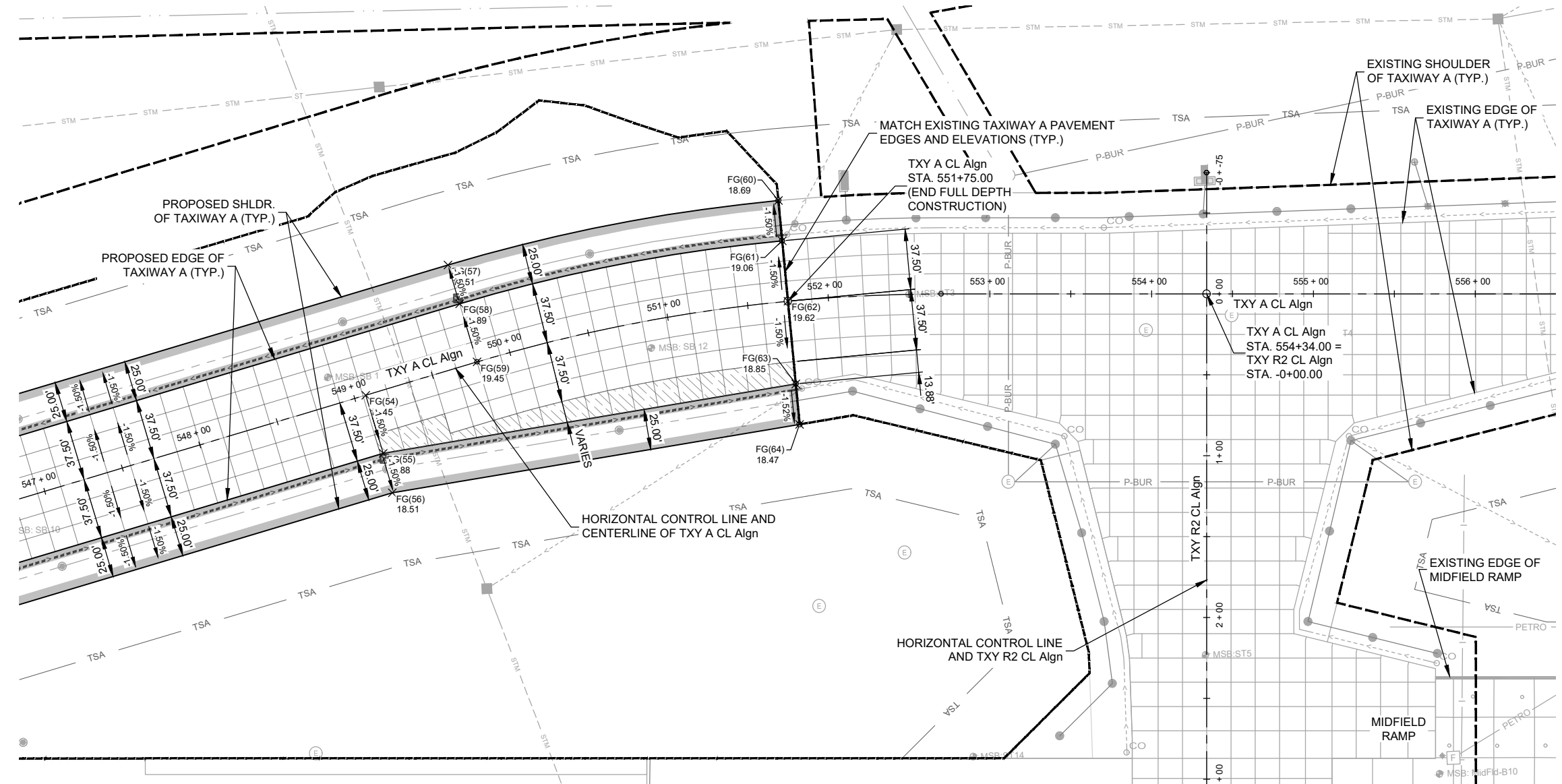
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MN.  
**Jarrod R. Nelson**  
 Jarrod R. Nelson, PE  
 DATE 05-29-25 LICENSE NO. 26794

**TAXIWAY A RECONSTRUCTION - PHASE 6**  
 DULUTH, MINNESOTA

**PLAN & PROFILE GRADE - TXY A**

**C2.01**

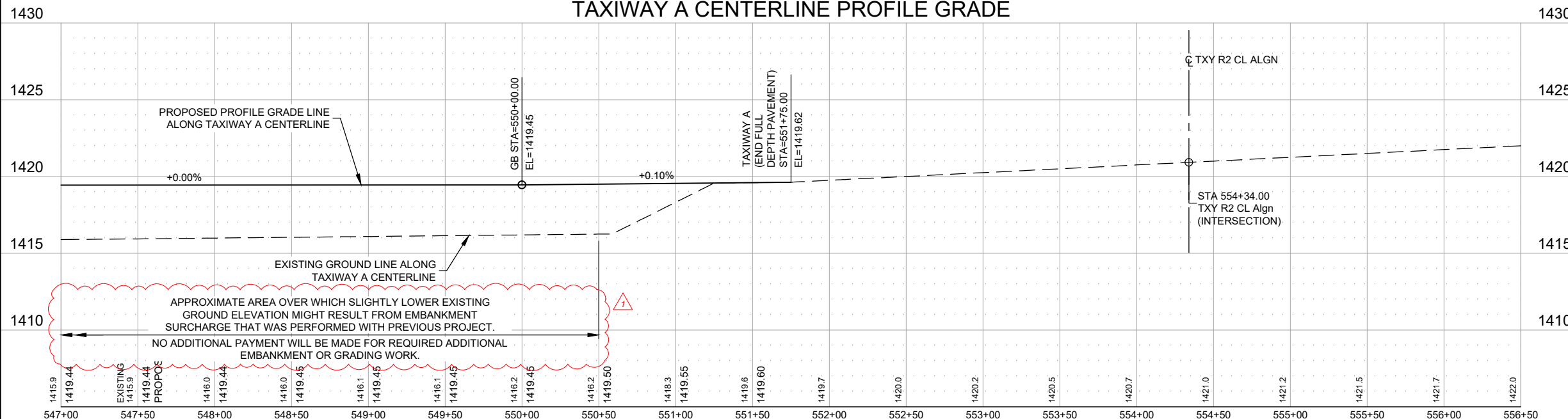
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- NOTES:**
- SEE SHEET C2.03 FOR FINISHED GRADE POINTS TABLE.

- GEOMETRIC CONTROL NOTES:**
- COORDINATES SHOWN ARE BASED ON THE ST. LOUIS COUNTY SOUTH COORDINATE SYSTEM. PACS/SACS CONTROL INFORMATION AT THE AIRPORT WILL BE PROVIDED TO THE CONTRACTOR TO SET PROJECT CONTROL SHOWN ON SHEET C0.30.
  - CONTRACTOR SHALL FIELD VERIFY ALL ELEVATIONS FOR TIE IN OF PROPOSED PAVEMENT TO EXISTING PAVEMENT.

**TAXIWAY A CENTERLINE PROFILE GRADE**



**LEGEND**

— RSA —	RUNWAY SAFETY AREA
— TSA —	TAXIWAY SAFETY AREA
- - -	PROPOSED GRADING LIMIT
- - -	PROPOSED CONSTRUCTION LIMIT
— P-BUR —	EXISTING BURIED POWER
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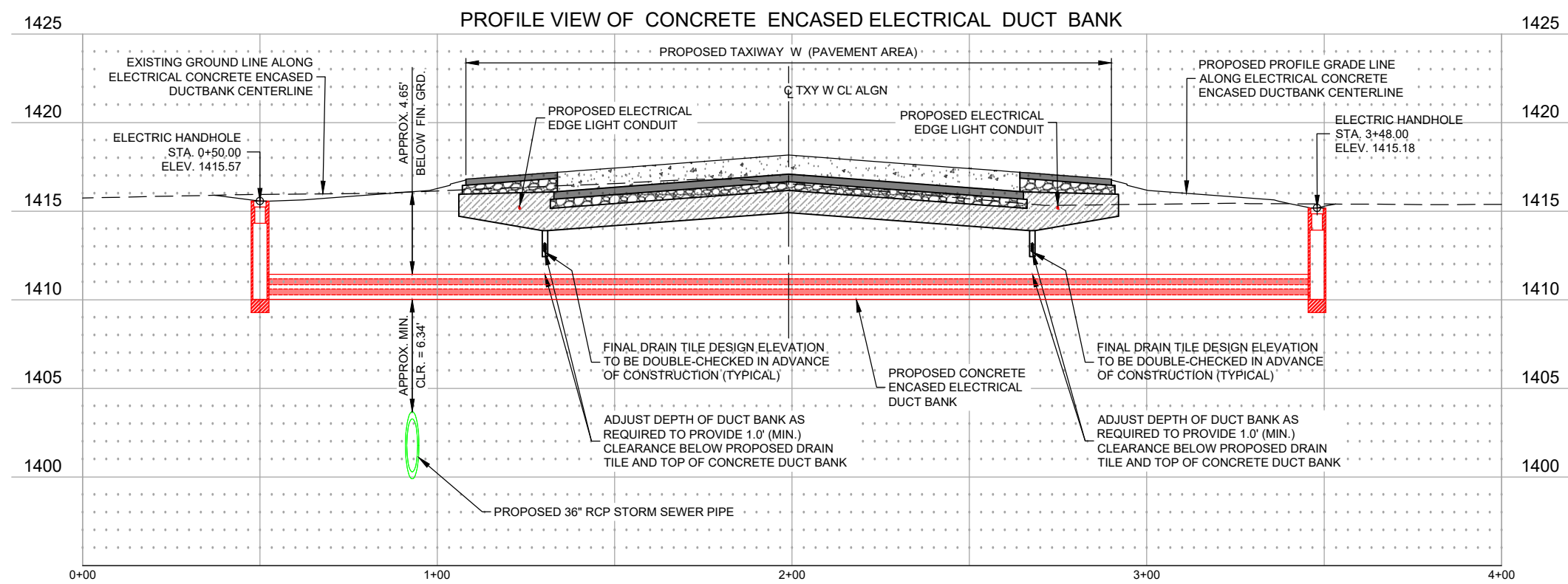
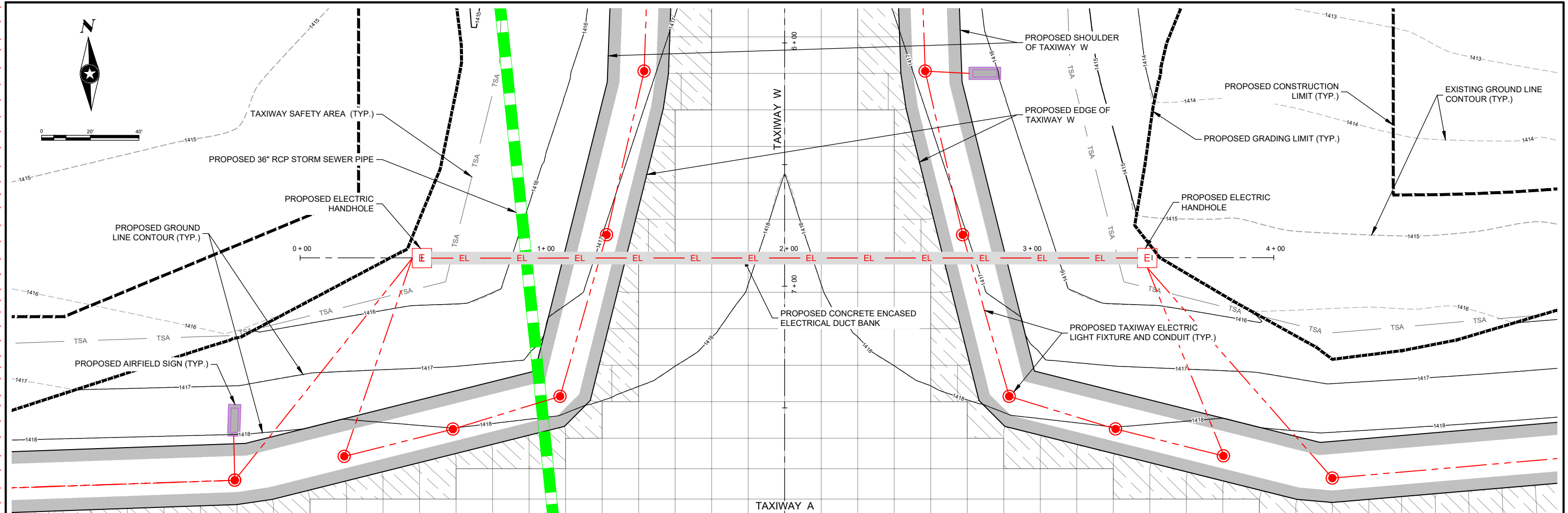
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MN.

**SEH**

JARROD R NELSON, PE  
DATE: 05-29-25 LICENSE NO. 26794

*Jarrod R Nelson*

**TAXIWAY A RECONSTRUCTION - PHASE 6**  
DULUTH, MINNESOTA



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TAXIWAY A RECONSTRUCTION -  
 PHASE 6  
 DULUTH, MINNESOTA

STORM SEWER - ELECTRICAL DUCT BANK PLAN  
 AND PROFILE

C5.05

**STORM SEWER - STRUCTURE SCHEDULE**

Name	Reference Alignment	Structure Station	Inner Structure Diameter [ft.]	Structure Offset [ft.]	Structure Northing [ft.]	Structure Easting [ft.]	Insertion Rim Elevation [ft.]	Sump Elevation [ft.]	Rim To Sump Height [ft.]	Invert Elevation 1 (Pipe In)	Invert Elevation 2 (Pipe In)	Invert Elevation 3 (Pipe In)	Invert Elevation 1 (Pipe Out)
CB-1	TXY A CL Algn	541+58.44	8	-341.51	169683.19	561160.26	1407.11	1398.79	8.32	1398.84	1404.38		1398.79
CB-2	TXY A CL Algn	538+27.30	8	-356.11	169673.28	560931.39	1407.92	1399.21	8.71	1399.26	1404.26		1399.21
CB-3	TXY A CL Algn	534+71.34	8	-327.51	169657.67	560574.63	1414.60	1399.35	15.25	1403.76	1399.88	1407.76	1399.83
CB-4	TXY A CL Algn	531+39.81	6	-388.08	169730.28	560245.53	1412.20	1405.45	6.75	1405.55			1405.45
CB-5	TXY A CL Algn	530+64.81	5	-388.08	169733.02	560170.58	1411.80	1406.30	5.50	1408.40	1408.00		1406.30
MH-06	TXY A CL Algn	535+18.07	7	122.16	169206.60	560604.94	1414.80	1400.92	13.88	1406.92			1400.92

**STORM SEWER - PIPE SCHEDULE**

Name	Description	Start Structure	End Structure	Pipe Slope (%)	Start Invert Elevation [ft.]	End Invert Elevation [ft.]	3D Length Center to Center [ft.]	Pipe Pay Length [ft]
Pipe - 1	48" RCP Class III	CB-1		-0.16	1398.79	1398.17	388.15	392
Pipe - 2	48" RCP Class III	CB-2	CB-1	-0.16	1399.21	1398.84	229.08	232
Pipe - 3	48" RCP Class III	CB-3	CB-2	-0.16	1399.83	1399.26	357.11	360
Pipe - 4	30" RCP Class III	CB-4	CB-3	-0.50	1405.45	1403.76	337.02	344
Pipe - 5	24" RCP Class III	CB-5	CB-4	-1.00	1406.3	1405.55	75.00	80
Pipe - 6	36" RCP Class III	MH-06	CB-3	-0.23	1400.92	1399.88	452.09	456

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SEH Project DLH 179719  
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**TAXIWAY A RECONSTRUCTION -  
 PHASE 6**  
 DULUTH, MINNESOTA

**STORM SEWER SCHEDULE**

C5.06

**DRAIN TILE STRUCTURE - SCHEDULE**

Name	Reference Alignment	Structure Station	Description	Structure Offset [ft.]	Structure Northing [ft.]	Structure Easting [ft.]	Insertion Rim Elevation [ft.]	Sump Elevation [ft.]	Rim To Sump Height [ft.]	Invert Elevation 1 (Pipe In)	Invert Elevation 2 (Pipe In)	Invert Elevation 3 (Pipe In)	Invert Elevation 1 (Pipe Out)	Invert Elevation 2 (Pipe Out)	Casting
PIT (1)	TXY W CL Algn	0+89.93	27 - 4020 MH	-83.63	170069.87	560798.09	1417.62	1412.62	5.00				1412.62		R-3492 (Solid)
PIT (2)	TXY W CL Algn	2+22.98	27 - 4020 MH	-51.33	169938.08	560760.96	1416.42	1411.28	5.14	1411.28			1411.28		R-3492 (Solid)
PIT (3)	TXY W CL Algn	4+18.75	27 - 4020 MH	-44.43	169742.69	560746.93	1416.17	1410.30	5.88	1410.30	1410.30		1410.30		R-3492 (Solid)
PIT (4)	TXY W CL Algn	6+19.26	27 - 4020 MH	-52.28	169542.03	560747.47	1417.04	1411.44	5.60	1411.44			1411.44		R-3492 (Solid)
PIT (5)	TXY W CL Algn	7+49.84	27 - 4020 MH	-87.66	169410.24	560778.07	1417.97	1412.53	5.44	1412.53			1412.53		R-3492 (Solid)
PIT (6)	TXY A CL Algn	538+14.04	27 - 4020 MH	-52.72	169370.58	560907.09	1418.63	1413.62	5.01				1413.62	1413.62	R-3492 (Solid)
PIT (7)	TXY A CL Algn	541+25.28	27 - 4020 MH	-41.00	169384.28	561204.38	1418.81	1413.02	5.79	1413.02			1413.02		R-3492 (Solid)
PIT (8)	TXY A CL Algn	545+72.01	27 - 4020 MH	-41.05	169496.51	561636.14	1418.82	1412.11	6.72	1412.11	1412.11	1412.11	1412.11		R-3492 (Solid)
PIT (9)	TXY A CL Algn	549+78.86	27 - 4020 MH	-41.00	169598.87	562029.91	1418.83	1412.92	5.91	1412.92			1412.92		R-3492 (Solid)
PIT (10)	TXY W CL Algn	0+89.93	27 - 4020 MH	83.62	170075.95	560630.94	1417.66	1412.66	5.00				1412.66		R-3492 (Solid)
PIT (11)	TXY W CL Algn	2+22.88	27 - 4020 MH	51.33	169941.92	560658.37	1416.42	1411.43	4.98	1411.43			1411.43		R-3492 (Solid)
PIT (12)	TXY W CL Algn	4+18.75	27 - 4020 MH	44.43	169745.93	560658.13	1416.17	1410.80	5.37	1410.80	1410.80		1410.80		R-3492 (Solid)
PIT (13)	TXY W CL Algn	6+19.26	27 - 4020 MH	52.28	169545.84	560642.98	1417.04	1412.05	4.99	1412.05			1412.05		R-3492 (Solid)
PIT (14)	TXY W CL Algn	7+49.84	27 - 4020 MH	87.66	169416.63	560602.87	1417.96	1412.96	5.00	1412.96			1412.96		R-3492 (Solid)
PIT (15)	TXY A CL Algn	533+77.76	27 - 4020 MH	-52.28	169386.03	560471.08	1418.62	1413.64	4.99				1413.64	1413.64	R-3492 (Solid)
PIT (16)	TXY A CL Algn	530+74.88	27 - 4020 MH	-40.85	169385.65	560167.99	1418.79	1413.02	5.77	1413.02			1413.02		R-3492 (Solid)
PIT (17)	TXY A CL Algn	530+75.00	27 - 4020 MH	41.00	169303.84	560165.13	1418.78	1413.68	5.11				1413.76		R-3492 (Solid)
PIT (18)	TXY A CL Algn	532+81.00	27 - 4020 MH	41.00	169296.34	560370.99	1418.79	1412.90	5.89	1413.35			1413.35		R-3492 (Solid)
PIT (19)	TXY A CL Algn	533+27.50	27 - 4020 MH	103.50	169232.19	560415.18	1417.36	1412.00	5.36	1412.36			1412.36		R-3492 (Solid)
PIT (20)	TXY A CL Algn	533+84.50	27 - 4020 MH	103.46	169230.15	560472.15	1417.39	1412.25	5.14	1412.25	1412.25		1412.25		R-3492 (Solid)
PIT (21)	TXY A CL Algn	534+31.00	27 - 4020 MH	41.00	169290.87	560520.89	1418.79	1413.11	5.68	1413.11			1413.11		R-3492 (Solid)
PIT (22)	TXY A CL Algn	535+74.53	27 - 4020 MH	40.84	169285.80	560664.33	1418.80	1413.35	5.45	1413.43			1413.43		R-3492 (Solid)
PIT (23)	TXY A CL Algn	538+74.00	27 - 4020 MH	41.08	169274.93	560964.61	1418.80	1414.09	4.71				1414.09	1414.09	R-3492 (Solid)
PIT (24)	TXY A CL Algn	541+40.38	27 - 4020 MH	41.00	169308.46	561239.07	1418.81	1413.42	5.40	1413.42			1413.42		R-3492 (Solid)
PIT (25)	TXY A CL Algn	544+13.07	27 - 4020 MH	41.00	169377.09	561502.97	1418.82	1412.87	5.95	1412.87			1412.87		R-3492 (Solid)
PIT (26)	TXY A CL Algn	545+72.00	27 - 4020 MH	41.00	169417.10	561656.79	1418.82	1412.55	6.27	1412.55	1412.55		1412.55		R-3492 (Solid)
PIT (27)	TXY A CL Algn	545+80.33	27 - 4020 MH	133.08	169330.08	561688.03	1418.53	1413.45	5.09	1413.53			1413.53		R-3492 (Solid)
PIT (28)	TXY A CL Algn	546+33.66	27 - 4020 MH	147.32	169329.72	561743.22	1418.48	1413.60	4.89	1413.68			1413.68		R-3492 (Solid)
PIT (29)	TXY A CL Algn	546+47.00	27 - 4020 MH	41.00	169435.98	561729.37	1418.83	1414.08	4.75				1414.08	1414.42	R-3492 (Solid)
PIT (30)	TXY A CL Algn	549+06.88	27 - 4020 MH	41.00	169501.39	561980.88	1418.83	1413.81	5.02	1413.97			1413.97		R-3492 (Solid)



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SEH Project DLH 179719  
 Drawn By LZ  
 Designed By JN  
 Checked By AVE

Rev.#	Plan Revision Issue	Date	Rev.#	Sheet Revision Issue	Date
1	ADDENDUM 1	06-02-2025	#	#	#
#	#	#	#	#	#
#	#	#	#	#	#

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MN.



JARROD R NELSON, PE  
 DATE: 05-13-25 LICENSE NO. 26794

**TAXIWAY A RECONSTRUCTION -  
 PHASE 6**  
 DULUTH, MINNESOTA

**DRAIN TILE SCHEDULE**

C6.05

Save: 6/2/2025 3:52 PM azhuo Plot: 6/2/2025 3:54 PM X:\AE\DL\179719\5-final-dsgn\5-1-drawings\65-Aviation\Plans\DLH-179719\_DT\_SCHED.dwg

DRAIN TILE PIPE - SCHEDULE								
Name	Description	Start Structure	End Structure	Pipe Slope (Hold Start) [%]	Start Invert Elevation [ft.]	End Invert Elevation [ft.]	3D Length Center to Center [ft.]	Pipe Pay Length [ft.]
Pipe - (1)	6" HDPE	PIT (1)	PIT (2)	-0.98	1412.62	1411.28	136.93	144
Pipe - (2)	6" HDPE	PIT (2)	PIT (3)	-0.50	1411.28	1410.30	195.89	200
Pipe - (3)	6" HDPE	PIT (3)		-3.06	1410.30	1404.26	197.18	200
Pipe - (4)	6" HDPE	PIT (4)	PIT (3)	-0.57	1411.44	1410.30	200.67	208
Pipe - (5)	6" HDPE	PIT (5)	PIT (4)	-0.81	1412.53	1411.44	135.30	136
Pipe - (6)	6" HDPE	PIT (6)	PIT (5)	-0.81	1413.62	1412.53	134.98	136
Pipe - (7)	6" HDPE	PIT (6)	PIT (7)	-0.20	1413.62	1413.02	297.61	304
Pipe - (8)	6" HDPE	PIT (7)	PIT (8)	-0.21	1413.02	1412.11	446.11	448
Pipe - (9)	6" HDPE	PIT (8)		-4.04	1412.11	1403.17	221.54	224
Pipe - (10)	6" HDPE	PIT (9)	PIT (8)	-0.20	1412.92	1412.11	406.85	408
Pipe - (11)	6" HDPE		PIT (9)	-0.44	1413.84	1412.92	207.72	208
Pipe - (12)	6" HDPE	PIT (10)	PIT (11)	-0.90	1412.66	1411.43	136.82	144
Pipe - (13)	6" HDPE	PIT (11)	PIT (12)	-0.32	1411.43	1410.80	195.99	200
Pipe - (14)	6" HDPE	PIT (12)		-2.51	1410.80	1407.76	121.54	128
Pipe - (15)	6" HDPE	PIT (13)	PIT (12)	-0.62	1412.05	1410.80	200.67	208
Pipe - (16)	6" HDPE	PIT (14)	PIT (13)	-0.67	1412.96	1412.05	135.29	136
Pipe - (17)	6" HDPE	PIT (15)	PIT (14)	-0.50	1413.64	1412.96	135.29	136
Pipe - (18)	6" HDPE	PIT (15)	PIT (16)	-0.20	1413.64	1413.02	303.10	304
Pipe - (19)	6" HDPE	PIT (16)		-1.45	1413.02	1408.00	347.42	352
Pipe - (20)	4" HDPE		CB (5)	0.00	1408.40	1408.40	20.00	24
Pipe - (21)	6" HDPE	PIT (17)	PIT (18)	-0.20	1413.76	1413.35	206.00	208
Pipe - (22)	6" HDPE	PIT (18)		-1.05	1413.35	1412.58	73.05	80
Pipe - (23)	6" HDPE		PIT (19)	-1.40	1412.58	1412.36	16.00	24
Pipe - (24)	6" HDPE	PIT (19)	PIT (20)	-0.20	1412.36	1412.25	57.00	64
Pipe - (25)	6" HDPE	PIT (20)		-5.43	1412.25	1404.92	135.14	136
Pipe - (26)	6" HDPE		PIT (20)	-1.20	1412.44	1412.25	15.96	16
Pipe - (27)	6" HDPE	PIT (21)		-0.91	1413.11	1412.44	73.73	80
Pipe - (28)	6" HDPE	PIT (22)	PIT (21)	-0.22	1413.43	1413.11	143.53	144
Pipe - (29)	6" HDPE	PIT (23)	PIT (22)	-0.22	1414.09	1413.43	300.47	304
Pipe - (30)	6" HDPE	PIT (23)	PIT (24)	-0.24	1414.09	1413.42	277.31	280
Pipe - (31)	6" HDPE	PIT (24)	PIT (25)	-0.20	1413.42	1412.87	272.69	280
Pipe - (32)	6" HDPE	PIT (25)	PIT (26)	-0.20	1412.87	1412.55	158.93	160
Pipe - (33)	6" HDPE		PIT (26)	-0.75	1412.80	1412.55	33.77	40
Pipe - (34)	6" HDPE			-1.01	1413.31	1412.80	50.77	56
Pipe - (35)	6" HDPE	PIT (27)		-0.86	1413.53	1413.31	25.22	32
Pipe - (36)	6" HDPE	PIT (28)	PIT (27)	-0.27	1413.68	1413.53	55.19	56
Pipe - (37)	6" HDPE		PIT (28)	-0.36	1413.75	1413.68	19.39	24
Pipe - (38)	6" HDPE			-0.30	1413.95	1413.75	67.96	72
Pipe - (39)	6" HDPE	PIT (29)		-0.37	1414.08	1413.95	33.77	40
Pipe - (40)	6" HDPE	PIT (29)	PIT (30)	-0.17	1414.42	1413.97	259.88	264
Pipe - (41)	6" HDPE	PIT (30)		-0.17	1413.97	1413.53	261.67	264
Pipe - (42)	6" HDPE	PIT (26)	PIT (8)	-0.54	1412.55	1412.11	82.06	88
Pipe - (43)	4" HDPE		CB (1)	0.00	1404.38	1404.38	20.00	24



SEH Project DLH 179719  
 Drawn By XX  
 Designed By JN  
 Checked By AVE

Rev.#	Plan Revision Issue Description	Date
1	ADDENDUM 1	06-02-2025

Rev.#	Sheet Revision Issue Description	Date
#	#	#
#	#	#
#	#	#



I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MN.  
 JARROD R NELSON, PE  
 DATE 05-13-25 LICENSE NO. 26794

*Jarrod R Nelson*

TAXIWAY A RECONSTRUCTION -  
 PHASE 6  
 DULUTH, MINNESOTA

DRAIN TILE SCHEDULE

C6.06

DRAIN TILE STRUCTURE - SCHEDULE (ALT)														
Name	Reference Alignment	Structure Station	Description	Structure Offset [ft.]	Structure Northing [ft.]	Structure Easting [ft.]	Insertion Rim Elevation [ft.]	Sump Elevation [ft.]	Rim To Sump Height [ft.]	Invert Elevation 1 (Pipe In)	Invert Elevation 2 (Pipe In)	Invert Elevation 1 (Pipe Out)	Invert Elevation 2 (Pipe Out)	Casting
PIT (31)	TXY A CL Algn	528+59.12	27 - 4020 MH	-41.00	169393.65	559952.38	1419.00	1413.76	5.24	1413.76		1413.76		R-3492 (Solid)
PIT (32)	TXY A CL Algn	526+35.96	27 - 4020 MH	-41.00	169418.03	559737.83	1419.85	1414.54	5.31			1414.54	1414.54	R-3492 (Solid)
PIT (33)	TXY A CL Algn	522+50.00	27 - 4020 MH	-41.00	169501.34	559361.50	1418.92	1413.95	4.97	1413.95		1413.95		R-3492 (Solid)
PIT (34)	TXY A CL Algn	522+49.70	27 - 4020 MH	40.85	169421.50	559343.49	1418.78	1413.81	4.97	1413.81	1413.81	1413.81		R-3492 (Solid)
PIT (35)	TXY A CL Algn	526+16.42	27 - 4020 MH	41.41	169341.60	559701.41	1419.95	1414.54	5.42			1414.54	1414.54	R-3492 (Solid)
PIT (36)	TXY A CL Algn	528+38.94	27 - 4020 MH	41.00	169312.44	559929.22	1419.02	1413.90	5.12	1413.90		1413.90		R-3492 (Solid)



DRAIN TILE PIPE - SCHEDULE (ALT)								
Name	Description	Start Structure	End Structure	Pipe Slope (Hold Start) [%]	Start Invert Elevation [ft.]	End Invert Elevation [ft.]	3D Length Center to Center [ft.]	Pipe Pay Length [ft.]
Pipe - (44)	6" HDPE	PIT (31)		-0.34	1413.76	1413.02	215.76	216
Pipe - (45)	6" HDPE	PIT (32)	PIT (31)	-0.36	1414.54	1413.76	216.33	224
Pipe - (46)	6" HDPE	PIT (32)	PIT (33)	-0.15	1414.54	1413.95	385.45	392
Pipe - (47)	6" HDPE	PIT (33)	PIT (34)	-0.17	1413.95	1413.81	81.85	88
Pipe - (48)	6" HDPE	PIT (34)		-6.59	1413.81	1407.00	103.54	104
Pipe - (49)	6" HDPE	PIT (35)	PIT (34)	-0.20	1414.54	1413.81	366.73	368
Pipe - (50)	6" HDPE	PIT (35)	PIT (36)	-0.28	1414.54	1413.90	230.00	232
Pipe - (51)	6" HDPE	PIT (36)		-0.27	1413.90	1413.26	236.06	240



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SEH Project DLH 179719  
 Drawn By XX  
 Designed By JN  
 Checked By AVE

Rev.# # #  
 Plan Revision Issue Description  
 ADDENDUM 1  
 Date 06-02-2025

Rev.# # #  
 Sheet Revision Issue Description  
 Date # # #



I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MN.  
 Jarrod R. Nelson  
 JARROD R. NELSON, PE  
 DATE 05-13-25 LICENSE NO. 26794

TAXIWAY A RECONSTRUCTION -  
 PHASE 6  
 DULUTH, MINNESOTA

DRAIN TILE SCHEDULE (ALT BID)

C6.07