



ADDENDUM

Public Building Commission of Chicago | Richard J. Daley Center | 50 West Washington Street, Room 200 | Chicago, Illinois 60602 | (312) 744-3090 | pbcchicago.com

ADDENDUM NO.: 03
PROJECT NAME: Emergency Medical Services (EMS) Addition
PROJECT NO.: 07215
CONTRACT NO.: C1611
DATE OF ISSUE: July 26, 2024

NOTICE OF CHANGES, MODIFICATIONS, OR CLARIFICATIONS TO CONTRACT DOCUMENTS

The following changes, modifications, or clarifications are hereby incorporated and made an integral part of the Contract Documents. Unless clearly expressed otherwise by this Addendum, all terms and conditions defined in the original Contract Documents shall continue in full force and effect and shall have the same meaning in this Addendum. Issued Addenda represent responses/clarifications to various inquiries. Contractors shall be responsible for including all associated labor/material costs in its bid. Drawings/specifications corresponding to inquiry responses will be issued with the Issue for Construction Documents, upon issuance of building permit.

ITEM NO. 1: CHANGE TO KEY DATES
None.

ITEM NO. 2: REVISIONS TO BOOK 1 – PBC INSTRUCTIONS TO BIDDERS
None.

ITEM NO. 3: REVISIONS TO BOOK 2 – PBC STANDARD TERMS AND CONDITIONS
None.

ITEM NO. 4: REVISIONS TO BOOK 3 – TECHNICAL SPECIFICATIONS

- Change 1 Book 3 – Volume 1 – REVISED** – Specification Section 00 01 02 Table of Contents, updated dates for sections included in this addendum.
- Change 2 Book 3 – Volume 1 – REVISED** – Specification Section 01 60 00 – Product Requirements: Added line 1.6A3.
- Change 3 Book 3 Volume 1 – REVISED** – Specification Section 03 30 00 – Cast-In-Place Concrete: Deleted 1.5A6 Color Pigments; Removed 1.5A11a.
- Change 4 Book 3 Volume 1 – REVISED** – Specification Section 06 41 16 – Plastic Laminate Clad Architectural Cabinets: Deleted 1.3C5 AWI Quality Certification Program Labels to Shop Drawings; Deleted 1.5A Closeout Submittals; Added 1.6B Preferred Manufacturer's Qualifications; Added 2.1B1 Preferred Quality Standard.
- Change 5 Book 3 – Volume 1 – REVISED** – Specification Section 07 54 23 – Thermoplastic-Polyolefin (TPO) Roofing: Added lines 1.13A3, 1.13B2, and 1.13C2.
- Change 6 Book 3 – Volume 1 – REVISED** – Specification Section 12 50 00 – Furniture Package: SG3.1 Added to specification.
- Change 7 Book 3 – Volume 2 – REVISED** Specification Section 23 09 00 – Controls and Instrumentation: Updated to include language from the City of Chicago Department of Procurement Global Management System Technical Specifications.
- Change 8 Book 3 – Volume 2 – REVISED** Specification Section 28 55 00 – Entrance Security Intercom: Added card reader to video intercom stations and removed previous project language.

ITEM NO. 5: REVISIONS TO DRAWINGS

- Change 1 REVISED** Drawing No. G001– Updated index to reflect new drawings.
- Change 2 REVISED** Drawing No. G003 - Sign type S-7 renamed to S-7A. Level name and number in sign type S-7 made generic as this is going to be used for several floors. Sign type S-7B created.

- Change 3** **REVISED** Drawing No. G107 - Gate diagram updated to reflect the changes as shown in the civil, landscape, telecom and electrical drawings.
- Change 4** **REVISED** Drawing No. G200 – Area of work modified on plan to surround entire project scope area. “Current Phase” renamed to “Building Addition (Current Phase of Work)”. Additional modifications to drawing notes per Owner request.
- Change 5** **REVISED** Drawing No. G201 – “Current Phase” renamed to “Building Addition (Current Phase of Work)”. Additional modifications to drawing notes per Owner request.
- Change 6** **ADDED** Drawing No. G202 – Added additional Site Phasing and Logistics Plan to show new gate at Chicago Avenue
- Change 7** **REVISED** Drawing Nos. C100 & C102 – Revised clear & grub/excavation limits and curb & gutter removal per C200.
- Change 8** **REVISED** Drawing Nos. C200 & C202 – Revised landscape restoration limits for conduit and grading, added concrete sidewalk pad at pedestrian gate & CA-6 stone paths per Landscape, reconfigured part of existing gravel path, and replaced curb & gutter as necessary for these changes.
- Change 9** **REVISED** Drawing Nos. C300 & C302 – Revised grading for CA-6 stone paths and gravel path.
- Change 10** **REVISED** Drawing Nos. C500 & C503 – Updated silt fence limits to include all landscape work/restoration per C202.
- Change 11** **REVISED** Drawing No. L301 - Included new signage examples for display. Revised the security/egress gates. Removed and repositioned fencing. Replaced vehicle sensor loops with laser vehicle sensors. Updated notes. Revised the restoration layout.
- Change 12** **REVISED** Drawing No. L302 - Removed non-relevant information from Pedestrian Gate Checklist (Detail 2). Added Details 3, 4, and 5.
- Change 13** **REVISED** Drawing No. L303 - Added note #7 on Detail 1.
- Change 14** **REVISED** Drawing No. L304 - Revised language in details 1 and 2.
- Change 15** **REVISED** Drawing No. S105 – Revised the retaining wall partial plan and added clarifying notes.
- Change 16** **REVISED** Drawing No. S404 – Revised the retaining wall detail for final design.
- Change 17** **REVISED** Drawing Nos. A161, A162 & A163 – Sign type S-7 changed to sign type S-7A near elevator. Note M added "Refer to Sheet G003 for Signage Types".
- Change 18** **REVISED** Drawing Nos. A164 & A165 – Existing building wayfinding signage modifications added to plan and tagged.
- Change 19** **REVISED** Drawing No. A800 – Updated schedule per RFI Question 5 to show CT-1 on wet wall only in restrooms. All other walls to receive FRP-3 up to 4' for all multi-user restrooms.
- Change 20** **REVISED** Drawing No. A801 – Added wall finish tags in rooms 268A and 268B.
- Change 21** **REVISED** Drawing Nos. A901, A902 and A903 – SG3.1 Added to all training rooms and schedule.
- Change 22** **REVISED** Drawing No. E002 - Updated to add general and keynote note for power and telecom connections to new gate.
- Change 23** **REVISED** Drawing No. E606 – Added Detail for Demolition of Gate Wiring and New Gate Wiring Detail shown in the lighting control schedule sheet.

ITEM NO. 6: REQUESTS FOR INFORMATION

RFI-1.

Question: Please confirm that the furniture described in 12 50 00 and shown on A901, A902 and A903 is to be furnished and installed by the Contractor.

Response: Confirmed - all furniture is to be furnished and installed by the Contractor.

RFI-2.

Question: The finish schedule indicates CT 1 Wall tile on all 4 walls at the toilet rooms. Sheet A401 wall tile details show wall tile on 1 wall. Additionally, A401 shows the restroom as typical. Please verify the wall tile elevations and indicate if this is typical of all 11 toilet rooms.

Response: The finish schedule on Sheet A800 has been updated and is included in this Addendum 3. CT-1 is on the wet wall only in all multi-user restrooms as per Sheet A401. All other walls in the multi-user restrooms to be FRP-3 at 4'-0". For single user restrooms refer to Sheet A402 and the updated Sheet A800 included in this Addendum No. 3.

RFI-3.

Question: The Division 06 41 16 specifications for Plastic Laminate-Clad Architectural Cabinets currently state the manufacturers need to be part of the AWI “Quality Certification Program” (QCP). There are a few interested contractors who do not meet the “QCP” certification requirement. Please advise whether a waiver request can be issued to absolve the QCP certification.

Response: QCP certification is not required, but preferred. Refer to Revised Specification Section 06 41 16.

RFI-4.

Question: Spec. section 27 15 13 – Copper Horizontal cabling. Basis of design shall be: Systimax. We are interested in bidding this project but are not systimax certified. Would Berk-Tech or Panduit be approved alternatives for the horizontal cabling and connectivity?

Response: The City of Chicago Standards require the cabling system to be Systimax.

RFI-5.

Question: Can a Panduit equivalent be used for the structured cabling?

Response: The City of Chicago Standards require the cabling system to be Systimax.

RFI-6.

Question: Is there a preferred Security Contractor?

Response: Access control / security systems are to be manufactured by Genetec, as per the Contract Documents.

RFI-7.

Question: Can Directional Boring be used for the secondary under the concrete slab?

Response: Directional boring for any secondary electrical work shall not permitted.

RFI-8.

Question: Does everything under a parking lot need to be concrete encased?

Response: Underground conduits shall be encased in concrete as per the Contract Documents. Refer to Sheet E002.

RFI-9.

Question: Reference Specification 03 30 00 Part 1.5.A.11.a. Specification references color pigment. However, drawings do not indicate any colored concrete. Please clarify locations where color, and what color, is required.

Response: Colored concrete is not required. Please refer to revised Specification 03 30 00 included in this Addendum No. 3.

RFI-10.

Question: Reference Specification 03 30 00 Part 2.9. Specification references waterstops. However, drawings do not indicate any waterstops. Please clarify locations where waterstops are required.

Response: Waterstops are required in the elevator pit as per the Contract Documents. Refer to details shown on Sheet S005.

RFI-11.

Question: Reference Specification 03 30 00 Part 2.11.A. Specification references Slip- Resistive Emery Aggregate finish. However, drawings do not indicate where this finish is required. Please provide locations where Slip- Resistive Emery aggregate finish is required.

Response: Slip resistive aggregate finish is not required. Please refer to revised Specification 03 30 00 included in this Addendum No. 3.

RFI-12.

Question: Reference Specification 03 30 00 Part 2.11.B. Specification references penetrating liquid floor treatment. However, drawings do not indicate where this treatment is required. Please provide locations where penetrating liquid floor treatment is required.

Response: Penetrating liquid floor treatment is required for SC-1 floor finish, as per the Contract Documents. Refer to Interior Finishes Plans in A800 series drawings for locations of SC-1 floor finish.

This Addendum No. 3 and all attachments below can be found at the following Link:

[PBC Emergency Medical Services \(EMS\) Addition C1611](#) by clicking on: Addendum No. 3

This Addendum includes the following attached Specifications and/or Documents:

1. Specification Section 00 01 02 – Table of Contents
2. Specification Section 01 60 00 – Product Requirements
3. Specification Section 03 30 00 – Cast-In-Place Concrete
4. Specification Section 06 41 16 – Plastic Laminate Clad Architectural Cabinets
5. Specification Section 07 54 23 – Thermoplastic-Polyolefin (TPO) Roofing
6. Specification Section 12 50 00 – Furniture Package
7. Specification Section 23 09 00 – Controls and Instrumentation
8. Specification Section 28 55 00 – Entrance Security Intercom

This Addendum includes the following attached Drawings:

1. G001 – ABBREVIATIONS, LEGENDS, & SHEET INDEX, dated 07/25/2024
2. G003 – SIGNAGE DETAILS, dated 07/25/2024
3. G107 – SLIDING GATE PLAN AND NARRATIVE, dated 07/25/2024
4. G200 – SITE PHASING AND LOGISTICS PLAN, dated 07/25/2024
5. G201 – LOGISTICS BUILDING PLAN, dated 07/25/2024
6. G202 – SITE PHASING AND LOGISTICS PLAN GATE, dated 07/25/2024
7. C100 – OVERALL DEMOLITION PLAN, dated 7/25/2024
8. C102 – DEMOLITION PLAN, dated 7/25/2024
9. C200 – OVERALL SITE PLAN, dated 7/25/2024
10. C202 – SITE PLAN, dated 7/25/2024
11. C300 – OVERALL GRADING PLAN, dated 7/25/2024
12. C302 – GRADING PLAN, dated 7/25/2024
13. C500 – OVERALL SOIL EROSION AND SEDIMENT CONTROL PLAN, dated 7/25/2024
14. C503 – SOIL EROSION AND SEDIMENT CONTROL PLAN, dated 7/25/2024
15. L301 – SLIDING GATE PLAN, dated 07/25/2024
16. L302 – SLIDING GATE REQUIREMENTS, dated 07/25/2024
17. L303 – SLIDING GATE DETAILS, dated 07/25/2024
18. L304 – PEDESTRIAN GATE DETAILS, dated 07/25/2024
19. S105 – PARTIAL PLANS, dated 07/25/2024
20. S404 – SECTIONS & DETAILS, dated 07/25/2024
21. A161 – SECOND FLOOR – SIGNAGE PLAN, dated 07/25/2024
22. A162 – THIRD FLOOR – SIGNAGE PLAN, dated 07/25/2024
23. A163 – FOURTH FLOOR – SIGNAGE PLAN, dated 07/25/2024
24. A164 – OVERALL SECOND FLOOR – SIGNAGE PLAN, dated 07/25/2024
25. A165 – OVERALL THIRD FLOOR – SIGNAGE PLAN, dated 07/25/2024
26. A800 – FINISH AND TOILET ACCESSORY SCHEDULES, dated 07/25/2024
27. A801 – SECOND FLOOR – INTERIOR FINISHES PLAN, dated 07/25/2024
28. A901 – SECOND FLOOR – EQUIPMENT AND FURNITURE PLAN, dated 07/25/2024
29. A902 – THIRD FLOOR – EQUIPMENT AND FURNITURE PLAN, dated 07/25/2024
30. A903 – FOURTH FLOOR – EQUIPMENT AND FURNITURE PLAN, dated 07/25/2024
31. E002 – CAMPUS SITE PLAN, dated 07/25/2024
32. E606 – LIGHTING CONTROL SCHEDULE, dated 07/25/2024

END OF ADDENDUM NO. 03

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SECTION 01 60 00 - PRODUCT REQUIREMENTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 23 00 - ALTERNATES for products selected under an alternate.
 - 2. Section 01 25 00 - SUBSTITUTION PROCEDURES for requests for substitutions.
 - 3. Section 01 42 00 - REFERENCES for applicable industry standards for products specified.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 working days of receipt of request, or seven calendar days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00 - SUBMITTAL PROCEDURES.
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 - SUBMITTAL PROCEDURES. Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each Contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors and sub-contractors.
 2. If a dispute arises between contractors or sub-contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Client.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Client.
 3. **For Manufacturer's Warranty and Special Warranty, provide warranty inspections to determine existing warranty compliance at no additional cost to Owner.**
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - CLOSEOUT PROCEDURES.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Client reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. "Products" or "Manufacturers" paragraphs where Client allows naming of available products or manufacturers but does not limit selection to those named and does not consider unnamed products as substitutions, which may require a Change Order or Construction Change Directive.

B. Product Selection Procedures:

1. It shall be the responsibility of the Contractor to select and provide products that comply with the Buy American ACT and all quality and performance standards set forth on the Drawings and in the Project Manual.
2. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
4. Products:
 - a. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
5. Manufacturers:
 - a. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
6. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following

conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Client, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-ground.
 - 2. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, slag cement, and silica fume; subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- D. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings." Minutes of the meeting shall be recorded, typed, and printed out by the Contractor and distributed by the Contractor to all parties concerned within 5 days of the meeting.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.

- d. Concrete Subcontractor.
- e. Laboratory responsible for field quality control.
- f. Admixture manufacturer.
- g. Concrete pumping equipment operator.
- h. Owner's representative (attendance at Owner's option).
- i. AECOM representative (attendance at Owner's option)

2. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
- b. Construction joints, contraction joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31).
- o. Steel reinforcement installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

~~6. Color pigments.~~

7. Fiber reinforcement.
8. Vapor retarders.
9. Floor and slab treatments.
10. Liquid floor treatments.
11. Curing materials.

- ~~a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.~~

12. Joint fillers.
 13. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Slump limit.
 6. Air content.
 7. Nominal maximum aggregate size.
 8. Sieve analysis reports.
 9. Designation, type, quality, and source of fine and coarse aggregates.
 10. Synthetic fiber content.
 11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 12. Intended placement method.
 13. Include certification test indicating compliance with any specified chloride ion content limits.
 14. Include testing indicating compliance with any specified shrinkage limits.
 15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings: Comply with ACI SP-066:
1. Include placing drawings that detail fabrication, bending, and placement.
 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 3. Detailing and orientation of Shop Drawing Plans and Schedules shall be consistent with the Construction Drawings. The reviewer reserves the right to reject and order redrawn any Shop Drawings that could cause field placement problems due to crowding, illegibility, or lack of detailing. Complicated structures shall have each level of reinforcing detailed individually. All resubmitted Shop Drawings shall have changes clouded.
- D. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of the A/E.
- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS**A. Qualification Data: For the following:**

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates/Product Data: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Each type of steel reinforcement
5. Mechanical splice couplers
6. Form materials and release agents
7. Form ties
8. Waterstops
9. Curing compounds.
10. Floor and slab treatments.
11. Bonding agents.
12. Adhesives.
13. Vapor retarders.
14. Semirigid joint filler.
15. Joint-filler strips.
16. Repair materials.
17. Statement from supplier stating if aggregate is possibly alkali-reactive, based on tests and past service. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
18. Statement from supplier stating if aggregate can possibly cause pop-outs, "D" cracking or other disruptions due to moisture gain, freezing or other mechanisms based on tests and past service.

C. Material Test Reports of In-Place Construction: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.**E. Research Reports:**

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Vertical hoistway tolerances for plumbness and clearance within elevator shafts shall be coordinated with equipment manufacturer.
- I. Minutes of preinstallation conference.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete and incorporating permeability-reducing admixtures.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.
- C. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- D. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- E. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

- F. Mock-Ups: Cast concrete wall mockup of the 7-inch perimeter concrete wall at the base of the building to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Mock-up shall be 80 SF, and should contain a construction joint.
1. Notify A/E seven days in advance of dates and times when mock-ups will be constructed.
 2. Obtain A/E's approval of mock-ups before starting construction.
 3. If A/E determines that mock-ups do not meet requirements, demolish and remove them from the site and cast another until the mockup is approved.
 4. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove mock-ups when directed.
- G. References: Comply with the edition in effect per governing building code or the latest of the following, unless more stringent provisions are indicated. Maintain one copy of the publications in the Project field office at all times during concrete work. Contractor's supervisory personnel shall be familiar with the publications as they apply to this Project.
1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials and Commentary."
 3. ACI 311.7, "Specification for Inspection of Concrete Construction."
 4. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 5. ACI 306.1, "Standard Specification for Cold Weather Concreting."
 6. ACI 305.1, "Specification for Hot Weather Concreting."
 7. ACI 308.1, "Specification for Curing Concrete."
 8. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures and Commentary."
 9. SP-66, "ACI Detailing Manual."
 10. CRSI "Manual of Standard Practice."
 11. CRSI "Recommended Practice for Placing Reinforcing Bars."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94 and ACI301.
- B. Deliver, store, and handle steel reinforcement to prevent bending and damage.
- C. Waterstops shall be stored under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Cool ingredients before mixing to maintain concrete temperature at time of discharge to less than 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For concrete exposed to view when construction is complete, limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.3 FORM-FACING MATERIALS

- A. Provide form materials compatible with finish surface indicated and achieving the specified finish quality and tolerances.
- B. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified, and as follows:
 - a. Plywood, metal, or other approved panel materials.
- C. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.

2.4 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- C. Steel Bar Mats: ASTM A 184, assembled with clips.
 - 1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.
 - 2. Steel Reinforcement: ASTM A 706, deformed bars.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.5 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports. Stainless steel supports shall be used if concrete is to be rubbed or sand-blasted after form removal.
 - 2. Reinforcement chaired off earth such as in slabs on ground and footings shall utilize chairs that will not sink into the earth. Cast concrete cubes may be used, but clay brick chairs are not permitted.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

- C. Deformed Bar Anchors (DBA): Conforming to ASTM A496 with a minimum yield strength of 75,000 psi. All bar anchors shall be arc stud welded to steel members.
- D. Mechanical Reinforcing Splicing Systems: conforming with ACI 318, Type 1 and Type 2.
 - 1. Unless specified, provide Type 1 couplers with tension and compression capacity of 125% of the specified yield strength (F_y) for the bar intended.
 - 2. Where indicated, provide Type 2 couplers with tension and compression capacity equal to the specified tensile strength (f_u) for the bar intended.
 - 3. Provide standard transition couplers with tapered thread for creation of mechanical butt splice of two different diameter sections of reinforcing steel. Reinforcing bars will require special end-preparation to engage with the couplers. See manufacturer for details.
 - 4. Mechanical lock-couplers with coupler sleeve and interlocking bolts may not be used without special request and acceptance on a case-by-case basis, due to the over-size of the system.
- E. Mechanically Anchored Deformed Bars in Tension: conforming with ACI 318-19, Section 25.4.5.1.
- F. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.

2.6 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150, Type I
 - 2. Portland Cement: ASTM C 150, Type I/II.
 - 3. Fly Ash: ASTM C 618, Class C or F.
 - 4. Slag Cement: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33, Severe weathering region, Class 4S or 5S coarse aggregate, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches for drilled shafts and 1 inch nominal, typical.
 - 2. Coarse-Aggregate Type: Limestone.
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

4. For concrete exposed to view, provide coarse aggregate from sources that do not contain amounts of deleterious substances, as determined by the following limits:
 - a. Staining (**Test Method ASTM C641**)—An aggregate producing a stain index of 60 or higher shall be rejected when the deposited stain is found upon chemical analysis to contain an iron content, expressed as Fe_2O_3 equal to or greater than 1.5mg/200 g of sample.
 5. For concrete in slabs on ground: Total coarse and fine aggregate combined gradation shall result in between 8% to 18% retained on each sieve, except largest sieve shall have 1% to 4% retained and No. 100 sieve shall have 2% to 5% retained. Total of No. 100 and No. 200 sieves plus pan is to be 3% to 8%.
 6. Alkali Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
- D. Water: Potable and complying with ASTM C 94.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Admixtures used in concrete in contact with potable water shall meet the requirements of ANSI/NSF Standard 61.
- G. Water-Reducing Admixture: ASTM C 494, Type A.
- H. High-Range, Water-Reducing Admixture: ASTM C 494, Type F
- I. Shrinkage-Reducing Admixture, ASTM C494, Type S.

2.8 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - b. GCP Applied Technologies; Strux 90/40.
 - c. Master Builders Solutions US LLC; MasterFiber MAC Series
 - d. Nycon, Inc.; XL.
 - e. Sika Corporation; SikaFiber Force 650.

2.9 WATERSTOPS

- A. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
 - b. Greenstreak; Hydrotite.
 - c. Vinylex Corp.; Duroseal Gasket.
 - d. Synko-Flex Plastic Adhesive Waterstop; Synko-Flex Products.
 - e. JP Specialties, Inc.; Type 20.

2.10 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A with a maximum perm rating of .01 and a minimum thickness of 15 mils. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fortifiber Building Systems Group; Moistop Ultra 15.
 - b. Insulation Solutions; Viper VaporCheck II 15 mil "Class A".
 - c. Stego Industries, LLC; Stego Wrap 15 mil Class A.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.
- C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.11 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
- B. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- D. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Slip-Resistive Emery Aggregate Finish:
 - a. Emery Non-Slip, Dayton Superior Corporation, Oregon, IL.
 - b. EMAG-20, Lambert Corporation, Orlando, FL.

- c. Grip It, L&M Construction Chemicals, Inc., Omaha, NE.
 - d. MasterTop 120SR, Master Builders Solutions US LLC, Shakopee, MN
 - e. Metco Anti-Skid Aggregate, Metalcrete Industries, Cleveland, OH.
2. Penetrating Liquid Floor Treatment:
- a. Basis of Design: Seal Hard; L&M Construction Chemicals, Inc., Omaha, NE
 - b. Titan Hard; Burke Group, LLC (The), Long Beach, CA
 - c. Chemisil Plus; ChemMasters, Madison, OH
 - d. Intraseal; Conspec Marketing & Manufacturing Co., Inc., Kansas City, KS
 - e. Ashford Formula; Curecrete Chemical Co., Inc., Springville, UT
 - f. Day-Chem Sure Hard; Dayton Superior Corporation, Oregon, IL
 - g. Euco Diamond Hard; Euclid Chemical Co., Cleveland, OH
 - h. MasterProtect HD Series, Master Builder Solutions US LLC, Shakopee, MN
 - i. Vexcon Starseal PS; Vexcon Chemicals, Inc., Philadelphia, PA

2.12 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Curing Paper: Eight-foot-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable.
- F. Clear, Waterborne, Membrane-Forming Dissipating Curing Compound: ASTM C 309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Products: Subject to compliance with requirements, provide one of the following:
 1. Evaporation Retarder:
 - a. Spray-Film; ChemMasters, Madison, OH.
 - b. Aquafilm; Conspec Marketing & Manufacturing Co., Inc., Kansas City, KS.
 - c. Sure Film; Dayton Superior Corporation, Oregon, IL.
 - d. Eucobar; Euclid Chemical Co., Cleveland, OH.
 - e. MasterKure ER 50; Master Builders Solutions US LLC, Shakopee, MN.
 2. Clear, Waterborne, Membrane-Forming Curing Compound:
 - a. Safe-Cure Clear; ChemMasters, Madison, OH.
 - b. Day-Chem Rez Cure; Dayton Superior Corporation, Oregon, IL.
 - c. Kurez W VOX; Euclid Chemical Co., Cleveland, OH.
 - d. MasterKure CC 180WB; Master Builders Solutions US LLC, Shakopee, MN.
 - e. 1100-CLEAR; W. R. Meadows, Inc., Elgin, IL.

2.13 RELATED MATERIALS

- A. Expansion and Isolation Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 2. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.
- F. Reglets: Fabricate reglets of not less than 0.022-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- G. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- H. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- I. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- J. Form Release Agent: Commercially formulated form release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form release agent with rust inhibitor for steel form-facing materials
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
 - 3. Surfaces in contact with potable water shall use a form release agent in conformance with ANSI/NSF Standard 61.
- K. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.

2.14 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

- B. Repair Overlayment: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch, and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.15 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 - 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

- C. Proposed concrete proportions and mixes must be submitted to the A/E and may be reviewed by the A/E. However, the Contractor is solely responsible for producing concrete of the quality, durability and strength so stated in the Specifications and on the Drawings.

- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows (unless specifically noted otherwise):
 - 1. Fly Ash: 20 percent.
 - 2. Slag Cement: 25 percent.
 - a. Combined percentage of fly ash and slag cement shall not exceed 30 percent.

- E. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Do not air entrain normal-weight concrete for trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
 5. Calcium chloride and admixtures containing calcium chloride shall not be used. Water soluble chloride ions in the total concrete mix shall not exceed specified limits.
 - a. Per ASTM C 1281, submit a minimum of one test of the chloride content for each concrete mix with a specified maximum chloride limit. Mixture shall be tested at an age of between 28 and 42 days.
- F. Shrinkage (Length Change): When maximum shrinkage is specified, determine length change of hardened concrete test specimens in accordance with ASTM C 157, except as noted in paragraphs below. Existing test data from previous projects is acceptable.
1. Test specimens shall be moist cured, including period in molds for 7 days. Then store specimens in air for period of 28 days.
 2. Use the same concrete materials and design mix proportions submitted for use on this Project.
 3. Report length change of specimens after periods of air drying after curing of 4, 7, 14, 21, and 28 days

2.16 CONCRETE MIXTURES

- A. Class F0: Normal-weight concrete for footings, deep foundations, grade beams, and tie beams not exposed to weather.
1. Exposure Class: ACI 318 F0, S0, W0, C1.
 2. Minimum Compressive Strength: As indicated on Drawings at 28 days.
 3. Cementitious Material Type: Per ACI 318 Table 19.3.2.1
 4. Maximum w/cm: 0.64
 5. Slump Limit:
 - a. 5 inches, plus or minus 1 inch
 - b. 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- B. Class F1: Normal-weight concrete for mat foundations exposed to weather and light water
1. Exposure Class: ACI 318 F1, S1, W0, C1
 1. Minimum Compressive Strength: As indicated on Drawings at 28 days.
 2. Cementitious Material Type: Per ACI 318 Table 19.3.2.1
 3. Maximum w/cm: 0.50.
 4. Slump Limit:
 - a. 5 inches, plus or minus 1 inch

- b. 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site
 5. Air Content:
 - a. 4.5 percent, plus or minus 1.5 percent at point of delivery
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- C. Class EX: Normal-weight concrete exposed to weather and de-icing salts, including foundation walls and grade beams that are fully or partially exposed to the exterior of the building.
1. Exposure Class: ACI 318 F2, S1, W0, C1
 2. Minimum Compressive Strength: As indicated on Drawings at 28 days.
 3. Cementitious Material Type: Per ACI 318 Table 19.3.2.1
 4. Maximum w/cm: 0.40.
 5. Slump Limit:
 - a. 4 inches, plus or minus 1 inch
 - b. 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site
 6. Air Content:
 - a. 6 percent, plus or minus 1.5 percent at point of delivery
 7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Class NWT: Typical normal-weight concrete unless noted otherwise.
1. Exposure Class: ACI 318 F0, S0, W0, C0
 2. Minimum Compressive Strength: As indicated on Drawings at 28 days.
 3. Cementitious Material Type: Per ACI 318 Table 19.3.2.1
 4. Maximum w/cm: 0.53.
 5. Slump Limit:
 - a. 4 inches, plus or minus 1 inch
 - b. 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
 7. Fiber reinforcement: Uniformly disperse in concrete mixture per manufacturer's recommendations. Dosage rate shall be as indicated on the Drawings.
- E. Class NWS: Normal-weight concrete over metal deck.
1. Exposure Class: ACI 318 F0, S0, W0, C0
 2. Minimum Compressive Strength: As indicated on Drawings at 28 days.
 3. Cementitious Material Type: Per ACI 318 Table 19.3.2.1

4. Maximum w/cm: 0.53.
 5. Slump Limit:
 - a. 4 inches, plus or minus 1 inch
 - b. 8 inches, plus or minus 1 inch for concrete with verified slump of 6 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
 7. Fiber reinforcement: Uniformly disperse in concrete mixture per manufacturer's recommendations. Dosage rate shall be as indicated on the Drawings.
- F. Class LC: Lean Concrete.
1. Exposure Class: Not Applicable
 2. Minimum Compressive Strength: As indicated on Drawings at 28 days.
 3. Maximum w/cm: 0.70.
 4. 3/8" aggregate.
 5. Fly ash and slag cement content not to exceed 30 percent of cementitious material weight
 6. Slump Limit:
 - a. 8 inches, plus or minus 1 inch

2.17 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information. Mixing of concrete with fibers shall comply with ASTM C1116.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.18 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.19 EMBEDDED ITEMS

- A. It is solely the Contractor's responsibility to coordinate with all Trades for the setting of sleeves, anchors, dovetail slots, inserts, frames, flashing reglets, and other items to be embedded and to provide all openings required for the installation of other work.
 - 1. Such coordination shall include, but not be limited to, review of all Contract Documents and the various subcontractors' Shop Drawings.
 - 2. No insert shall be allowed to displace reinforcement.
 - 3. All inserts embedded in concrete exposed to the environment shall be hot-dipped galvanized.

- B. Continuous concrete inserts shall be "Unistrut" type.
 - 1. The anchors of the insert shall not be allowed to project past the body of the insert.
 - 2. The maximum height of the insert body shall be as follows:
 - a. Inserts placed in slabs and joists: 7/8 inch.
 - b. Inserts placed in beams: 1-3/8 inch.

- C. Embedment of conduits and pipes shall be in accordance with ACI 318, "Conduits and Pipes Embedded in Concrete," except that;
 - 1. No conduits shall be embedded in concrete slabs, beams, girders, walls and columns unless specifically detailed on the Structural Drawings.
 - 2. Aluminum shall not be embedded in concrete.

- D. Structural Integrity: Do not provide any sleeves or openings in structural members unless shown on the Structural Drawings.

- E. Anchor Bolts: The Contractor shall be responsible for the correct orientation and exact center line location of anchor bolts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the surface finish designations specified.
- C. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
 1. Wall or column footings may be trenched (excavated neat) and cast without formwork if the soil is suitable and the size of footing does not increase by more than 2 inches in any direction.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 1. Class A, 1/8 inch, for smooth formed surfaces.
 2. Class C, 1/2 inch, for rough formed surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
 1. Minimize joints.
 2. Exposed Concrete: Symmetrically align joints in forms.
- F. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- G. Do not use rust-stained, steel, form-facing material.
- H. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 1. Provide and secure units to support screed strips
 2. Use strike-off templates or compacting-type screeds.
 3. The new floor construction must meet and match the existing floor line and elevation where tie-ins to adjacent structures are made.
- I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
 3. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 4. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- J. Chamfer exterior corners and edges of permanently exposed concrete.
- K. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- L. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of A/E prior to forming openings not indicated on Drawings.
- M. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by A/E.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures as indicated
 - 5. Clean embedded items immediately prior to concrete placement.

3.5 REMOVING AND REUSING FORMS

- A. It shall be solely the responsibility of the Contractor to remove the forms in a manner which will ensure complete safety of the structure.
- B. Formwork, for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete must also be hard enough to not be damaged by form-removal operations and curing and protection operations must be maintained.
- C. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. At least 70 percent of 28-day design compressive strength.
 - 2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
 - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- D. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- E. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by A/E.

3.6 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring. Reshoring design and execution is the responsibility of the Contractor.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. The design live loads indicated on the Drawings shall not be exceeded at any time.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Choke top layer of granular base with fine graded material to elevation tolerances of +0 inches or -3/4 inch. Place the vapor barrier over fine graded material.
 - 2. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 3. Face laps away from exposed direction of concrete pour.
 - 4. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 - 5. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 6. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 7. Turn vapor barrier up at walls to top of slab.
 - 8. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 9. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.8 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- D. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- E. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- G. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped as indicated on Drawings.
 - 2. Stagger splices in accordance with ACI 318.
 - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 - 4. Weld reinforcing bars in accordance with AWS D1.4, where indicated on Drawings.
- H. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.

3.9 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by A/E.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 4. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete. Provide keys in all construction joints, including footings, unless specifically noted otherwise in the Contract Documents.
 - 5. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-

- girder intersection. Locate joints in strip footings in the middle third of the distance between columns.
6. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 7. Space vertical joints in walls at a maximum of 40'-0" unless otherwise indicated on the Drawings. Space vertical joints in walls at a maximum of 20'-0" from corners unless otherwise indicated on Drawings. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 8. Space joints in footings at a maximum of 100'-0" unless otherwise indicated on the Drawings.
 9. In foundation mat slabs and tank base slabs, space joints at a maximum of 40'-0" on center unless noted otherwise on the Drawings. Align joints in slabs and walls where possible.
 10. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 11. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Ground: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Contraction joints shall be spaced in each direction at no more than 3 times the slab thickness in feet, unless otherwise indicated on the Drawings. For example, a 5-inch thick slab shall have a maximum joint spacing of 15 feet. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - a. All sawn contraction joints shall be made using the "Soff-Cut" type of equipment with operating vacuum attached to saw. Saw joints immediately following the final finishing operation in accordance with recommendations of Soff-Cut. Replace saw blades at first sign of raveling at the joint. Skid plate shall be replaced each time a saw blade is replaced. Use "joint saver" inserts, provided by the saw manufacturer, at all intersecting joints and at location where front wheel crosses perpendicular to the previously cut joint.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

2. For proprietary dowel plate systems, see manufacturers recommendation for placement of sleeve block-out and steel plate dowel.

3.10 INSTALLATION OF WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

3.11 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify A/E and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by A/E, but not to exceed the amount indicated on the concrete delivery ticket
 1. Do not add water to concrete after adding high range water reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. If a variation in texture or color is evident, the Contractor shall revise construction procedures until uniformity is maintained.
 4. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 5. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

- d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
 6. In no case shall concrete be allowed to drop freely for more than 3'-0". For drops greater than 3'-0", use a tremie or other approved method for placing.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.12 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish Rough Formed Finish: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class C.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply after concrete has been smooth-formed finished.

1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.

- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
- d. Maintain required patterns or variances as shown on Drawings.
- e. Apply finish where indicated on the architectural drawings.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.13 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-ground.
 - b. Specified overall values of flatness, F(F) 25; with minimum local values of flatness, F(F) 17; for unshored slabs over metal deck. F(L) measurements shall not be taken for unshored slabs, but the entire slab shall fall within plus or minus 3/8 inch of its specified plane. The Contactor will not be compensated for additional concrete placed due to the deflection of the unshored framing.

- C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings where ceramic or quarry tile is to be installed by either thickset or thinset

method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with A/E before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with A/E before application.
- E. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.14 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
 2. Screed, tamp, and trowel finish concrete surfaces.

3.15 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations. Apply evaporation retarder according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing if moisture loss exceeds this level.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. If forms remain during curing period, moist cure after loosening forms.
 3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.

- 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
 - a. For Floors to Receive Floor Coverings Specified in Other Sections, Floors to Receive Penetrating Liquid Floor Treatments, Post-Tensioned Concrete, and Concrete used to Contain Liquids: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

- a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Chemical Stain:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- d. Floors to Receive Urethane Flooring:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Curing Compound:
- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Maintain continuity of coating, and repair damage during curing period
 - 4) Curing compounds shall not be used to cure post-tensioned concrete.
 - 5) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.16 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than seven days old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 4. Rinse with water; remove excess material until surface is dry.
 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.17 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least six months.
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint and trim joint filler flush with top of joint after hardening.

3.18 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by A/E. Remove and replace concrete that cannot be repaired and patched to A/E's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete. It is not required to patch voids less than 1/2 inch in depth unless total area of all voids in any 1-foot by 1-foot square area exceed 15 square inches. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by A/E.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to A/E's approval, using adhesive and patching mortar as specified by the A/E.
- F. Repair materials and installation not specified above may be used, subject to A/E's approval.
- G. All repair procedures and products shall be reviewed and approved by the A/E prior to commencing with the remedial work.

3.19 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
 2. Testing agency shall immediately report to A/E, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency shall report results of tests and inspections, in writing, to Owner, A/E, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 50 cu. yd., plus one set for each additional 100 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least

five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 - c. No concrete shall be placed that does not meet specified slump requirements. Slump exceeding the specified maximum, when occurring in 2 consecutive tests made on different portions of the same sample, will be cause for rejection of that truckload and shall be reported to the A/E immediately. The replacement of such concrete shall be done at no additional expense to the Owner
3. Air Content: ASTM C231 pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. No concrete shall be placed that does not meet specified air content requirements.
4. Concrete Temperature: ASTM C1064:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31:
 - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or two sets of three 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of two standard 6-inch by 12-inch or three 4-inch by 8-inch cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39:
 - a. Test one set of laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is less than or equal to 5000 psi, or no compressive strength test value is

- less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by A/E but will not be used as sole basis for approval or rejection of concrete.
 10. If the 28-day test results do not meet the specified strength f'c, the mix proportions shall be adjusted for the remaining portion of the structure at no additional expense to the Owner.
 11. Additional Tests:
 - a. Where concrete is considered partially deficient, the Owner may require additional testing to be made at no additional expense to the Owner. Any such testing shall be done by an independent testing laboratory. If additional tests do not indicate concrete meets the Project requirements, Contractor shall remove and replace deficient concrete as directed by A/E. In lieu of additional testing, Contractor has option to immediately remove and replace deficient concrete at no additional expense to the Owner or Project Schedule
 - b. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by A/E.
 - c. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by A/E.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301section 1.6.6.3.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to A/E.
- F. Inspection Services: Inspection work shall be performed in accordance with ACI 311 by an independent testing laboratory.
1. The inspecting agency shall perform the following duties:
 - a. Inspect batching and mixing operations of concrete.
 - b. Inspect storage facilities and methods of material handling.
 - c. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 - d. Inspect placed reinforcing steel, shoring, bracing, embedded items, anchor bolts, joints, etc.
 - e. Inspect concrete handling, placing, consolidating, finishing, curing, protection, and repair or patching.
 - f. Submit certified reports the same day that duties are performed to all those designated by the A/E or the Owner. Any noncompliance with Project requirements shall be reported immediately.

2. The Contractor shall fully cooperate with the inspecting agency in their performance of specified duties and render any necessary physical assistance.
3. The reinforcing steel and embedded item placement must be completed before inspection. Concrete placement shall not commence until the area has been inspected and given final approval by the inspecting agency.

3.20 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit use of pipe-cutting machinery over concrete surfaces.
4. Prohibit placement of steel items on concrete surfaces.
5. Prohibit use of acids or acidic detergents over concrete surfaces.
6. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
7. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

- #### B. Slabs on ground shall not receive any type of loading other than people foot traffic until the concrete has cured for at least seven days and the concrete has reached 80 percent of its required strength.

END OF SECTION 03 30 00

SECTION 06 41 16 – PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic - laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Refer to Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic - laminate architectural cabinets.

~~5. Apply AWI Quality Certification Program label to Shop Drawings.~~

- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

1. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and surface finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of product.
- B. Field quality-control reports.

~~1.5 CLOSEOUT SUBMITTALS~~

- ~~A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.~~

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in - service performance.
- B. Preferred Manufacturer's Qualifications (not required):
 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- C. Installer Qualifications: Manufacturer of products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
- B. Preferred Quality Standard (not required):
 1. Provide certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
- C. Architectural Woodwork Standards Grade: Custom.
- D. Regional Materials: Manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- E. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.
- F. Type of Construction: Frameless.
- G. Door and Drawer-Front Style: Fulloverlay.
 1. Reveal Dimension: 1/2 inch.
- H. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 1. Basis-of-Design Product: Wilsonart Portico Teak Gloss Line Finish
 2. Approved equal by Architect.
- I. Laminate Cladding for Exposed Surfaces:
 1. Horizontal Surfaces: Grade HGS.
 2. Vertical Surfaces: Grade HGS.
 3. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
 4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

- J. Materials for Semi-exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
 - b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
 3. Drawer Bottoms: Thermally fused laminate panels.
- K. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- L. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- M. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by laminate manufacturer's designations.
- N. Provide filler panels at ends of cabinets unless noted otherwise.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one - half of pre-consumer recycled content not less than 25 percent.
 2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

3. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
4. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
5. Softwood Plywood: DOC PS 1, medium-density overlay.
6. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 100 degrees of opening.
- B. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- C. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.
 1. Finish: Brushed Nickel
- D. Catches: Push-in magnetic catches, ANSI/BHMA A156.9, B03131.
- E. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- G. Drawer Slides: ANSI/BHMA A156.9.
 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Undermount.
 - a. Type: Full extension.
 - b. Material: Galvanized steel ball bearing, Stainless steel, or Zinc-plated ball bearing slides.
 - c. Motion Feature: Soft close dampener.
 2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
 3. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
 4. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
- H. Door Locks: ANSI/BHMA A156.11, E07121.
- I. Drawer Locks: ANSI/BHMA A156.11, E07041.
- J. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- K. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Color: Black.

- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - 1. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
 - 2. Satin Stainless Steel: ANSI/BHMA 630.
 - M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.
- 2.4 MISCELLANEOUS MATERIALS
- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
 - B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
 - C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing -in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 06 41 16

SECTION 07 54 23 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fully adhered, thermoplastic polyolefin (TPO) roofing system.
 - 2. Substrate board.
 - 3. Vapor retarder.
 - 4. Roof insulation.
 - 5. Cover board.
 - 6. Walkways.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural- use roof deck panels.
 - 2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
 - 3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
 - 4. Section 076000 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
 - 5. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint assemblies.
 - 6. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
 - 7. Section 221316 "Building Sanitary and Storm Drainage" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 QUALITY CONTROL

- A. Prior to the Notice of Award, the Contractor shall submit evidence that his existing company has five (5) years continuous successful experience in applying specified material(s), and is currently an approved applicator for the specific material manufacturer(s).

- B. Reference Standards: Except as modified by the Drawings and Specifications, the following documents, or applicable portions thereof, govern the work.
 - 1. National Roofing Contractors Association (NRCA) "Roofing and Waterproofing Manual - Fifth Edition.
- C. Qualifications:
 - 1. Contractor: Have installations of specified materials in use for a minimum period of five (5) years or authorized by manufacturer for application of specified roofing system.
 - 2. Same contractor that performed roof installation for adjacent Phase 1 existing building to be used for any required repair/tie-in work on this Project.
- D. Manufacturer's Products: Obtain roofing materials from only one manufacturer. Provide materials not available from the manufacturer from sources which are recommended and approved by the manufacturer.
- E. Underwriters Laboratories (UL) Listed Products: Provide materials which have been tested and listed by UL, and bear UL label on each package, or are shipped to the project with a UL certification of compliance.
- F. Fire and Insurance Ratings: Comply with ratings as required by governing authorities and codes, and comply with the following:
 - 1. Underwriters Laboratories (UL) "Class A" rating.
 - 2. Factory Mutual (FM) "1-90" minimum rating.
- G. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist the factored design uplift pressures calculated according to SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems."

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For insulation and roof system component fasteners, include copy of FM Approvals' Roof Nav listing.
- B. Sustainable Design Submittals:
 - 1. Refer to Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS
- C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

D. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.
2. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer and testing agency.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Evaluation Reports: For components of roofing system, from ICC-ES.

D. Field Test Reports:

1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

C. Copy of membrane manufacturer's guarantee inspection report.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and listed in

FM Approvals' RoofNav for roofing system identical to that used for this Project.

- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.11 PROTECTION

- A. Temporary tie-offs and water cut-offs shall be provided by the Roofing Contractor at the end of each day, and where and when a danger exists that water caused by precipitation may get under the new roofing membrane. Tie-offs or cut-offs shall extend beyond new insulation and membrane, and be adhered to the existing roof system. All temporary tie-offs and water cut-offs shall be removed prior to proceeding with the work by uncovering the edge of the insulation and removing all temporary materials.
- B. When installing temporary tie-offs or water cut-offs, do not cut any staggered insulation pieces that are already installed. Rather, straighten the staggered insulation with unattached pieces of insulation. Remove all temporary insulation pieces prior to proceeding with the work.
- C. Avoid heavy traffic on completed work.
- D. Restore to original condition or replace all work and materials damaged by roofing operations.

- E. Protect paving and building surfaces adjacent to hoists and other roofing equipment.
- F. Remove protection upon completion of roofing work.

1.12 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.13 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
 - 3. Provide roof inspections to determine existing warranty compliance at no additional cost to Owner.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.
 - 2. Provide roof inspections to determine existing warranty compliance at no additional cost to Owner.
- C. Existing Roof Warranty: Maintain existing roof warranty at Phase I building for modification of existing roof. See drawings for extents of existing roof modification.
 - 1. Utilize previous installer or other methods approved by architect to maintain existing roof warranty. Provide documentation that warranty has not been affected after completion of Phase I building roof modification.
 - 2. Provide roof inspections to determine existing warranty compliance at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
- D. Puncture Resistance: 265 lbf (1174 N), minimum, when tested in accordance FTM 101C Method 2031.
- E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 or initial SRI not less than 82 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- G. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- H. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class B; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fleece-backed TPO sheet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Holcim-Elevate Building Products.
 - c. GAF.
 - d. Johns Manville; a Berkshire Hathaway company.

2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.
3. Thickness: 60 mils (1.5 mm), nominal.
4. Exposed Face Color: White.
5. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
 2. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 60 mils (1.5 mm) thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Roof Vents: As recommended by roof membrane manufacturer.
 1. Size: Not less than 4-inch (100-mm) diameter.
- E. Bonding Adhesive: Manufacturer's standard.
- F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
- H. Fasteners: Factory-coated stainless steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Saint-Gobain North America.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - 2. Thickness: 1/2 inch (13 mm) thick.
 - 3. Surface Finish: Unprimed.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: ASTM D1970/D1970M, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil (1.0-mm) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer. Vapor retarder to be produced by roof membrane manufacturer or approved by roofing manufacturer.

2.6 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Holcim-Elevate Building Products.
 - c. GAF.
 - d. Johns Manville; a Berkshire Hathaway company.
 - 2. Compressive Strength: 20 psi (138 kPa).
 - 3. Size: 48 by 48 inches (1219 by 1219 mm).
 - 4. Thickness:
 - a. Base Layer: 1-1/2 inches (38 mm).
 - b. Upper Layer: 4 inches (101.6 mm).

- C. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Holcim-Elevate Building Products.
 - b. GAF.
 - c. Insulfoam; Carlisle Construction Materials Company.
 - d. Johns Manville; a Berkshire Hathaway company.
 2. Facer: Type VII, glass-mat-faced gypsum board facer.
 3. Size: 48 by 48 inches (1219 by 1219 mm).
 4. Thickness: 1/2 inches.
- D. Tapered Insulation: Provide factory-tapered insulation boards.
1. Material: Match roof insulation.
 2. Minimum Thickness: 1/2 inch (12.7 mm).
 3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.7 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 2. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Cover Board: HD Polyiso Coverboard
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum Company.
 - c. USG Corporation.
2. Thickness: 1/2 inch (13 mm).
 3. Surface Finish: Unprimed.
- 2.8 EXPANSION JOINT COVERS
- A. Manufacturer List: Expansion joint covers of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
 1. Johns Manville – Expand-O-Flash Expansion Joint Cover
 2. Approved equal
 - B. Thickness: 0.060" (1.52 mm)
 - C. Width: 16" min.
 - D. Color: White
- 2.9 WALKWAYS
- A. Walkway Roof Pads: Thermoplastic walk pads, welded to roofing membrane with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.
 - b. Wausau Tile Inc.
 2. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
 3. Weight: 18 lb/sq. ft. (90 kg/sq. m).
 4. Compressive Strength: 6500 psi (45 MPa), minimum.
 5. Colors and Textures: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Examine the surface condition of the substrate and the conditions under which roofing work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected in an approved manner.
- D. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.
- E. Provide temporary protection as needed if watertightness is compromised.
- F. Close off roof drains and other penetrations to prevent materials from entering and clogging drains and conductors, and from spilling or migrating onto adjacent surfaces. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072715 "Self-Adhering Water Resistive Air Barrier Membrane."
- D. Install roofing membrane and base flashings according to roofing-system manufacturer's written instructions and applicable recommendations of NRCA/ARMA Quality Control Guidelines for Application of Thermoplastic Polyolefin Roofing.

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSTALLATION OF VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches (90 and 150 mm), respectively.
 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
 2. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 1. Install base layer of insulation with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump

with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

- 1) Trim insulation so that water flow is unrestricted.
- e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.8 INSTALLATION OF SELF-ADHERING ROOF MEMBRANE

- a. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- b. Unroll roof membrane and allow to relax before installing.
- c. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.
- d. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer.
 - 1) Stagger end laps.
- e. Fold roof membrane to expose half of sheet width's bottom surface.
 - 1) Remove release liner on exposed half of sheet.
 - 2) Roll roof membrane over substrate while avoiding wrinkles.
- f. Fold remaining half of roof membrane to expose bottom surface.
 - 1) Remove release liner on exposed half of sheet.
 - 2) Roll roof membrane over substrate while avoiding wrinkles.
- g. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- h. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- i. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1) Test lap edges with probe to verify seam weld continuity.
 - 2) Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
 - 3) Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 4) Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- j. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required

rate, and allow to partially dry. Do not apply to seam area of flashing.

- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 INSTALLATION OF WALKWAYS

- A. Roof Walkway Pads: Install walkway roof pads according to manufacturer's written instructions.
 - 1. Install roof walkway pads at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - f. Locations indicated on Drawings.
 - g. As required by roof membrane manufacturer's warranty requirements.
 - 2. Provide 3 inches (75 mm) of space between adjacent roof pads

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner to engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
 - 1. High or Low Voltage Electronic Leak Detection: Perform testing for each roof area.
 - 2. Flood Testing: Flood test at each drain location to identify leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - a. Perform tests before overlying construction is placed.
 - b. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
 - c. Flood each area for 24 hours.

- d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

3.13 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____
of _____,
_____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: _____
 - 2. Address: _____
 - 3. Building Name/Type: _____
 - 4. Area of Work: _____
 - 5. Acceptance Date: _____.
 - 6. Warranty Period: _____
 - 7. Expiration Date: _____.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 55 mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of

such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 54 23

SECTION 12 50 00 – FURNITURE PACKAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Furniture and equipment

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to furniture installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures
 - b. Identify space for furniture installation staging area
 - c. Clarify if manufacturer's delivery/installation staff will be placing furniture in specified rooms
 - d. Review finishes for all furniture items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics and durability.
- B. Shop Drawings: Show furniture, finishes, quantities, locations of each furniture item.
- C. Samples: For each furniture, provide respective finishes.
- D. Product Schedule: Use same designations indicated on Drawings and furniture package.
- E. Sustainable Design Submittals:
 - 1. Refer to Section 01 81 13 - Sustainable Design Requirements

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: Manufacturer's standard warranty

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For furniture include maintenance manuals. Include the following:

1. Methods for maintaining furniture, including cleaning and manufacturer's recommended maintenance schedule.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match furniture installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Furniture: Provide 5 percent of amount installed for each type indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver furniture in factory packages, marked with manufacturer and product name. Install furniture on project site at designated staging area; coordinate with Client and Contractor for furniture staging area. Deliver furniture to specified locations as indicated on Drawings in furniture package; coordinate final locations with Client. and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install furniture until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.10 WARRANTY

- A. Special Warranty for Furniture: Manufacturer agrees to repair or replace components or whole furniture that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Dimensional instability
 - b. Cracking
 - c. Delamination
- B. Warranty Period: Manufacturer's standard warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: As indicated in furniture schedule.

- B. Approved Equal by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FURNITURE INSTALLATION

- A. Install furniture level, plumb, and aligned according to manufacturer's written instructions.
- B. Furniture Locations: As designated in Drawings.

3.3 ADJUSTING









- A. Adjust and balance furniture to operate smoothly, easily, safely, and free from binding or malfunction throughout the entire operational range.

3.4 CLEANING AND PROTECTION











- A. Clean furniture, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that the furniture are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged furniture that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.


END OF SECTION 12 50 00










FURNITURE SPECIFICATION EMS ADDITION

Item Label	Furniture Image	Manufacturer	Model	Model Number	Description	Dimensions	Fabric / Finish	Room	Total Counts
Accessory									
AC01		Erg International	Drake	DRPD	Mobile Podium with Modesty, Locking Casters, PVC Edgeband	28"W x 18"D x 28"H	Top: Formica Brite White 459-58 Base: Brushed Aluminum Casters: Black Locking	Classrooms	17
Chair									
CH1.1		VIA	Brisbane HD Mid Back with Large Seat C	1603-67C-SS-FT-39 A6-18BB-16SCG-BA LL1-9GA-GR1	With ergonomic enhancement - #67 Quick Adjust Advanced Synchro Control Mech #SS-FT - Seat depth adjustment & ergonomic forward tilt #39A - Black roll back arms #18BB - Black Nylon 5-Star Swivel Base #16SCG - Two-toned black and grey soft rubber tread all floor casters #BALL1 - Ballistic Brisbane Nylon		9FA - Fabric Textile - Momentum Hue Black (Grade 1) Base- black nylon 5-star swivel base #18BB	Workstations, Offices	146
CH03		OFS	Harpin Mid Back Chair	85115-M	Molded plastic one-piece shell, Swivel base, black hard casters for use on carpet, armless	18.75"Wx34.75"Hx21.5"D	Seat: Graphite Plastic Shell (GRPH) Base: Polished Aluminum (PAL) Caster: Black Hard casters - std (W48)	EMS Staff 103	4
CH04		OFS	Harpin Mid Back Chair	85138-M	Molded plastic one-piece shell, 4 leg with casters for use on carpet, armless	18.75"Wx34.75"Hx21.5"D	Seat: Graphite Plastic Shell (GRPH) Seat Upholstery: Modena Ecosense Graphite Base: Polished Aluminum (PAL) Caster: Black Hard casters - std (W48)	Classroom Seating	742
CH05		Emeco	Broom Stacking Chair	FBROOMDARKGRE Y	Polypropylene chair	19" W x 19.5" D x 32.5" H	Propylene shell - Dark Grey	Simulation Apartment	2
Lounge Seating									
LS03		Keilhauer	Meander	56033+56000+560 32	Fully Upholstered Sofa with PC01 Onyx powdercoat base.	131.5" x 33.75" x 27.5"	Upholstery - Maharam, Beck; 466570-002 Molecule Legs - PC01 Onyx	Simulation Apartment	2
Markerboard									
MB01		Claridge. Alternates will be accepted	MB S-Deluxe	C-LCS2044R	LCS3 Porcelain Dry Erase Whiteboards Aluminum Trim MT/MR	48" x 48"	LCS3-217-M #100 White Chalk Tray - Flat Tray Trim Finish - Clear Anodized	Private Office, Typical	22
MB02		Claridge. Alternates will be accepted	MB S-Deluxe	C-LCS2048R	LCS3 Porcelain Dry Erase Whiteboards Aluminum Trim MT/MR	48 x 96"	LCS3-217-M #100 White Chalk Tray - Flat Tray Trim Finish - Clear Anodized	Training Room Typical	20
MB03 (NOT IN SCOPE)						60"x 96"		Large Classrooms	11

FURNITURE SPECIFICATION EMS ADDITION

Item Label	Furniture Image	Manufacturer	Model	Model Number	Description	Dimensions	Fabric / Finish	Room	Total Counts
Storage									
SG2.1		AIS	L Series Lateral File	S-LATJJ2D30 / W-WSL230JJ	Universal lateral file; (3) 2-drawer 30" wide files w/ (1) common top at 90"w	3H x 30"W	Base - Metal with Satin White Paint; Pulls - rectangular Top - Midwest Maple	EMS Staff 103	3
SG3.1		Three H		487540	Computer Storage Cabinet; top grommet and ventilated back; base with levelers and standard pulls	30"H x 36" W	Base - Metal with Satin Pulls - rectangular Top - Laminate white	Training Rooms	17
Stool									
ST01		Emeco	111 Navy Barstool	HCEM-N1S2	111 Navy Barstool	17" x 18.5" x 43" H (SH30")	TBD	Corridor, Simulation	27
Table									
TB02.1		AIS	Day to Day Table	T-RCR488429ATG	AIS Day to Day rectangle table with metal base w/ 2 grommets	84" x 48" x 29"	Top - Midwest Maple Base - white matte Grommet - White	Breakout Rooms	4
TB02.2		AIS	Day to Day Table	T-RCR489629ATG	AIS Day to Day rectangle table with metal base w/ 2 grommets	96" x 48" x 29"	Top - Midwest Maple Base - white matte Grommet - White	Conference Rooms	3
TB4.1		AIS	Day to Day Table	T-RDR3629SXG	AIS Day to Day Round table with metal X base	42" round x 29"H	Top - Midwest Maple Base - white matte	EMS Staff 103	1
TB4.3		AIS	Day to Day Table	T-RDR3629SXG	AIS Day to Day Round table with metal X base	36" round x 29"H	Top - Midwest Maple Base - white matte	Offices	1
TB4.4		AIS	Day to Day Table	T-RDR3624SXG	AIS Day to Day Round table with metal X base	36" round x 42H	Top - Midwest Maple Base - white matte	Corridors, Simulation Bar	6
TB4.5		AIS	Day to Day Table		AIS Day to Day Round table with metal X base	24" round x 29"H	Top - Midwest Maple Base - white matte	Simulation Apartment	1
TB6.1		AIS	Day to Day Table	T-RCR246029ATC	AIS Day to Day rectangle table with metal base on casters - 24" deep	60"L x 24"D x 29"H	Top - Midwest Maple Base - Metallic Silver	Classrooms	348

Item Label	Furniture Image	Manufacturer	Model	Model Number	Description	Dimensions	Fabric / Finish	Room	Total Counts
TB6.3		AIS	Day to Day Table	T-RCR306029SCC / T-MOD60 / A-ROK / E-ADTCW	AIS Day to Day Rectangle table, metal base on casters, modesty panel, spin out pencil drawer, clamp mount power 2/Out 2/USB	60"L x 30"D x 29"H	Top - Midwest Maple Base - Metallic Silver	Guardshack	2

Item Label	Furniture Image	Manufacturer	Model	Model Number	Description	Dimensions	Fabric / Finish	Room	Total Counts	Level 2	Level 3	Level 4
TB09		OFS	Kosa	KS-19RD20H	End Table	19"DIA x 20" H	Top - Solid Surface Quartz Modern White Base - Bone White	Simulation Apartment	2	1	1	0
Private Office												
OFA		AIS Magnuson	Calibrate, Univrsal, L Series, Day to Day Tables, DS-Series		U-Shape Desk w/ wire management, (1) Grommet Overhead Storage, Tackboard & Task Light Lateral File & Mobile BF Manuson Group DS Series Wall Racks	Varies	Metal Door Overhead Paint - White Surfaces & Modesty Laminate - Midwest Maple Grommet - White Table Base & Legs - Paint White Tackboard Fabric - Engage Rain Cloud Wall Racks - Lunar White	Private Offices	3	1	2	0
OFC		AIS Magnuson	Calibrate, Univrsal, L Series, Day to Day Tables, DS-Series		L-Shape Desk w/ wire management, (1) Grommet Overhead Storage, Tackboard & Task Light Mobile BF Magnuson Group DS Series Wall Racks	Varies	Metal Door Overhead Paint - White Surfaces & Modesty Laminate - Midwest Maple Grommet - White Table Base & Legs - Paint White Tackboard Fabric - Engage Rain Cloud Wall Racks - Lunar White	Private Offices	3	1	1	1
OFE		AIS Magnuson	Calibrate, Univrsal, L Series, Day to Day Tables, DS-Series		U-Shape Desk w/ wire management, (1) Grommet Overhead Storage, Tackboard & Task Light Lateral File & Mobile BF	Varies	Metal Door Overhead Paint - White Surfaces & Modesty Laminate - Midwest Maple Grommet - White Table Base & Legs - Paint White Tackboard Fabric - Engage Rain Cloud	Private Offices	1	0	1	0
OFF		AIS Magnuson	Calibrate, Univrsal, L Series, Day to Day Tables, DS-Series		L-Shape Desk w/ wire management, (1) Grommet Overhead Storage, Tackboard & Task Light Lateral File & Mobile BF	Varies	Metal Door Overhead Paint - White Surfaces & Modesty Laminate - Midwest Maple Grommet - White Table Base & Legs - Paint White Tackboard Fabric - Engage Rain Cloud	Private Offices	2	0	2	0
OFI		AIS Magnuson	Calibrate, Univrsal, L Series, Day to Day Tables, DS-Series		L-Shape Desk w/ wire management, (1) Grommet Overhead Storage, Tackboard & Task Light Lateral File & Mobile BF	Varies	Metal Door Overhead Paint - White Surfaces & Modesty Laminate - Midwest Maple Grommet - White Table Base & Legs - Paint White Tackboard Fabric - Engage Rain Cloud	Private Offices	5	0	3	2
Workstation												
WSA		AIS	Oxygen Benching		Double Sided 4-Pack Cluster Straight Leg Base (4) Mobile BF24"D Access Boxes for Hardwired Chicago Code Power Center Spline Screen	OA - 60"D x 144"W Each 30"Dx72"W	Laminate: Midwest Maple Paint Metal: White Fabric: Engage Rain Cloud	Open Offices	20	6	11	3
WSC		AIS	Oxygen Benching		Single Sided 2-Pack Cluster Straight Leg Base (2) Mobile BF24"D Access Boxes for Hardwired Chicago Code Power Center Spline Screen	OA - 60"D x 144"W Each 30"Dx72"W	Laminate: Midwest Maple Paint Metal: White Fabric: Engage Rain Cloud	Open Offices	3	3	0	0
WSD		AIS	Oxygen Benching		Double Sided 2-Pack Cluster Straight Leg Base (2) Mobile BF24"D Access Boxes for Hardwired Chicago Code Power Center Spline Screen	OA - 60"D x 72"W Each 30"Dx72"W	Laminate: Midwest Maple Paint Metal: White Fabric: Engage Rain Cloud	Open Offices	11	3	5	3

SECTION 23 09 00 – CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.
- E. The BMS Contractor shall be responsible for obtaining existing main building temperature controls system submittals and field verification as required to facilitate the addition of new controls network componentry and devices.
- F. All controls work shall comply with the City of Chicago Department of Procurement Services, Global Building Management System Technical Specifications.

1.2 DEFINITIONS

- A. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- B. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- C. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.
- D. Adjustable (Adj): A characteristic of a control logic parameter such that it can be varied by the operator without downloading the program.
- E. Algorithm: A logical procedure for solving a recurring problem.
- F. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.

- G. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).
- H. Application Programming Tool (APT): A vendor unique software tool used to create applications for programmable controllers. This software tool may also be used for system programming, controller commissioning, network management.
- I. Application Specific Controller (ASC): Control product that incorporates solid state components based upon the Neuron chip to perform multiple control loops or functions as part of a specific application. ASC shall conform to the LONMARK® functional profiles and interoperability standards. Modbus, BACnet and proprietary communication protocols are utilized in some ASC units.
- J. BACnet or BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135 and all current addenda and annexes.
- K. BACnet Interoperability Building Blocks (BIBB): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a Specification.
- L. Building Automation System (BAS). The complete facility control system comprised of mechanical system automation, security control, lighting control, automatic temperature control, etc., as defined in the contract documents. The BAS is comprised of a two tier network structure. The second tier uses BACnet for distributed control processing. The first tier uses Tridium N4 over Ethernet, TCP/IP protocol in a 10/100 Base T wiring configuration. The BAS also includes interface panels, bridges, network controllers, LAN wiring, raceways, etc. All system data shall be made available to the City's Wide Area Network for building management. The functionality of the system will allow building engineers the ability to view and modify the facility from any point on the City's WAN.
- M. Bandwidth Utilization: The average utilization of the network capacity. Generally speaking the amount of present network traffic as it relates to the maximum amount of traffic for which a network can support.
- N. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
- O. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended or required destinations. The concept of associating an output network variable from one device to the input network variable of a second (third, fourth, etc.) device.
- P. Bridge: A device that routes messages or isolates message traffic to a particular segment, sub net or domain of the same physical communication media.
- Q. Building Management System (BMS): The Control System Server installed on the City of Chicago Department of AIS Wide Area Network. The BAS consists of the server and Tridium N4 Supervisor software. The BMS will serve web based graphics for all buildings integrated to it. The BMS will also perform all long term trending and storage of historical data.

- R. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
- S. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.
- T. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- U. Bus Topology: A term used to describe the sequential connection of devices on a LON segment. The communication cable runs from device to device with no tees or stubs from the main communication cable to a device.
- V. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount.
- W. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount.
- X. Channel: A LON network consisting of two segments connected by a physical layer repeater or router configured as a repeater. Each segment can support a theoretical limit of 64 connections.
- Y. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
- Z. Commissioning: A process of ensuring that systems are installed, functionally tested, and capable of being operated and maintained to perform in conformity with design intent. Control System commissioning requires a point to point check out and the detail documentation of each parameter. Commissioning includes a complete functional test of the sequence of operation for each piece of equipment.
- AA. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).
- BB. Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- CC. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including HVAC control, switchgear, uninterruptible power supplies, lighting, security, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/ output summary shown on the drawings or specified herein and required to execute the sequence of operation.
- DD. Controller or Control Unit (CU): Intelligent standalone control panel. Controller is a generic reference and shall include NCs, PCUs, AACs, and ASCs as appropriate.

- EE. Control Systems Server (CSS): A computer that maintains the systems configuration and programming database. This may double as an operator workstation for smaller systems.
- FF. Dead band: A temperature or lighting range over which no heating, cooling, or lighting energy is supplied, such as 72-74°F, i.e., as opposed to single point changeover or overlap.
- GG. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- HH. Discrete: Binary or digital state.
- II. Distributed Control: A system whereby control processing is decentralized and independent of a central computer.
- JJ. Diagnostic Program: Machine executable instructions used to detect and isolate system and component malfunctions.
- KK. EEPROM: Electrically Erasable Programmable Read Only Memory – user modifiable read only memory that can be erased and reprogrammed repeatedly through the application of a higher than normal electrical voltage.
- LL. Energy Monitoring System (EMS): The Energy Monitoring System is software that would store meter consumption data to perform analysis of the City's utility consumption.
- MM. FTT: Free Topology Transceiver – A LonWorks standard hardware device that enables communication between nodes. The FTT transceiver facilitates interoperability by creating a media standard while allowing flexible network design through bus and free topologies.
- NN. Functional Profile: A collection of variables required to define key parameters for a standard application. For the HVAC industry, this includes applications like VAV terminal units, fan coil units, etc.
- OO. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BMS Contractor's cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.
- PP. Gateway: A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them.
- QQ. Graphical User Interface (GUI): A Man Machine Interface device (PC, laptop or dumb display terminal) which incorporates web browsing for remote network client services as a thin client machine. The Graphical User Interfacing allows the operator to manage, command, monitor, configure and program the system. It shall function as the point of interface for all control and monitoring functions as well as all data logs, trends, and alarming.
- RR. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.

- SS. HTTP: Hypertext Transfer Protocol: the set of rules for exchanging data files (text, graphic images, sound, video and other multimedia files) over the Internet.
- TT. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- UU. Interface Panel: A device that contains an I/O software driver to translate data from a particular format to that conforming to BACnet standards.
- VV. Intelligent Sensor or Actuator (ISA's): Control products that incorporate solid state components based around the Neuron chip to perform a single dedicated control loop or function (e.g.: actuators, sensors, switches). Device functional profiles are based on upon BACnet Standards.
- WW. IT LAN: Reference to the facility's Information Technology network, used for normal business related e mail and Internet communication.
- XX. LAN: Local Area Network – a group of computers and/or associated devices which share a common communications line and typically share the resources for single processor or server within a small geographic area.
- YY. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS.
- ZZ. Master Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard.
- AAA. Maximum Send Time Parameter: A parameter used to ensure the periodic update of network data. If a time period equal to the value of this parameter has expired without a broadcast of the variable, a re broadcast of the current value shall be executed. See also send on delta and maximum send time parameter definitions.
- BBB. Minimum Send Time Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an updated value shall not occur unless a time period equal to the value of this parameter has expired. The expiration of the time period does not mandate are broadcast. See also send on delta and maximum send time parameter definitions.
- CCC. Network: A system of distributed control units and intelligent devices that are linked together on a communications bus. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location.
- DDD. Network Controller (NC): A controller that incorporates BACnet network services host API to perform localized network management and network access services over a group of channel(s). Supervises groups of intelligent devices and Control Units to perform a global sequence of operation (ex: fire and life safety control). Can be configured to serve as a SCADA client on the BAS, Tier 1, and Local Area Network. Provides integration to BACnet, Enterprise level systems. The NC serves three primary functions:
1. Time Schedules: Time schedule algorithms shall reside in the NC. Occupancy/energize commands shall be broadcast to the building level controllers in the number required by the sequence of control.

2. Trend Data Storage: The NC shall collect data from the building level controls at specified intervals and store the data for periodic uploading to the server. Polling communication techniques are acceptable for data collection by the network controller.
3. Alarm Generation: The NC shall receive binary alarm variables from the building level controllers and transmit this data to the alarm handling software module within the server and operator work stations. Receipt of alarm data from the building level controls shall be based on broadcasting from the building level controls and not based on polling by the Network Controller.

EEE. Node: A digitally programmable entity existing on the BMS network.

FFF. Open Database Connectivity (ODBC): An open standard application programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.

GGG. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.

HHH. Operating System (OS): Software which controls the execution of computer programs and which provides scheduling, debugging, input/output controls, accounting, compilation, storage assignment, data management, and related services.

III. Operator Workstation (OWS): A Man Machine Interface device (PC, laptop or dumb display terminal) which incorporates web browsing for remote network client services. As the BAS network devices are stand alone, the OWS is not required for normal operation.

JJJ. PC: Personal Computer from a recognized major manufacturer

KKK. Peer to Peer: Mode of communications between controllers in which each device connected to the network has equal status and each shares its database values with all other devices connected to network as defined in the LonMark standard.

LLL. Peripheral: Input/Output equipment used to communicate to and from the computer and make hard copies of system outputs and magnetic files. Peripherals include CRT, printer, hard drives, disk drives, modems, etc.

MMM. Point: Analog or discrete instrument with addressable database values.

NNN. Point to Point (PTP): Serial communication as defined in the BACnet standard.

OOO. Polling: The concept of a control device requesting a network variable from a second control device at a specified interval. Polling communication is typically used to populate dynamic data on an active graphic page and for temporary or short term trending of data where the trend data is not stored at the controller level.

PPP. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.

- QQQ. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
- RRR. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.
- SSS. Programmable Control Unit (PCU): Control product that incorporates solid state components based upon the Neuron chip to perform multiple control loops or functions as part of applications that can be entered as part of the controller commissioning / programming. PCU shall conform to the BACnet functional profiles and interoperability standards. BACnet and proprietary communication protocols are utilized in some control units.
- TTT. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- UUU. Repeater: A physical device used to connect two segments while amplifying, conditioning, or strengthening the signal. A Repeater does not provide any routing or filtering of network traffic.
- VVV. Router: A device which routes or forwards messages destined for a node on another subnet or domain of the control network. The device controls message traffic based on node address and priority. Routers also serve as communication interfaces between power line, twisted pair and RF media.
- WWW. Secure Socket Layer (SSL): A commonly used protocol for managing the security of messages transmission on the Internet.
- XXX. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
- YYY. Simple Object Access Protocol (SOAP): A method for a program running in one type of operating system to communicate with a program in the same or different type of an operating system by using the World Wide Webs Hyper Text Transfer Protocol (HTTP) and its Extensible Markup Language (XML) as the mechanisms for information exchange.
- ZZZ. Smart Device: A control I/O device such as a sensor or actuator that can directly communicate with the controller network to which it is connected. This differs from an ASC in that it typically deals only with one variable.
- AAAA. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
- BBBB. Solenoid: Electric two position actuator.
- CCCC. Standard Network Variable Type (SNVT): A data format statement for implicit ‘open’ communication on a BACnet Network. This can either be simple SNVT (which defines the format of a single piece of data) or Structured SNVT (which defines the format of a network variable that contains several different data elements).

- DDDD. Structured Query Language (SQL): A standard interactive and programming language for retrieving information from and for updating a database via an organized series of queries.
- EEEE. Stand Alone Controller: A standalone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A standalone controller may rely on other networked devices for time schedule inputs and trend data storage.
- FFFF. Supervising Control and Data Acquisition (SCADA) Node: A MMI incorporating a graphical object oriented user interface software application which provides supervisory control and data acquisition from a high level processing personnel computer.
- GGGG. Supervisory Logic: The concept of gathering performance data from multiple terminal units to determine if a specific condition exists within the family of terminal devices.
- HHHH. Terminator: An electric component that consists of a resistive and capacitive circuit specifically designed to enhance the quality of communication on a segment. On a bus topology, a termination is connected at each end of a segment.
- IIII. Trend Log: A trend log is a collection of samples from a specified variable that are stored within a device on the BACnet Network. This data may be periodically sent up to or requested by a Network Controller or an Operator Workstation for the purpose of report generation.
- JJJJ. WAN: Wide Area Network Internet based network connecting multiple facilities with a central data warehouse and server, accessible via standard web browser.
- KKKK. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.
- LLLL. XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.
- MMMM. The following abbreviations and acronyms may be used in describing the work of this :
- ADC - Analog to Digital Converter
 - AHJ - Authority Having Jurisdiction
 - AI - Analog Input
 - AN - Application Node
 - ANSI - American National Standards Institute
 - AO - Analog Output
 - ASCII - American Standard Code for Information Interchange
 - ARI - American Refrigeration Institute
 - ASC - Application Specific Controller
 - ASHRAE - American Society of Heating, Refrigeration & Air Conditioning Engineers
 - ASPE - American Society of Plumbing Engineers
 - ASME - American Society of Mechanical Engineers
 - ASTM - American Society for Testing and Materials
 - ATC - Automatic Temperature Control System
 - AWG - American Wire Gauge

BAS	-	Building Automation System
BMS	-	Building Management System
BTL	-	BACnet Testing Laboratories
CAD	-	Computer Aided Design
CCC	-	Central Communications Controller
CCU	-	Central Control Unit
CMF	-	Central Monitoring Facility
COS	-	Change of State
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DALI	-	Digital Addressable Lighting Interface
DCP	-	Digital Control Panel
DDC	-	Direct Digital Control
DI	-	Digital Input
DMA	-	Direct Memory Access
DO	-	Digital Output
EEPROM	-	Electrically Erasable Programmable Read Only Memory
EIA	-	Electronics Industries Alliance
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
IT	-	Information Technology
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current

WAN - Wide Area Network

1.3 BMS DESCRIPTION:

- A. The Building Any and all components of the BMS that are connected via field bus or IP network, including the network controllers, field controllers, application specific controllers, server and user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system, and shall be manufactured by the same BMS manufacturer. Systems that use or require network controllers, field controllers, application specific controllers, server and user interface software, programming tools and software from more than one BMS manufacturer shall not be accepted.
- B. Any and all components of the BMS that are connected via field bus or IP network, including the network controllers, field controllers, application specific controllers, server and user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system, and shall be manufactured by the same BMS manufacturer. Systems that use or require network controllers, field controllers, application specific controllers, server and user interface software, programming tools and software from more than one BMS manufacturer shall not be accepted.
- C. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
- D. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification.
- E. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
- F. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.
- G. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- H. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

- I. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BMS functions.
 - 5. Offsite monitoring and management access.
 - 6. Energy management
 - 7. Standard applications for terminal HVAC systems.
 - 8. Integration or monitoring connections to all other systems provided by others as identified in the sequence of operations.

- J. The BMS will house all the graphics to operate the buildings and be accessible from anywhere on the City of Chicago Wide Area Network.

- K. The sub systems integrated at the building level for GBMS include existing; Mechanical Systems including, but not limited to, chillers, Air Handling equipment, and boiler systems, Lighting Control Systems, Intrusion Detection and access control points, utility metering, and any sustainability systems such as irrigation, co gen, and solar systems.

- L. The Building Management System will supervise all the integrated buildings, provide a Graphical User Interface, and perform trending, alarming and scheduling through a Tridium N4-Supervisor running on the City's virtual server environment.

1.4 QUALITY ASSURANCE

- A. General:
 - 1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
 - 2. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS.
 - 3. The Building Management System (BMS) installer shall be a BMS manufacturer-owned branch office, or an independent controls contractor who is factory trained and authorized by the BMS manufacturer to sell, service and support the Building Management System specified herein.
 - 4. Independent controls contractors who are authorized by the BMS manufacturer must provide a letter written and signed by a company officer of the specific BMS manufacturer. This document must be dated within the 30 days prior to bid submittal and must state that they are currently a "direct authorized representative" in good standing for the BMS manufacturer for the building management system products described and listed in this specification, that they have "direct purchasing access" to all of the BMS manufacturer's controllers, servers, software and components and technical support, and that they will continue to be an Authorized representative with this access for the duration of the installation and warranty phases of project.
 - 5. If an independent controls contractor is to be considered via addendum, the contractor must provide a letter written by a company officer of the specific BMS manufacturer with

the following verbiage; "should this contractor fail to provide a complete and operational system (as judged by the Design-Builder), the Manufacturer will complete the project to the Design-Builder's satisfaction at no additional cost to the Owner". This letter must be dated within 30 days prior to bid submittal and provided to the engineer along with the other supporting documentation at the time of request for equivalence.

6. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. The BMS Contractor shall have at this facility at least eight (8) factory trained, directly employed and full time technical staff, spare parts inventory, and all necessary test and diagnostic equipment.
7. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
8. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.
9. The use of all proprietary equipment is prohibited. It is the Contractor's responsibility to verify that the equipment manufacturers provide the appropriate interface boards as defined in these specifications and design drawings.
10. The contractor shall provide hardware and software components of the same manufacturer wherever possible.
11. The enterprise level equipment shall utilize Tridium components based on the Niagara N4 framework. All Tridium devices shall be N4 and be provided without restriction. Niagara Inter Compatability Statements (NICS) shall be open to any manufacturer or contractor.
12. Materials and equipment shall be catalogued products and shall be manufacturer's latest standard design that complies with the specification requirements. Where multiple units of the same type or function are required for this project, these units shall be products of a single manufacturer.
13. All equipment shall be manufactured, installed and tested to comply with the acceptance testing requirements specified herein.
14. Product Line Demonstrated History: The product line being proposed for the Project must have an installed history of demonstrated satisfactory operation for a length of one (1) year since date of final completion in at least ten (10) installations of comparative size and complexity. Submittals shall document this requirement with references.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades shall comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA rules that have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Design-Builder within the same day. The

Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Manage the financial aspects of the BMS Contract.
 - c. Coordinate as necessary with other trades.
 - d. Be responsible for the work and actions of the BMS workforce on site

D. Contractor Qualifications

1. The Contractor shall have a successful history in the design and installation of BACnet control systems with web browser based monitoring and control on both the Local and Enterprise levels using the Tridium N4 software platform.
2. The Contractor must demonstrate experience in large scale Tridium integrations and metering installations of similar scope for not less than 5 years. If the installer is a Value Added Reseller (VAR) of a manufacturer's product, installer must demonstrate at least three years prior experience with that manufacturer's products. Experience starts with awarded Final Completion of previous projects.
3. The Contractor shall have experience in integrating proprietary systems into the Tridium Framework via drivers and gateways.
4. The Installers shall be individuals with appropriate Tridium Certifications including Niagara Framework Certification from the Tridium N4 Certification Program.
5. Firms shall be experienced in the installation of the proposed products and/or product line for not less than one year from date of final completion on at least three (3) projects of similar size and complexity. Submittals shall document this requirement with references.
6. Contractor's Field Coordinator and Programmer Qualifications
 - a. Installer shall be individual(s) that are specialized in and be experienced with control system installation for not less than five (5) years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than two (2) projects of similar size and complexity. Contractor shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. Proposed individuals must show proof of the following training:

- 1) **Product Line Training:** Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the manufacturer(s) on that product line for installation and configuration.
- 2) **Programming Training:** Individuals involved with programming the Site specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the manufacturer(s).

7. Service Qualifications

- a. The Contractor must be experienced in control system operation, maintenance, and service. The Contractor must document a minimum five (5) year history of servicing installations of similar size and complexity.

8. Contractor's Response Time and Proximity

- a. Contractor shall have an office, which is staffed with BACnet, Tridium N4 and network infrastructure trained engineers and technicians fully capable of providing instruction and routine emergency maintenance service on the Building Management System and control installations within 24 hours of notification.

E. Contractor Service And Maintenance Requirements

1. Contractor shall have a service facility within a 50 mile radius of the job site, staffed with qualified service personnel as defined above, fully capable of providing instructions and routine or emergency maintenance service. The Contractor must also have staff located within a 25 mile radius of the job site to insure a response time of one hour or less for all construction and warranty related issues. The local staff shall be qualified in all aspects related to the control system repair and troubleshooting including HVAC and mechanical/electrical equipment operation, network management, as well as Tridium JACE and controller programming and configuration.
2. Contractor shall coordinate with the City of Chicago's AIS to obtain access to their network for service and maintenance on the Building Management System and installed Tridium JACEs.

1.5 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.

- 9. NFPA 92A and 92B Smoke Purge/Control Equipment.
- 10. Factory Mutual (FM).
- 11. American National Standards Institute (ANSI).
- 12. National Electric Manufacturer’s Association (NEMA).
 - a. **NEMA 250: Enclosure for Electrical Equipment.**
 - b. **NEMA ICS 1: General Standards for Industrial Controls.**
- 13. American Society of Mechanical Engineers (ASME).
- 14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- 15. Air Movement and Control Association (AMCA).
- 16. Institute of Electrical and Electronic Engineers (IEEE).
 - a. **IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems.**
 - b. **IEEE 802.3: CSMA/CD (Ethernet – Based) LAN.**
 - c. **IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.**
- 17. American Standard Code for Information Interchange (ASCII).
- 18. Electronics Industries Alliance (EIA).
 - a. **EIA 709.1 a 99: Control Network Protocol Specification.**
 - b. **EIA 709.3 99: Free Topology Twisted Pair Channel Specification.**
 - c. **EIA 232: Interface between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange.**
 - d. **EIA 458: Standard Optical Fiber Material Classes and Preferred Sizes.**
 - e. **EIA 485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.**
 - f. **EIA 472: General and Sectional Specifications for Fiber Optic Cable.**
 - g. **EIA 475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.**
 - h. **EIA 573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.**
 - i. **EIA 590: Standard for Physical Location and Protection of below Ground Fiber Optic Cable Plant and all Sectional Specifications.**
- 19. Occupational Safety and Health Administration (OSHA).
- 20. American Society for Testing and Materials (ASTM).
- 21. Federal Communications Commission (FCC) including Parts 15 and 16, Radio Frequency Devices.
- 22. Americans Disability Act (ADA)
- 23. ANSI/ASHRAE Standard 195-2008 (BACnet)
- 24. **Instrument Society of America (ISA)**
- 25. **Joint Industrial Council (JIC)**
- 26. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- 27. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.6 WORK BY OTHERS

A. The demarcation of work and responsibilities between the BMS Contractor and other related trades shall be as outlined in the BMS RESPONSIBILITY MATRIX.

BMS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	LOW VOLT. WIRING /	LINE POWER (*1)

			CONDUIT (*1)	
BMS low voltage and communication wiring (note 1)	BMS	BMS	BMS	N/A
VAV box controller (note 2)	BMS	23 (*2)	BMS	26
VAV boxes	23	23	N/A	N/A
BMS conduits and raceway	BMS	BMS	BMS	BMS
Automatic control dampers	BMS	23	N/A	N/A
Automatic control damper actuators	BMS	BMS	BMS	26
Air Flow Stations	BMS	23	BMS	N/A
Manual valves and dampers	23	23	N/A	N/A
Automatic control valves	BMS	23	BMS	N/A
Automatic control valve actuators	BMS	BMS	BMS	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BMS	23	BMS	BMS
BMS Current Switches.	BMS	BMS	BMS	N/A
BMS Control Relays	BMS	BMS	BMS	N/A
Concrete equipment pads and bracing	23	23	N/A	N/A
All BMS Nodes, equipment, housings, enclosures and panels.	BMS	BMS	BMS	BMS
Smoke Detectors	28	28	28	28
Fire/Smoke Dampers	23	23	28	28
Fire Dampers	23	23	N/A	N/A
VFDs	23	26	BMS	26
BMS interface with Boiler plant control system	BMS	BMS	BMS	BMS
Boiler plant control system and interface with BMS	23	23	BMS	26
BMS interface with Chiller controls	BMS	BMS	BMS	BMS
Chiller controls and interface with BMS	23	23	23	26
BMS interface with CRAC units	BMS	BMS	BMS	26
CRAC unit controls and interface with BMS	23	23	23	26
Fan Coil Unit controls	BMS	BMS	BMS	26
Exhaust fan controls	BMS	BMS	BMS	26
Cabinet/Unit Heater controls (note 4)	BMS/23	26/BMS	BMS	26
VRF factory-mounted controls	23	23	BMS	26
VRF space-mounted controls	23	BMS	BMS	26
VRF field-mounted controls	BMS	BMS	BMS	26
Air Handling unit field-mounted controls	BMS	BMS	BMS	26
Air Handling unit factory-mounted controls	23	23	BMS	26
Firing Range DDC System	Carey's	Carey's	BMS	26
Automatic Transfer Switches	26	26	BMS (*3)	26
Surge Protective Devices	26	26	BMS (*3)	26
Medium Voltage Switchgear	26	26	BMS (*3)	26
Unit Substations	26	26	BMS (*3)	26
Low Voltage Switchgear	26	26	BMS (*3)	26
Low Voltage Switchboards	26	26	BMS (*3)	26
Distribution Panelboards	26	26	BMS (*3)	26
Electric Vehicle Charging Station	26	26	BMS (*3)	26
Starters, HOA switches	26	26	N/A	26

Interior & Exterior Cameras	28	28	BMS (*3)	26
Fire Alarm System	28	28	BMS (*3)	26
Elevator Sump System	22	22	BMS (*3)	26
Natural Gas Meter	22	22	BMS (*3)	26
Potable Water Meter	22	22	BMS (*3)	26
Irrigation Water Meter	22	22	BMS (*3)	26

Footnotes:

- *1: BMS controls contractor must hire the electrical contractor for the project to route and install all conduit.
- *2: VAV box controller factory install would normally be by Division 23 Mechanical who furnishes the VAV boxes; could be by BMS for field installation where applicable
- *3: BMS controls contractor is only responsible for the low voltage wiring and conduit associated with connecting the system into BMS system. All other low voltage wiring and conduit is the responsibility of the contractor furnishing and installing the system.
- *4: Cabinet/Unit Heater Controls – for line voltage stand-alone controls: furnished by Division 23 Mechanical Contractor who furnishes the Cabinet/Unit Heaters; line voltage stand-alone controls installed and connected by Division 26 Electrical Contractor. Alternately, controls may be furnished and installed by BMS Contractors for projects requiring Cabinet/Unit Heater controls to be integrated into BMS.

1.7 SUBMITTALS

A. Shop Drawings, Product Data, and Samples.

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Design-Builder.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
 - a. BMS network architecture diagrams including all nodes and interconnections.
 - b. Systems schematics, sequences, and flow diagrams.
 - c. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
 - d. Samples of Graphic Display screen types and associated menus.

- e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
- f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
- g. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
- h. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
- i. Details of all BMS interfaces and connections to the work of other trades.
- j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. General: Operation and Maintenance manuals shall be provided in accordance with Division 01.
 - 1. The contractor shall provide a minimum of six (6) copies of each manual and CD ROMs as defined herein.
 - 2. Manuals shall be 8 1/2 inches x 11 inches size or 11 x 17 folded sheets in hard back 3 ring loose leaf binders. Provide labeled tabs between sections; use more than one volume if required. Do not overfill binders. Manufacturer supplied user manuals that are bound need not be inserted in the O&M Manual Binders.
 - 3. Prior to assembling the required quantities of manuals submit one (1) copy to the City for review and approval. After review and acceptance, assemble other copies.
 - 4. Manuals shall be completed, delivered, and accepted by the City at least 7 days prior to instruction of operating personnel.
 - 5. O&M Manuals shall be provided in electronic format by the Contractor. The electronic versions shall be stored on the BAS control systems server and shall be incorporated into the GUI. The user shall have access to these O&M manuals by clicking a link on the menu tree located on the interface. This link shall open up the appropriate viewer, Adobe, Word, etc for viewing of this file.
- B. Contents of O&M Manuals: The O&M manuals shall include the following minimum information:
 - 1. Installation Contractor's name, address, 24 hour telephone number, and job control number. As applicable, also include telephone numbers, and contact names for service during normal hours, service during off hours, and technical support.
 - 2. Name, signature and title of Contractor's representative responsible for preparation of technical manual. Include date of issuance and revision number.
 - 3. Warranty information including start and end dates. Coverage's as they pertain to labor, service parts, replacements, etc.
 - 4. Alphabetical list of all system components installed as part of this job, including power supplies and accessory items. List manufacturer name and manufacturer's part number,

and include the name, address, and 24 hour phone number of the company responsible for servicing and supplying each item during the first year of operation or warranty period, whichever is greater. Identify where each replacement part can be purchased for future replacement.

5. Include a wiring identification matrix which shows wire color codes and assignments, and labeling definitions.
6. Generate a maintenance procedure for all devices added to the system. The procedures shall indicate recommended durations and frequency for each task as well as the means and methods to accomplish each item. This procedure shall include the following minimum requirements:
 - a. Procedure for updating operating software on the system controllers. This shall include a procedure for obtaining security patches, updates, and network software updates and patches. Coordinate this with the City of Chicago’s AIS.
 - b. Procedures for updating operating software on workstations. This shall include Microsoft patches and updates as well as all updates for browser software and third party software residing on the PC such as alarming consoles or printer drivers. Coordinate this procedure with the City of Chicago’s AIS Department.
 - c. Required maintenance for all other system components.
 - d. Procedures for scheduled Tridium JACE Network Controller and Building Management System Server reboots.
7. Include installation and service manuals for each device supplied as part of this project.
8. Include a documented list of every user name and password required to access all aspects of the BAS system. This shall include user names and passwords to gain access and modify the following components but shall not be limited to:
 - a. Building Management System Server.
 - b. Network Controllers.
 - c. Network Electronics.

C. Prepare separate sections for the following system components:

1. "Ancillary devices."
2. "Network Controller Integration components"
3. "Network Management/Programming."

D. Include the following as built drawings as a minimum. All drawings requested shall be updated to include field modifications and change orders. The drawings shall be printed on 11x17 sheets, folded to 8.5 x 11, and included in the binder.

1. All submittal drawings updated to include field modifications and change orders, and all information requested below:
 - a. Floor plans indicating the exact installed location of the following equipment and/or devices:
 - b. All control panels and miscellaneous control devices.
 - c. All network controllers.

- d. Indicate all communications / network wiring between control devices.
 - e. Indicate all BAS FACLAN wiring.
2. Additional drawings to include:
- a. Legend of all symbols, line types, and abbreviations used.
 - b. Wiring details for any device wiring or interconnection that varies from accepted industry practices or for which none exist.
- E. Electronic Documentation
- 1. Provide Software User Manuals with instructions on CD ROM for the following software:
 - a. Building Management System Sever and Workstation Software
 - b. User Interface Software pertaining to the approved network controller including all loaded software drivers, plug in's, applications, and the like.
 - c. BACnet Network Management.
 - 2. On the same or separate USB, provide electronic copies of all As Built, Manufacturer and System Documentation required in this section.
 - 3. Provide electronic backup copies of all Database files and configuration properties used for the operation of the BAS. This shall include but shall not be limited to current database files from the date of substantial completion to include the following:
 - a. GUI development database
 - b. All DDC controllers database files

1.9 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals

- 1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Design-Builder upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturer's product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BMS network diagrams.
 - g. Interfaces to all third-party products and work by other trades.

2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.
- B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server.

1.10 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a three-year labor and material warranty on the BMS.
2. If within twelve months from the date of acceptance of product, upon written notice from the Design-Builder, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor
 - a. The warranty period for work and systems of this project shall commence after written notification of City's final acceptance.
 - b. In the last month of the Warranty Period, all System software and controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours

1.11 CITY OF CHICAGO REQUIREMENTS

- A. All work performed must follow City of Chicago and National Code Requirements.
- B. Contractor shall consider specification sections, design drawings, and contract documents while performing work. Contractor should notify the Commissioner rep of any discrepancies between the documents.
- C. The Department of Assets and Information Services only uses JCI Facility Explorer, Honeywell Spyder, or Distech Direct Digital Bacnet Controllers. All controllers must be open protocol and compatible with the Tridium Niagara N4 platform. All Temperature control wire must be bare or pure copper encased in conduit. All JACE Supervisory WEB Enabled N4 controllers must be licensed to the City of Chicago and any other field controller and software.
- D. Comply with all current codes, ordinances, regulations, and the City of Chicago insurance underwriters. In all cases of conflict between the work of this Division and the City of Chicago, and omission of items required for code compliance, the issue shall be brought to the attention of the Commissioner prior to the time of bid.

- E. Should any change in Drawings or Specifications be required to comply with regulations, the Contractor shall notify the City prior to execution of the work and wait for direction from the City.
- F. The City reserves the right to make changes to the BAS during the Warranty Period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by City.
- G. At no cost to the City, during the Warranty Period, Contractor shall provide maintenance services for software, firmware and hardware components as specified below:
 - 1. Maintenance services shall be provided for all devices, software, and hardware specified in the Contract Documents. Service all equipment per the manufacturer's recommendations.
 - 2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the City to the Contractor. Emergency service shall be provided 24 hours per day, 7 days per week, and 365 days per year with no exceptions and at no cost to the City.
 - a. Response by telephone to any request for service shall be provided within two (2) hours of the City's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the City's Site within four (4) hours of the City's initial telephone request for such services, as specified.
 - 3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the City to the Contractor.
 - a. Response by telephone to any request for service shall be provided within eight (8) working hours (Contractor specified 40 hours per week normal working period) of the City's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the City's Site within three (3) working days of the City's initial telephone request for such services, as specified.
 - 4. At any time during the Warranty Period that Contractor is on Site for maintenance, emergency, or normal service, Contractor shall notify City and the local building operating personnel. Contractor shall notify said personnel of all work anticipated being involved for the service work. In addition, no work affecting system operation shall commence until express permission is granted. After the work is completed a work order ticket describing in detail all work performed (i.e. hardware replaced or serviced,

- software or firmware modifications made, etc.), hours worked, follow up work required, etc., and must be signed by an authorized building operator.
5. City's Telephonic Request for Service: Contractor shall specify a minimum of three telephone numbers for City to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times.
 6. Technical Support: Contractor shall provide technical support by telephone throughout the Warranty Period.
 7. Preventive maintenance shall be provided throughout the Warranty Period in Accordance with the hardware component manufacturer's requirements.
- H. Submit under provisions of Division 01. Two (2) copies of the materials shall be delivered directly to City of Chicago's Department of General Service or City of Chicago representative, in addition to the copies required by other Sections. In addition, an electronic version of the completed materials shall be provided on USB. Data can be in native file format or scanned where necessary. Refer to Part 3 for additional Commissioning submittal requirements.
- I. The Contractor(s) will be responsible for the integration of the various sub systems within City of Chicago buildings that require a connection to the GBMS as defined in the Contract Documents. The Contractor shall work with the City of Chicago to obtain all available documentation available on the existing system.
- J. Network Controllers
1. All Network Controllers and Server equipment and software furnished by or integrated with this project shall be fully licensed to the City of Chicago. The licensing rights shall include the rights for the City of Chicago to authorize any Contractor Contractor of their choosing to perform work on the BAS system. The installing Contractor Contractor shall hold no exclusive rights to the system as it pertains to software, hardware, system updates, system access, modifications, developed databases, etc.
 2. Provide the City of Chicago all required user names and passwords for system access yielding full administration and configuration rights. These shall apply to workstations, servers, network controllers, configurable network electronics, controllers, system software / database and the like.
 3. All network controllers shall include the City on the system ORG ID.
- K. System Commissioning
1. The Contractor shall meet with the City when applicable to review any specific requirements pertaining to documentation or test procedures which the City may enforce while evaluating the system performance and acceptance.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open

communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

- B. The Building Management System shall consist of the following:
1. Standalone Network Automation Engine(s)
 2. Field Equipment Controller(s)
 3. Input/Output Module(s)
 4. Local Display Device(s)
 5. Portable Operator's Terminal(s)
 6. Distributed User Interface(s)
 7. Network processing, data storage and communications equipment
 8. Other components required for a complete and working BMS
- C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 2. The System shall maintain all settings and overrides through a system reboot.
 3. Acceptable Manufacturers
 - a. Basis of Design: Johnson Controls, Inc., Facility Explorer by Local Branch Office
 - b. Siemens Building Systems, APOGEE

2.2 BMS ARCHITECTURE

- A. The existing Joint Public Safety Training Campus (JPSTC) is served by a JCI Facility Explorer system hardware with Tridium Niagara framework.
- B. Automation Network
1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
 2. The BMS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
 3. All BMS devices on the automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
 4. Network Automation Engines (NAE) shall reside on the automation network.
 5. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- C. Control Network

1. Network Automation Engines (NAE) shall provide supervisory control over the control network and shall support the following communication protocols:
 - a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
 - 1) The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

D. Integration

1. Hardwired
 - a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
 - b. There will be one separate physical point on each system for each point to be integrated between the systems.
2. Direct Protocol (Integrator Panel)
 - a. The BMS system shall include appropriate hardware equipment and software to allow bi-directional data communications between the BMS system and 3rd party manufacturers' control panels. The BMS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, and medical gas.
 - b. All data required by the application shall be mapped into the Automation Engine's database, and shall be transparent to the operator.
 - c. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BMS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
3. BACnet Protocol Integration - BACnet
 - a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2008.
 - b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
 - c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.3 USER INTERFACE

A. Dedicated Web Based User Interface

1. Where indicated on plans (Engineering & CUP) the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability.
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.
 - a. Microsoft Internet Explorer for user interface functions
 - b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
 - c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
 - d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries
3. PC Hardware – The two personal computer(s) shall be configured as follows:
 - a. Memory – 16 GB (8 GB Minimum)
 - b. CPU– Pentium 4 processor. 3.2 GHz Clock Speed (2.0 GHz minimum)
 - c. Hard Drive – 500 GB free hard drive space (80GB minimum)
 - d. Hard drive backup system – CD/RW, DVD/RW or network backup software provided by IT department
 - e. CD ROM Drive – 32X performance
 - f. Ports – (2) USB 3.0, Ethernet, VGA, microphone/headset.
 - g. Keyboard – 101 Keyboard and 2 Button Mouse
 - h. CRT configuration – 1-2 CRTs as follows:
 - 1) Each Display – 24” Flat Panel Monitor 1920 x 1080 resolution minimum
 - 2) 16 bit or higher color resolution
 - 3) Display card with multiple monitor support
 - 4) LAN communications – Ethernet communications board; 3Comm or equal
4. Operating System Software
 - a. Windows 10 or higher (64 bit)
 - b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
 - c. Provide software registration cards to the Owner for all included software.
5. Peripheral Hardware
 - a. Reports printer:

- 1) Printer Make – Hewlett Packard DeskJet
- 2) Print Speed – 600 DPI Black, 300 DPI Color
- 3) Buffer – 64 K Input Print Buffer
- 4) Color Printing – Include Color Kit

B. Distributed Web Based User Interface

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
2. The software shall run on the Microsoft Internet Explorer (11.0 or higher) browser supporting the following functions:
 - a. Configuration
 - b. Commissioning
 - c. Data Archiving
 - d. Monitoring
 - e. Commanding
 - f. System Diagnostics
3. Minimum hardware requirements:
 - a. 8GB RAM
 - b. 3.0 GHz Clock Speed Pentium 4 Microprocessor
 - c. 100 GB Hard Drive.
 - d. 1 Keyboard with 83 keys (minimum).
 - e. SVGA 1024x768 resolution display with 64K colors and 16 bit color depth
 - f. Mouse or other pointing device

C. Site Management User Interface Application Components

1. Operator Interface
 - a. An integrated browser-based client application shall be used as the user operator interface program.
 - b. The System shall employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user.
 - c. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
 - d. The user interface software shall provide help menus and instructions for each operation and/or application.
 - e. The system shall support customization of the UI configuration and a home page display for each operator.
 - f. The system shall support user preferences in the following screen presentations:
 - 1) Alarm
 - 2) Trend
 - 3) Display
 - 4) Applications

- g. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
 - h. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - 1) User access for selective information retrieval and control command execution
 - 2) Monitoring and reporting
 - 3) Alarm, non-normal, and return to normal condition annunciation
 - 4) Selective operator override and other control actions
 - 5) Information archiving, manipulation, formatting, display and reporting
 - 6) BMS internal performance supervision and diagnostics
 - 7) On-line access to user HELP menus
 - 8) On-line access to current BMS as-built records and documentation
 - 9) Means for the controlled re-programming, re-configuration of BMS operation and for the manipulation of BMS database information in compliance with the prevailing codes, approvals and regulations for individual BMS applications
 - i. The system shall support a list of application programs configured by the users that are called up by the following means:
 - 1) The Tools Menu
 - 2) Hyperlinks within the graphics displays
 - 3) Key sequences
 - j. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
2. Navigation Trees
- a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
 - b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
 - c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar. A simple keystroke will reattach the navigation to the primary display of the user interface.
3. Alarms
- a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

- 1) Log date and time of alarm occurrence.
 - 2) Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
 - 3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - 4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - 5) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
 - 6) Configuration of which NAE offline alarms are seen by each user
 - 7) Any attribute of any object in the system may be designated to report an alarm.
- b. The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
 - c. The BMS shall allow a minimum of 4 categories of alarm sounds customizable through user defined wav.files.
 - d. The BMS shall annunciate application alarms at minimum, as required by Part 3.
4. Reports and Summaries
- a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - 1) All points in the BMS
 - 2) All points in each BMS application
 - 3) All points in a specific controller
 - 4) All points in a user-defined group of points
 - 5) All points currently in alarm
 - 6) All points locked out
 - 7) All user defined and adjustable variables, schedules, interlocks and the like.
 - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
 - c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
 - d. Provide the capability to view, command and modify large quantities of similar data in tailored summaries created online without the use of a secondary application like a spreadsheet. Summary definition shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported. Summary viewing shall be available over the network using a standard Web browser.
 - e. Provide a focused set of reports that includes essential information required for effective management of energy resources within the facility. Energy reports shall be configurable from predefined, preconfigured templates. Required includes but shall not be limited to:

- 1) Energy Overview
- 2) Load Profile
- 3) Simple Energy Cost
- 4) Consumption
- 5) Equipment Runtime
- 6) Electrical Energy
- 7) Energy Production

f. Reports shall be selectable by date, time, area and device. Each report shall include a color visual summary of essential energy information.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

- 1) Weekly schedules
- 2) Exception Schedules
- 3) Monthly calendars

b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.

c. It shall be possible to define one or more exception schedules for each schedule including references to calendars

d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.

e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.

f. Schedules and Calendars shall comply with ASHRAE SP135/2008 BACnet Standard.

g. The Calendar object supports an option to add a reference to another Calendar Object that is designated to be the master for the facility. Any Supervisory and BAC calendars can be configured to reference a single master Global Calendar. Changes to the master global calendar are automatically synced with all calendars that are referenced.

h. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

i. Software shall be provided to configure and implement optimal start and stop programming based on existing indoor and outdoor environmental conditions as well as equipment operating history

j. The system Solar Clock shall support the scheduling and energy management functions. The Solar Clock will calculate the sunrise, sunset, and sun angle values for a specified latitude and longitude. A time offset can also be specified. An example would be to use the Solar Clock object as a master to an interlock to turn lights on 30 minutes after sunset and off 30 minutes before sunrise.

6. Security/Passwords

- a. Multiple-level passwords access protection shall be provided via roles and permissions. The feature will allow the system to base access on a user's job title or role and allow the user/manager access interface control, display, and database manipulation capabilities based on an assigned password.
- b. Roles may be copied and altered to meet specific roles and permissions based on the particular policies.
- c. Each user shall have the following: a user account name (with a maximum of 30 characters), a complex password or passphrase (with a min of 8 characters and a max of 50 characters), other user account policies (such as session timeout), timesheet access based on day of the week and time of day, and specific user view.
- d. The system shall allow each user to change his or her password at will.
- e. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
- f. A maximum of 150 categories may be used to determine or assign areas of responsibilities to each user account. A maximum of 13 (of the 150) named categories which are specifics such as "No Access, View, Advanced Review, Operate, Intervene, Diagnostic, Manage Item Events, Manage Every, and Configure Items".
- g. A minimum of 100 unique passwords shall be supported.
- h. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
- i. Operators shall be further limited to only access, command, and modify those buildings, systems, and subsystems for which they have responsibility. Provide a minimum of 100 categories of systems to which individual operators may be assigned.
- j. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
- k. The system shall have the ability to provide a Department of Defense (DoD) specific warning banner for applicable sites that warns the user they are accessing a restricted site.
- l. After successful login to the Site Management Portal (SMP) the last time and date that user name was previously logged in is shown on the screen.
- m. Each login attempt is recorded in the system Audit Log with the option to record the IP address of the PC that made the login.

7. Screen Manager

- a. The system will allow a customized image on the login screen (i.e. organization name, logo).
- b. User View navigations can be displayed as either a set of tabs or a drop down list.
- c. Allows user preference for assigning of a background color for when an object is Out of Service which will enable the operator to quickly distinguish points that have been commanded to this state.

- d. The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics
- a. **Implementation and development of graphics shall follow City of Chicago 2FM GBMS specification section 17865. Contractor shall be responsible for obtaining the graphical standard from the owners representative.**
 - b. The naming/numbering/tagging convention used must be a coordinated effort between the Mechanical Contractor, Controls Contractor, Owner, Design-Builder, and A/E and must be approved by all parties prior to implementation. The naming/numbering/tagging convention must be consistent and reflected through the building automation control system, charts, diagrams, tagging and O&M manuals.
 - c. Graphic layouts are to be approved by the Design-Builder prior to implementation.
 - d. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
 - e. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
 - f. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
 - 1) All graphics shall be fully scalable
 - 2) The graphics shall support a maintained aspect ratio.
 - 3) Multiple fonts shall be supported.
 - 4) Unique background shall be assignable on a per graphic basis.
 - 5) The color of all animations and values on displays shall indicate the status of the object attribute.
 - 6) Graphics that represent buildings or systems shall allow natural links and transitions between related detailed tabular views of data that complement the graphic.
 - g. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment directly from the graphic.
 - h. Floor Plan graphics – The user interface shall provide graphic applications that summarize conditions on a floor. Floor plan graphics shall indicate thermal comfort using dynamic colors to represent zone temperature deviations from zone setpoint(s). Floor plan graphics shall display overall metrics for each zone in the floor.
 - i. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.
 - j. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

- 1) The graphic editing tool shall provide a library of standard HVAC equipment, floor plan, lighting, security and network symbols.
 - 2) The graphic editing tool shall provide for the creation and positioning of library symbols by dragging from tool bars or drop-downs and positioning where required.
 - 3) The graphics editing tool shall permit the importing of AutoCAD drawings for use in the system.
 - 4) The graphic editing tool shall be able to add additional content to any graphic by importing images in the SVG, PNG or JPG file formats.
9. Historical trending and data collection
- a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - 1) Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:
 - a) Defined time interval
 - b) Upon a change of value
 - 2) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
 - b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.
 - c. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.
 - d. The system shall provide data to enable optimization capabilities including fault detection and diagnostics, advanced analytics and central plant optimization without the need of a gateway or additional hardware.
10. Trend data viewing and analysis
- a. Provide a trend viewing utility that shall have access to all database points.
 - b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
 - c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
 - d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
 - e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
 - f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
 - g. The Display shall support the user's ability to change colors, sample sizes, and types of markers.

11. Database Management

- a. Where a separate SQL database is utilized for information storage the System shall provide a Database Manager that separates the database monitoring and managing functions by supporting two separate windows.
- b. Database secure access shall be accomplished using standard SQL authentication including the ability to access data for use outside of the Building Automation application.
- c. The database managing function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
 - 1) Backup
 - 2) Purge
 - 3) Restore
- d. The Database Manager shall support four tabs:
 - 1) Statistics – shall display Database Server information and Trend, Alarm (Event), and Audit information on the Databases.
 - 2) Maintenance – shall provide an easy method of purging records from the Server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.
 - 3) Backup – Shall provide the means to create a database backup file and select a storage location.
 - 4) Restore – shall provide a restricted means of restoring a database by requiring the user to log into an Expert Mode in order to view the Restore screen.
- e. The Status Bar shall appear at the bottom of all Database Manager Tabs and shall provide information on the current database activity. The following icons shall be provided:
 - 1) Ready
 - 2) Purging Record from a database
 - 3) Action Failed
 - 4) Refreshing Statistics
 - 5) Restoring database
 - 6) Shrinking a database
 - 7) Backing up a database
 - 8) Resetting internet information Services
 - 9) Starting the Device Manager
 - 10) Shutting down the Device Manager
 - 11) Action successful
- f. The Database Manager monitoring functions shall be accessed through the Monitoring Settings window and shall continuously read database information once the user has logged in.
- g. The System shall provide user notification via taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
- h. The Monitoring Settings window shall have the following sections:

- 1) General – Shall allow the user to set and review scan intervals and start times.
 - 2) Email – Shall allow the user to create and review e-mail and phone text messages to be delivered when a Warning or Alarm is generated.
 - 3) Warning – shall allow the user to define the Warning limit parameters, set the Reminder Frequency, and link the e-mail message.
 - 4) Alarm – shall allow the user to define the Alarm limit parameters, set the Reminder Frequency, and link the e-mail message.
 - 5) Database login – Shall protect the system from unauthorized database manipulation by creating a Read Access and a Write Access for each of the Trend, Alarm (Event) and Audit databases as well as an Expert Mode required to restore a database.
- i. The Monitoring Settings Taskbar shall provide the following informational icons:
- 1) Normal – Indicates by color and size that all databases are within their limits.
 - 2) Warning - Indicates by color and size that one or more databases have exceeded their Warning limit.
 - 3) Alarm - Indicates by color and size that one or more databases have exceeded their Alarm limit.
- j. The System shall provide user notification via Taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
12. Portable Operator Terminal
- a. For systems that do not provide full access to systems configuration and definition via the Browser Based user interface the BMS Contractor shall provide a portable operator terminal for programming purposes. The terminal shall be configured as follows:
- 1) Personal Laptop Computer Manufacturer – Dell, Compaq or HP
 - 2) 16 GB RAM (8 GB minimum) – Windows 10
 - 3) 2.0 GHz Clock Speed Pentium 4 Microprocessor or higher
 - 4) 80 GB Hard Drive (40 GB minimum)
 - 5) (1) CD-ROM Drive, 32x speed
 - 6) (1) Serial (1) Parallel (2) USB ports
 - 7) 1 Keyboard with 83 keys (minimum).
 - 8) Integral 2 button Track Point or Track Ball.
 - 9) 10" SVGA 1024x768 resolution color display
 - 10) Two PCMCIA Type II or one Type III card slot
 - 11) Complete operator workstation software package, including any hardware or software.
 - 12) Original printed manuals for all software and peripherals.
 - 13) Original installation disks or CD for all software, device drivers, and peripherals
 - 14) Software registration cards for all included software shall be provided to the Owner.
 - 15) Carrying case
 - 16) Spare battery.
 - 17) External power supply/battery charger

13. Proprietary Portable Terminal
 - a. Manufacturers providing proprietary portable terminals shall submit technical data sheets for the terminal and all associated software and hardware.
 - b. The proprietary terminal shall meet the same operator interface software requirements as specified above.

14. Software
 - a. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
 - b. When used to access First or Second Tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
 - c. When used to access Application Specific Controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.

2.4 NETWORK AUTOMATION ENGINES (NAE)

A. Network Automation Engine

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
 - a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 - b. The NAE shall support up a minimum of four (4) concurrent users.
 - c. The web based user shall have the capability to access all system data through one NAE.
 - d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
 - e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
 - f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
 - g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 - h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - 1) Configuration
 - 2) Commissioning

- 3) Data Archiving
 - 4) Monitoring
 - 5) Commanding
 - 6) System Diagnostics
- i. Systems that require workstation software or modified web browsers are not acceptable.
- j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
- k. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
- l. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
- m. Hardware Real Time Clock – The NAE shall include an integrated, hardware-based, real-time clock.
- n. The NAE shall include troubleshooting LED indicators to identify the following conditions:
- 1) Power – On/Off
 - 2) Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
 - 3) Ethernet Connection Speed – 10 Mbps/100 Mbps/1000 Mbps
 - 4) FC Bus A – Normal Communications/No Field Communications
 - 5) FC Bus B – Normal Communications/No Field Communications
 - 6) Peer Communication – Data Traffic between NAE Devices
 - 7) Run – NAE Running/NAE in Startup/NAE Shutting Down/Software Not Running
 - 8) Bat Fault – Battery Defective, Data Protection Battery Not Installed
 - 9) 24 VAC – 24 VAC Present/Loss Of 24VAC
 - 10) Fault – General Fault
 - 11) Modem RX – NAE Modem Receiving Data
 - 12) Modem TX – NAE Modem Transmitting Data
- o. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator’s terminals.
- 1) Two (2) USB port
 - 2) Two (2) URS-232 serial data communication port
 - 3) Two (2) RS-485 port
 - 4) One (1) Ethernet port
- p. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
- q. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall

be an orderly shutdown of all programs to prevent the loss of database or operating system software.

- 1) During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
- 2) Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

- r. Certification – The NAE shall be listed by Underwriters Laboratories (UL).
- s. Controller network – The NAE shall support the following communication protocols on the controller network:
- t. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The NAE shall be tested and certified as a BACnet Building Controller (B-BC) using BACnet Protocol Revision 12 or higher.
 - 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the NAE.
 - 4) The Conformance Statements shall be submitted 10 days prior to bidding.
 - (i) The NAE shall support a minimum of 100 control devices.

B. DDC System Controllers

1. Advanced Application Field Equipment Controller

- a. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol or optionally via N2Open.
- b. The FAC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The FAC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The FAC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the FAC.
 - 4) The Conformance Statement shall be submitted 10 days prior to bidding.
- c. The FAC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- d. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable. The

FAC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

- e. The FAC shall include an integral real-time clock and support time-based tasks which enables these field controllers to monitor and control:
 - 1) Schedules
 - 2) Calendars
 - 3) Alarms
 - 4) Trends
- f. The FAC can continue time-based monitoring when offline for extended periods of time from a system network.
- g. The FAC can operate as a stand-alone controller in applications that do not require a networked supervisory device or for network applications where it is preferred to have the scheduling, alarming, and/or trending performed locally in the field controllers.
- h. The FAC shall include troubleshooting LED indicators to identify the following conditions:
 - 1) Power On
 - 2) Power Off
 - 3) Download or Startup in progress, not ready for normal operation
 - 4) No Faults
 - 5) Device Fault
 - 6) Field Controller Bus - Normal Data Transmission
 - 7) Field Controller Bus - No Data Transmission
 - 8) Field Controller Bus - No Communication
 - 9) Sensor-Actuator Bus - Normal Data Transmission
 - 10) Sensor-Actuator Bus - No Data Transmission
 - 11) Sensor-Actuator Bus - No Communication
- i. The FAC shall accommodate the direct wiring of analog and binary I/O field points.
- j. The FAC shall support the following types of inputs and outputs:
 - 1) Universal Inputs - shall be configured to monitor any of the following:
 - a) Analog Input, Voltage Mode
 - b) Analog Input, Current Mode
 - c) Analog Input, Resistive Mode
 - d) Binary Input, Dry Contact Maintained Mode
 - e) Binary Input, Pulse Counter Mode
 - 2) Binary Inputs - shall be configured to monitor either of the following:
 - a) Dry Contact Maintained Mode
 - b) Pulse Counter Mode
 - 3) Analog Outputs - shall be configured to output either of the following:
 - a) Analog Output, Voltage Mode
 - b) Analog Output, Current Mode

- 4) Binary Outputs - shall output the following:
 - a) Line-voltage relay outputs
 - b) 24 VAC Triac
- 5) Configurable Outputs - shall be capable of the following:
 - a) Analog Output, Voltage Mode
 - b) Binary Output Mode
- k. The FAC shall have the ability to reside on a Field Controller Bus (FC Bus).
- l. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
- m. The FC Bus shall support communications between the FACs and the NAE.
- n. The FC Bus shall also support Input/Output Module (IOM) communications with the FAC and with the NAE.
- o. The FC Bus shall support a minimum of 100 IOMs and FACs in any combination.
- p. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FAC and the furthest connected device.
- q. The FAC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - 1) The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - 2) The SA Bus shall support a minimum of 10 devices per trunk.
 - 3) The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FAC and the furthest connected device.
- r. The FAC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
- s. The FAC shall support, but not be limited to, the following applications:
- t. Chilled water/central plant optimization applications including but not limited to:
 - 1) Selection and sequencing of up to eight chillers of different sizes
 - 2) Selection and sequencing of up to eight (each) primary and secondary chilled water pumps of varying pumping capacities
 - 3) Selection and sequencing of up to four heat exchangers, of different capacities
 - 4) A proven and documented central cooling plant optimization program that incorporates custom equipment efficiency profiles, without rewriting software code, in order to meet the building load using the least amount of energy as calculated.
 - 5) The use of advanced control algorithms that apply equipment specific parameters, including operational limits and efficiency profiles, in order to determine equipment start and runtime preferences
 - 6) Identification of the most efficient equipment combination and automatic control of state and speed of all necessary equipment to balance runtime, optimize timing and sequencing and ensure the efficiency and stability of the central cooling plant

- 7) Control definition for the chiller plant in a single FAC, FEC, or NCE, as supported by available memory and point Input/Output (I/O), or capable of being split across multiple FACs, FECs, or NCEs
 - a) Heating central plant applications
 - b) Built-up air handling units for special applications
 - c) Terminal & package units
 - d) Special programs as required for systems control

2. The FAC shall support a Local Controller Display (DIS-1710) either as an integral part of the FAC or as a remote device communicating over the SA Bus.
 - a. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.
 - b. The Display shall allow the user to view monitored points without logging into the system.
 - c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
 - d. The Display shall provide password protection with user adjustable password timeout.
 - e. The Display shall be menu driven with separate paths for:
 - 1) Input/Output
 - 2) Parameter/Setpoint
 - 3) Overrides
 - f. The Display shall use easy-to-read English text messages.
 - g. The Display shall allow the user to select the points to be shown and in what order.
 - h. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightness and automatic backlight brightening during user interaction.
 - i. The display shall be a minimum of 4 lines and a minimum of 20 characters per line
 - j. The Display shall have a keypad with no more than 6 keys.
 - k. The Display shall be panel mountable.

2.5 FIELD DEVICES

A. Input/Output Module

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.
3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - d. The Conformance Statement shall be submitted 10 days prior to bidding.

- 1) The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 - 2) The IOM shall have a minimum of 4 points to a maximum of 17 points.
 - 3) The IOM shall support the following types of inputs and outputs:
 - e. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - f. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - g. Analog Outputs - shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - h. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - i. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
4. The IOM shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Normal Data Transmission
 - g. No Data Transmission
 - h. No Communication
 5. Network Thermostat
 - a. The network thermostat shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters, a pressure dependent Variable Air Volume System, zoning type systems employing reheat including local hydronic reheat valves, or other similar equipment.
 - b. The Networked Thermostat shall communicate over the FC Bus using BACnet Standard protocol SSPC-135.

- 1) Communications shall be selectable locally at thermostat through the display
- c. The TEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 1) The TEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - 2) A BACnet Protocol Implementation Conformance Statement shall be provided for the TEC.
 - 3) The Conformance Statement shall be submitted 10 days prior to bidding.
- d. The network thermostat shall include a 4.2 inch LED backlit touch screen with the following configurable icons.
- e. Home screen configurable icons include
 - 1) On/Off icon
 - 2) Fan override icon
 - 3) Zone temperature icon
 - 4) Hold temperature icon
 - 5) Zone humidity (on applicable models) icon
 - 6) Occupancy status (on applicable models) icon
 - 7) Temperature setpoint icon
 - 8) Alarm icon
 - 9) Unit status icon
 - 10) Date/Time icon
 - 11) Fan override icon
- f. Home screen non-configurable icon includes
 - 1) Menu icon
6. The network thermostat shall provide the flexibility to support any one of the following inputs:
 - a. Integral indoor air temperature sensor
 - b. Analog input for remote air temperature sensing that supports the following sensor types
 - 1) Nickel
 - 2) Platinum
 - 3) A99B PENN
 - 4) 2.25k ohm NTC
 - 5) 10k ohm NTC
 - 6) 10k ohm NTC Type 3
 - c. Universal input that supports the following configurations
 - 1) Analog sensor
 - 2) Cooling when switch is closed
 - 3) Heating when switch is closed
 - d. Remote indoor air temperature sensor

- e. Two configurable binary inputs with the following configurations
 - 1) Disabled
 - 2) Occupancy
 - 3) Override
 - 4) Remote PIR
 - 5) Dirty filter
 - 6) Service
 - 7) Fan Lock
 - 8) Open door
 - 9) Open window

- f. The network thermostat shall provide the flexibility to support any one of the following fan outputs:
 - 1) Three speed fan control
 - 2) Proportional speed fan control configurable from 0 to 10V

- g. The network thermostat shall provide the flexibility to support any one of the following valve outputs:
 - 1) Two on/off
 - 2) Two floating

- h. The network thermostat shall provide 4 digit passcode security
- i. The network thermostat shall provide the flexibility to adjust the following control parameters:
 - 1) Adjustable maximum setpoint offset from 0 to 20°F
 - 2) Adjustable fan on delay from 0 to 120 seconds
 - 3) Adjustable fan off delay from 0 to 120 seconds
 - 4) Adjustable minimum cooling on time from 0 to 360 seconds
 - 5) Adjustable minimum cooling off time from 0 to 360 seconds
 - 6) Adjustable minimum heating on time from 0 to 360 seconds
 - 7) Adjustable minimum heating off time from 0 to 360 seconds
 - 8) Adjustable minimum reheat on time from 0 to 360 seconds
 - 9) Adjustable minimum reheat off time from 0 to 360 seconds
 - 10) Adjustable stroke time from 5 to 300 seconds
 - 11) Adjustable supply fan minimum command from 0 to 100%
 - 12) Adjustable supply fan Medium command from 0 to 100%
 - 13) Adjustable supply fan high command from 0 to 100%
 - 14) Adjustable reheat minimum damper position from 0 to 100%

- j. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral Passive Infra-Red (PIR) occupancy sensor models.

- k. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral relative humidity sensor model.

- l. The network thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

- m. The network thermostat shall have a temperature accuracy of $\pm 0.9^{\circ}\text{F}/\pm 0.5^{\circ}\text{C}$ at 70.0°F/21.0°C typical calibrated

- n. The network thermostat shall have a humidity accuracy of $\pm 5\%$ RH from 20 to 80% RH at 50 to 90°F (10 to 32°C)
- o. The network thermostat shall provide user equipment visibility from a mobile device through the Mobil Access Portal (MAP) release 4.0 or later.

B. VAV Modular Assembly

- 1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
- 2. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
- 3. The VAV Modular Assembly shall communicate over the Field Controller Bus (FC Bus) using BACnet Standard protocol SSPC-135, Clause 9.
- 4. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
- 5. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
- 6. Inputs:
 - a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - 1) 0-10 VDC Sensors
 - 2) 1000ohm RTDs
 - 3) NTC Thermistors
 - b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
 - c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
 - d. Provide side loop application for humidity control.
- 7. Outputs
 - a. Analog outputs shall provide the following control outputs:
 - 1) 0-10 VDC
 - b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
 - c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
 - d. Application Configuration

- 1) The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

e. Sensor Support

- 1) The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
- 2) The VMA shall support an LCD display room sensor.
- 3) The VMA shall also support standard room sensors as defined by analog input requirements.
- 4) The VMA shall support humidity sensors defined by the AI side loop.

C. Network Sensors

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone Temperature
 - b. Zone Humidity
 - c. Zone Setpoint
 - d. Discharge Air Temperature
 - e. Zone CO2
2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
3. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.
4. The Network Zone Temperature Sensors shall include the following items:
 - a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
 - b. An LED to indicate the status of the Override feature
 - c. A button to toggle the temperature display between Fahrenheit and Celsius
 - d. A button to program the display for temperature or humidity
 - e. A button to initiate a timed override command
 - f. Available in either surface mount, wall mount, or flush mount
 - g. Available with either screw terminals or phone jack
5. The Network Discharge Air Sensors shall include the following:
 - a. 4 inch or 8 inch duct insertion probe
 - b. 10 foot pigtail lead
 - c. Dip Switches for programmable address selection
 - d. Ability to provide an averaging temperature from multiple locations
 - e. Ability to provide a selectable temperature from multiple locations

6. The Network CO2 Zone Sensors shall include the following:
 - a. Available in either surface mount or wall mount
 - b. Available with screw terminals or phone jack
7. Many-To-One Wireless Room Temperature Sensor System

2.6 SYSTEM TOOLS

A. System Configuration Tool (SCT)

1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Automation Engine (NAE) or a Network Integration Engine (NIE).
2. The configuration tool shall provide an archive database for the configuration and application data.
3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
4. The configuration tool shall include the following features:
 - a. Basic system navigation tree for connected networks
 - b. Integration of BACnet enabled devices
 - c. Customized user navigation trees
 - d. Point naming operating parameter setting
 - e. Graphic diagram configuration
 - f. Alarm and event message routing
 - g. Graphical logic connector tool for custom programming
 - h. Downloading, uploading, and archiving databases
5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
 - a. BACnet Devices
6. The configuration tool shall be capable of programming the Field Equipment Controllers.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
 - b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
 - c. The configuration tool shall contain a library of standard applications to be used for configuration.
7. The configuration tool shall be capable of programming the field devices.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
 - b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.

- c. The configuration tool shall contain a library of standard applications to be used for configuration
 8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
 - a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
 - b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
 - c. The wireless connection shall use the Bluetooth Wireless Technology.
- B. Handheld VAV Balancing Sensor (ATV7003)
 1. The sensor shall be a light weight portable device of dimensions not more than 3.2 x 3.2 x 1.0 inches.
 2. The sensor shall be capable of displaying data and setting balancing parameters for VAV control applications.
 3. The sensor shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
 4. The sensor shall be a menu driven device that shall modify itself automatically depending upon what type of application resides in the controller.
 5. The sensor shall contain a dial and two buttons to navigate through the menu and to set balancing parameters.
 6. The sensor shall provide an adjustable time-out parameter that will return the controller to normal operation if the balancing operation is aborted or abandoned.
 7. The sensor shall include the following
 - a. 5 foot retractable cable
 - b. Laminated user guide
 - c. Nylon carrying case
 8. The sensor shall be Underwriters Laboratory UL 916 listed and CSA certified C22.2 N. 205, CFR47.

2.7 INPUT DEVICES

- A. General Requirements
 1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
- B. Temperature Sensors
 1. General Requirements:
 - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
 - b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

- c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .75°F.

C. Room Temperature Sensors

- 1. Room sensors shall be constructed for either surface or wall box mounting.
- 2. Room sensors shall have the following options when specified:
 - a. Setpoint warmer/cooler dial or reset slide switch providing a +3 degree (adjustable) range.
 - b. Individual heating/cooling setpoint slide switches.
 - c. A momentary override request push button for activation of after-hours operation.
 - d. Analog thermometer.

D. Room Temperature Sensors with Integral Display

- 1. Room sensors shall be constructed for either surface or wall box mounting.
- 2. Room sensors shall have an integral LCD display and either a setpoint adjustment dial or setpoint adjustment push buttons, and the following capabilities when specified:
 - a. Display room air temperatures.
 - b. Display and adjust room comfort setpoint.
 - c. Display and adjust fan operation status via push button.
 - d. Override request via Occupancy Override push button with LED status for activation of after-hours operation.
 - e. Override request via setpoint adjustment dial or setpoint adjustment push buttons for activation of after-hours operation.
 - f. Occupancy sensor
 - g. F/C toggle pushbutton to toggle between F and C.
 - h. RH%/Temperature toggle push button to temporarily display RH%

E. Thermo Wells

- 1. Thermowell manufacturer shall have models available in stainless steel, brass body, and copper bulb.
- 2. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and sensor.
- 3. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
- 4. Thermo wells and sensors shall be mounted in a direct mount (no adapter) offering faster installation or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.

5. Thermo wells constructed of 316 stainless steel shall comply with Canadian Registration Number (CRN) pressure vessel rating.

F. Outside Air Sensors

1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
3. Temperature transmitters shall be of NEMA 3R (IP54) or NEMA 4 (IP65) construction and rated for ambient temperatures.
4. The outdoor sensor can be easily mounted on a roof, pole or side of a building utilizing its already assembled mounting bracket.
5. Outside Relative Humidity sensors 0-100% full range of accurate measurement. Operating temperature -4 to 140F (-20 to 60C).
6. Outside temperature sensors operating temperature range is -40 to 140F, +/- .55F (+/- .3C).

G. Duct Mount Sensors

1. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

H. Averaging Sensors

1. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
2. For plenum applications, such as mixed air temperature measurements, a continuous averaging sensor or a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
3. Capillary supports at the sides of the duct shall be provided to support the sensing string.

I. Acceptable Manufacturers: Johnson Controls, Minco.

1. Note: Include others, as appropriate.

J. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Thin Film Capacitance or Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.

4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R (IP54) or NEMA 4 (IP65) enclosure with sealite fittings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Johnson Controls and Vaisala.

K. CO2 Sensors

1. Where shown on the drawings, CO2 sensors shall have the following features:
 - a. Jumper selectable: 0-20mA, 4-20mA & 0-10VDC output
 - b. Liquid Crystal Display
2. The CO2 sensors shall have the ability to monitor and output the following variables as required by the systems sequence of operations:
 - a. Zone carbon-dioxide
3. The CO2 shall transmit the information back to the controller via jumper selectable 0-20mA, 4-20mA & 0-10VDC output signals.
 - a. The CO2 sensors shall provide a maximum output current of 25mA; Maximum output voltage of 12.5V.
 - b. The CO2 sensors shall be FCC compliant to CFR47 Part 15 subpart B Class A.
4. The CO2 Sensors shall be available with
 - a. CO2 reponse time (0-63%) of 1 minute
 - b. Less than 0.083% of full scale/F° temperature dependence of CO2 output
 - c. Long term CO2 stability $\pm 5\%$ of full scale for 5 years
 - d. CO2 measurement accuracy of $\pm(40\text{ppm} + 2.0\%$ of reading)
 - e. CO2 non-linearity of less than 1.0% of full scale
5. The CO2 Sensors may include the following items :
 - a. Relay output module
 - b. Liquid Crystal Display module
 - c. Analog temperature module with linear 0-10VDC output for 32-122F

L. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:
 - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

- c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0" - 20" w.c.)
- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - c. .01-20" w.c. input differential pressure range.
 - d. 4-20 mA output.
 - e. Maintain accuracy up to 20 to 1 ratio turndown.
 - f. Reference Accuracy: +0.2% of full span.
 - g. Acceptable Manufacturers: Setra and Mamac.
3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
- a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - 1) Differential pressure range 10" w.c. to 300 PSI.
 - 2) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable Manufacturers: Setra and Mamac.
4. Building Differential Air Pressure Applications (-1" to +1" w.c.)
- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - 5) Acceptable Manufacturers: Johnson Controls

- 5. Low Differential Air Pressure Applications (0" to 2.5" w.c.)
 - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - 2) 4-20 mA, 0-5 VDC, 0-10 VDC, output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.25%, or 0.5% of full span.
 - c. Acceptable Manufacturers: Johnson Controls and Ruskin.
- 6. Medium Differential Air Pressure Applications (5" to 21" w.c.)
 - a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
 - 1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
 - 2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
 - 3) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable manufacturers: Johnson Controls and Ruskin.

M. Flow Monitoring

- 1. Air Flow Monitoring
 - a. Fan Inlet Air Flow Measuring Stations
 - 1) At the inlet of each fan and near the exit of the inlet sound trap, airflow sensors shall be provided that shall continuously monitor the fan air volumes or velocity pressure.
 - 2) Each sensor shall be surface mount type. Unit shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location through two or four sensing circuits. If a static pressure manifold is used, it shall incorporate dual offset static tips on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20° in the approaching air stream.

- 3) Devices creating fan performance degradation, resulting in additional energy consumption, caused from pressure drop associated with probes or mounting apparatus in the center of the fan inlet are not allowed. The device shall not induce a significant pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Sensor circuit casings shall be constructed of U.L. 94 flame rated, high impact ABS and include a stainless steel thermistor cap that maintains the precise calibrated flow over the heated and ambient measurement points. Each sensor circuit shall consist of two ceramic base, glass encapsulated, thermistors for measuring ambient temperature and velocity. Circuit shall be designed for operation in a wide range of environments, including high humidity (non-condensing) and rapid thermal cycling.
- 4) Acceptable manufacturers are: Johnson Controls or Ebtron Models GTC116P+ or GTC108-F

2. Single Probe Air Flow Measuring Sensor

- a. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a thermal dispersion and utilize one temperature sensor and a heated thermistor. The sensor pair shall measure the air temperature and airflow velocity.

3. Duct Air Flow Measuring Stations

- a. Furnish and install, at locations shown on plans or as in accordance with schedules, an equalized air measuring probe system piped to a high performance pressure transducer or an electronic type airflow temperature measuring station.
- b. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
- c. Assembly shall be AMCA tested and capable of measuring a range from 70 to 5,000 FPM (22 to 1524 MPM).
- d. Equalized air measuring assembly shall measure to $\pm 3\%$ average and consist of 6063T5 extruded aluminum step sensing blade(s) with anodized finish, plenum-rated polyethylene pressure tubing, brass barbed fittings, mounting hardware and a glass-on-silicone capacitance sensor pressure transducer capable of measuring up to five field-selectable pressure ranges up to 2.5 in. w.c.
- e. The transducer shall be accurate to $\pm 0.5\%$, or 0.25% of full scale and be contained in a National Electrical Manufacturer's Association (NEMA) 4 (IP-65) enclosure. Transducer shall be factory mounted and piped to high and low pressure ports through fittings made of brass.
- f. All sensor tubing shall terminate in solid brass barbed fittings.
- g. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
- h. Air straightener shall be provided for sizes over 17 square feet (1.6 sq meter).
- i. Airflow measuring station assemblies shall be fabricated of galvanized steel or aluminum casing of appropriate thickness for slip fits or with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically

fastened to the casing in such a way to withstand velocities up to 5000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.

- j. Equalized air measuring probe assemblies shall be, in all respects, equivalent to Johnson Controls® AD-1250 or AD-1251 airflow measuring systems.
- k. Electronic air measuring station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring probes containing multiple sensor points and a control transmitter that outputs a 4-20 mA linear signal.
- l. Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the sensor circuit(s).
- m. Each sensor circuit shall consist of coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB).
- n. Probe multiplexer circuit(s) shall include a microprocessor that collects data from each PCB and digitally communicates the average airflow and temperature of each probe to a microprocessor based control transmitter.
- o. Multiplexer board shall be encased to prevent moisture damage.
- p. Shielded CAT5e communications cable shall be Underwriters Laboratories Inc.® (UL) plenum-rated with RJ45 terminal connectors. Dust boot covers and gold-plated contacts shall link probes to electronic controller.
- q. Control transmitter shall be capable of processing independent sensing points and shall operate on a fused 24 VAC supply.
- r. Control transmitter shall feature a 16 x 2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.
- s. All electronic components of the assembly shall be Restriction of Hazardous Substances (RoHS) Directive compliant.
- t. Equal to Johnson Controls AD-1252
- u. Installation Considerations
 - 1) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .04" w.c. at 1000 feet per minute, or .11" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 3-5% as determined by AMCA.
 - 2) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be 1.5 inches to facilitate matching connecting ductwork.
 - 3) Where control dampers are shown as part of the airflow measuring station, parallel blade precision controlled volume dampers integral to the station and complete with actuator, and linkage shall be provided.
 - 4) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.
 - a) All air measuring devices shall be tested according to AMCA Standard 610
 - b) Acceptable manufacturers: Johnson Controls, Air Monitor Corp., Tek-Air, Ruskin, and Dietrich Standard.

4. Static Pressure Traverse Probe

- a. Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
 - b. Acceptable manufacturers: Cleveland Controls
5. Shielded Static Air Probe
- a. A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.
 - b. Water Flow Monitoring
 - 1) Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.
 - 2) Acceptable manufacturers: Onicon
- N. Power Monitoring Devices
1. Current Measurement (Amps)
- a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
 - b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
 - 1) Operating frequency – 50 - 400 Hz.
 - 2) Insulation – 0.6 Kv class 10Kv BIL.
 - 3) UL recognized.
 - 4) Five amp secondary.
 - 5) Select current ration as appropriate for application.
 - 6) Acceptable manufacturers: Setra
 - c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - 1) 6X input over amp rating for AC inrushes of up to 120 amps.
 - 2) Manufactured to UL 1244.
 - 3) Accuracy: +.5%, Ripple +1%.
 - 4) Minimum load resistance 30kOhm.
 - 5) Input 0-20 Amps.
 - 6) Output 4-20 mA.
 - 7) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
 - 8) Acceptable manufacturers: Setra
- O. Smoke Detectors

1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 28 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 28, Fire Alarm System.

P. Status and Safety Switches

1. General Requirements
 - a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Current Sensing Switches
 - a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
 - c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
 - d. Acceptable manufacturers: Johnson Controls
3. Air Filter Status Switches
 - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
 - c. Provide appropriate scale range and differential adjustment for intended service.
 - d. Acceptable manufacturers: Johnson Controls, Cleveland Controls
4. Air Flow Switches
 - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
 - b. Acceptable manufacturers: Johnson Controls, Cleveland Controls
5. Air Pressure Safety Switches
 - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
 - c. Acceptable manufacturers: Johnson Controls, Cleveland Controls
6. Water Flow Switches

- a. Water flow switches shall be equal to the Johnson Controls P74.

Q. Low Temperature Limit Switches

1. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
2. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
4. The low temperature limit switch shall be equal to Johnson Controls A70.

R. Control Relays

1. Control Pilot Relays

- a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
- b. Mounting Bases shall be snap-mount.
- c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
- d. Contacts shall be rated for 10 amps at 120VAC.
- e. Relays shall have an integral indicator light and check button.
- f. Acceptable manufacturers: Johnson Controls, Relay In Box (RIB)

2. Lighting Control Relays

- a. Lighting control relays shall be latching with integral status contacts.
- b. Contacts shall be rated for 20 amps at 277 VAC.
- c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
- d. Lighting control relays shall be controlled by:
 - 1) Pulsed Tri-state Output – Preferred method.
 - 2) Pulsed Paired Binary Outputs.
 - 3) A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
- e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

S. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.

4. Acceptable manufacturers: Advanced Control Technologies

T. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

2.8 OUTPUT DEVICES

A. Actuators and Operators

1. General Requirements

- a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
- b. The manufacturer shall be ISO 9001 certified.

B. Electronic Damper Actuators

1. Spring Return Actuators:

- a. Manufactured, brand labeled or distributed by Johnson Controls, Inc. or approved equivalent.
- b. Regulatory Agency Listing: cULus ,CSA C22.2 No. 24-93, and CE marked
- c. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.
- d. Coupling: toothed V-bolt clamp and nuts with toothed cradle.
- e. Reversible Mounting: Provides either clockwise or counterclockwise operation.
- f. Power Failure Operation: Mechanical spring return system drives load to the home position. Other forms of internal energy storage for power failure operation are not acceptable.
- g. Motor Technology:
 - 1) Modulating Types: Microprocessor-controlled Brushless DC motor
 - 2) On/Off Types: DC brush motor.
- h. Overload Protection: Electronic stall detection protects from overload at all angles of rotation without the use of end switches.
- i. Enclosure Ratings: NEMA type 2 / IP54 mounted in any orientation.
- j. Double-Insulated construction: Eliminate the need for electrical ground wires.
- k. Wiring: Integral cables with colored and numbered conductors.
- l. Sized for torque required to seal damper at load conditions
- m. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
- n. Proportional actuators shall be user configurable without the use of external computer software or programming tools. Calibration, input signal range selection, and control logic reversal shall be selectable with an external mode selection switch.
- o. Operating Temperature Range:

- 1) 70 lb·in. Torque and Below: -40°F to 140°F
 - 2) 71 lb·in. Torque and above: -40°F to 131°F
- p. Power Requirements:
- 1) Modulating Types:
 - a) 27 lb·in. Torque and Below: 5VA maximum
 - b) 70 lb·in. to 19 lb·in.Torque: 8VA maximum
 - c) 89 lb·in. to 71 lb·in.Torque: 10VA maximum
 - d) 90 lb·in. to 177 lb·in.Torque: 16VA maximum
 - 2) 2-Position Types:
 - a) 27 lb·in. Torque and Below: 5VA maximum
 - b) 70 lb·in. to 19 lb·in.Torque: 7VA maximum
 - c) 71 lb·in. to 177 lb·in.Torque: 25VA maximum
2. Non-Spring Return Actuators:
- a. Manufactured, brand labeled or distributed by Johnson Controls, Inc. or approved equivalent.
 - b. Regulatory Agency: UL Listed ,CSA Certified, and CE marked
 - c. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.
 - d. Coupling:
 - 1) Above 80 lb·in.: toothed V-bolt clamp and nuts with toothed cradled
 - 2) 80 lb·in.and below: single cup-point set screw and toothed cradle.
 - e. Overload Protection: Electronic stall detection or magnetic slip clutch protects from overload at all angles of rotation without the use of end switches.
 - f. Minimum Enclosure Ratings:
 - 1) Types with covered wiring terminals: NEMA type 2 / IP42 mounted in any orientation.
 - 2) Types without covered wiring terminals: NEMA type 1 / IP30 or IP40.
 - 3) Types with integrated cables: NEMA 2 / IP42 mounted in any orientation.
 - g. Sized for torque required to seal damper at load conditions
 - h. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
 - i. Proportional actuators shall be user configurable without the use of external computer software or programming tools.
 - j. Operating Temperature Range: -4°F to 122°F except for VAV and similar indoor applications in which case 32°F to 122°F is acceptable.
 - k. Power Requirements: 24 V with models available for both 24 VAC and 24 VDC operation, maximum
 - 1) Above 80 lb·in.: 7.5 VA at 24 VAC
 - 2) 80 lb·in.and below: 3.5 VA at 24VAC

- I. The manufacturer shall provide 5-year limited warranty from the date of sale covering defects in material or workmanship.

2.9 CONTROL VALVES

A. Pressure Independent Valves, 1/2 through 6 in.

1. Acceptable Manufacturers:
 - a. IMI Hydronics / TA (TA-Fusion P / TA-Compact P / TA Modulator)
2. The valve should be a control valve with adjustable, stepless, pre-settable balancing and built-in dp-controller. It shall be supplied and installed as shown on the drawings to ensure proper balancing and performs the control function for water flows.
3. The valve shall be pressure independent with integral spring and diaphragm arrangement for integral differential pressure control over built in control section.
4. The valve/actuator shall have retained EQM characteristic for all recommended pre-settings.
5. Test points shall be provided for measuring differential pressure and be integral with the body and incorporate means for positive leak tight shutoff when not in use.
6. True flow measurement must be possible with balancing instrument. Flow deviation max +/- 10%. Measurement of differential pressure with no valve coefficient will not suffice.
7. The valve shall have the capacity for manual, leak tight shutoff without the actuator attached for maintenance purposes and to allow measurement of available differential pressure for diagnostics.
8. It should be possible to perform a high speed flush with the valve installed in the system without causing damage to the product and without removing / replacing any parts.
9. The valve shall have a minimum valve authority rating of 0.75.
10. Material: Valve body with connection in sizes 1 1/2" to 2" shall be made of dezincification resistant alloy brass with a pressure rating of 235 psi. Sizes 2 1/2 - 6" shall consist of ductile iron housings and stainless steel valve plugs with a pressure rating of 365 psi. The minimum differential pressure shall be 5 psi.
11. Material: Valve body and insert with connection sizes 3/8" to 1 1/4" shall be of dezincification resistant alloy brass with stainless steel valve plug, spindle, and spring. EPDM membrane and o-rings with a pressure rating of 230 psi. The minimum differential pressure shall be 3 psi.
12. Threaded connections shall be NPT in accordance with ANSI/ASME B1.20.1-1983.
13. Valve actuators shall be full modulating, low voltage (24VAC) and of the same manufacturer as the control valve.

2.10 CONTROL DAMPERS

- A. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
 1. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

2. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
 3. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
 4. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.
 - a. Acceptable manufacturers are Johnson Controls VD-1250, VD1630, or VD-1330, Ruskin CD50 or CD60, and Vent Products 5650.
- B. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.
1. Acceptable manufacturers are: Johnson Controls VD-1620, VD-1320, Ruskin CD36, and Vent Products 5800.
 2. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

2.11 MISCELLANEOUS DEVICES

- A. Variable Frequency Motor Speed Control Drives
1. See specification section 23 0514 Variable Frequency Drives for requirements.
 2. Local Control Panels
 - a. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush
 - b. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
 - c. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
 - d. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
 - e. All wiring shall be neatly installed in plastic trays or tie-wrapped.

- f. A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.
3. Power Supplies
- a. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
 - b. Input: 120 VAC +10%, 60Hz.
 - c. Output: 24 VDC.
 - d. Line Regulation: +0.05% for 10% line change.
 - e. Load Regulation: +0.05% for 50% load change.
 - f. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
 - g. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
 - h. A power disconnect switch shall be provided next to the power supply.
- B. Gas Monitoring System
1. General:
- a. Contractor will furnish, install and place in operating condition a hazardous gas monitoring system suitable for detecting combustible gas and various toxic gases. The system shall be installed in accordance with the drawings and as specified herein complete with all accessories necessary for proper operation.
 - b. The system shall be designed to minimize the risk to personnel and facilities of exposure to dangerously high concentrations of gases. Also, inherent in the system design will be internal, continuous self-diagnostics to ensure the system is operating properly.
 - c. Products used in the work of this Section shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of satisfactory production acceptable to the Engineer. The manufacturer shall have an ISO 9001:2008 Registered Quality Control System in place and approved.
 - d. The controller shall be FM Approved. Combustible gas sensor modules shall also be FM approved (hazardous location and performance) and SIL-2 Certified. The combustible gas sensor shall have FM hazardous locations approval per FM Specification 3600, and FM Performance approval per FM Specification 6320.
 - e. The Contractor shall be responsible to ensure that all equipment items and accessories supplied as part of the gas monitoring system are compatible and will operate as a complete working system. The controller shall be capable of accepting a signal from any combination of combustible gas, or toxic gas sensors utilizing SentryBus, Modbus RTU, 4-20 mA or digital output.
 - f. The equipment shall be manufactured by Sierra Monitor Corporation, 1991 Tarob Court, Milpitas, CA 95035 USA, Phone (408) 262-6611, Fax (408) 262-9042, or approved equivalent.
2. Operation (Controller)
- a. The controller shall be capable of:
 - 1) Accepting input from devices utilizing 4-20 mA (2, 3 or 4-wire per ISA specifications), RS-485 Modbus RTU, SentryBus and binary (supervised or digital).

- 2) Large 5.7" color, backlit touch-screen interface with appropriate bar charts, text data screens necessary for display of operation and configuration/set-up.
- 3) Interface up to 32 module addresses
- 4) Capable of 4-20 mA (2 or 3-wire) output, SPDT relays, digital output
- 5) Multiple protocol communication
- 6) Capable of remote operation via WebServer or remote terminal
- 7) Configuration of the controller system shall be easy and meet user defined needs in terms of input, output, power and signal
- 8) There shall be a Warning and Alarm (Low and High) level alarm for each sensor and a trouble alarm for each controller. The type of alarm shall be annunciated on the controller display panel with an alarm LED.

3. Operation (Sensors)

- a. The sensor/transmitters shall have a minimum of 180 day calibration interval for the toxic gas sensor and 365 days for combustible gas sensor module.
- b. The gas sensor module must be able to be calibrated without opening the enclosure (non-intrusive calibration) using a magnetic wand to activate four keys.
- c. Utilizing an integral display and magnetic wand activated keys, the sensor module must have a menu-driven procedure for calibration, set-up, maintenance and alarm reset.
- d. Sensor module will have user selectable ranges.
- e. Operating temperature for toxic gas sensor modules shall be 4 degree F to plus 122 degree F.
- f. Operating temperature for toxic gas sensors shall be -4 degree F to 140 degree F.
- g. Operating ranges shall be up to 1200 PPM (User adjustable) for Carbon Monoxide gas sensor modules
- h. Operating ranges shall be 0 to 100% LEL for the combustible gas sensors.
- i. There shall be a high and a low level alarm for each sensor and a trouble alarm for each controller. The type of alarm shall be annunciated on the controller display panel with an alarm LED.
- j. The 5 amp alarm Relays for Alarm, Warning, and ¼ amp Trouble relay will be integral to the sensor module and will activate circuitry for remote alarm indication.
- k. HART communication for set up and diagnostics.

4. Interconnectivity

- a. Sensor module shall include multiple interface/connectivity capabilities, including:
 - 1) 4-20 mA output (selectable as Type 3 3-wire circuit or Type 4 4-wire circuit). 4-20 mA output will have:
 - a) User-selectable values for output during calibration and trouble conditions
 - b) Interface testing during set-up confirming 4mA and 20 mA matching between the module and the interface device
- b. RS-485 digital interface utilizing Modbus RTU protocol with baud rate user-adjustable between 2400 and 38400 baud. Manufacturer will supply a complete Modbus memory map that shall include addresses for:

- 1) Concentration
 - 2) High Alarm Value
 - 3) Low Alarm Value
 - 4) High Alarm Relay status
 - 5) Low Alarm Relay status
 - 6) Range
 - 7) Units
 - 8) Module number
- c. SentryBus digital interface to enable interconnectivity to Sentry controllers.
 - d. Integral High and Low alarm relays (SPDT type):
 - e. A minimum of 5 Amps to enable interface to control devices.
 - f. Shall be integral to the sensor module and field-selectable through non-intrusive means, without use of an external remote control unit. Selectable features include:
 - 1) Alarm level
 - 2) Latching/Non-Latching
 - 3) Sentry control or Module control
5. Sensor Enclosure
 - a. Sensor and transmitter housing for all gas sensor modules shall be FM or ATEX approved explosion proof for use in Class 1, Division I, Groups B, C and D areas.
 - b. Enclosures shall have a NEMA 4 rating and available in either epoxy-coated, die-cast copper-free aluminum or 316 Stainless Steel.
 6. Sensor Calibration
 - a. Calibration shall be single-person, auto-adjusting without any manual adjustments required and without exposing circuit electronics to the atmosphere. Global calibration procedure controls all calibration functions at IT Controller.
 - b. A calibration system shall be available consisting of cylinders of calibration gas plus pressure and flow regulator for delivery of the calibration gas to the sensor.
 7. Approvals
 - a. Combustibles and primary toxic gas sensor modules shall be SIL-2 Certified.
 - b. The combustible gas sensor module and controller shall have FM Performance approval.
 - c. The combustible gas sensor shall have FM hazardous locations approval per FM Specification 3600, and FM Performance approval per FM Specification 6320.
 - d. Manufacturer must be ISO9001:2008 certified.

PART 3 - PERFORMANCE/EXECUTION

3.1 BMS SPECIFIC REQUIREMENTS

A. Existing BMS

1. Coordinate the provision installation of all materials, UI and IoT componentry to be compatible with existing JPSTC front end system architecture.

B. Graphic Displays

1. The naming/numbering/tagging convention used must be a coordinated effort between the Mechanical Contractor, Controls Contractor, Owner, Design-Builder, and A/E and must be approved by all parties prior to implementation. The naming/numbering/tagging convention must be consistent and reflected through the building automation control system, charts, diagrams, tagging and O&M manuals.
2. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library. Utilize existing main building graphic icons and symbology.
3. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.
4. Custom Reports:
 - a. Provide custom reports as required for this project
5. Actuation / Control Type
6. Primary Equipment
 - a. Controls shall be provided by equipment manufacturer as specified herein.
 - b. All damper and valve actuation shall be electric.
7. Air Handling Equipment
 - a. All air handlers shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.
8. Terminal Equipment:
 - a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
 - b. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 INSTALLATION PRACTICES

A. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

a. Class 2 Wiring

- 1) All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - 2) Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
4. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 5. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BMS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 26.
2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BMS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BMS Panel Installation

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Air Flow Measuring Stations:
 - a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
 - b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

10. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.

11. Space Sensors:
 - a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

12. Low Temperature Limit Switches:
 - a. Install on the discharge side of the first water coil in the air stream.
 - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

13. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.

14. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
 - 1) HVAC Output Devices
 - 2) All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
 - 3) Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
 - 4) Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 - 5) Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI.
 - 6) Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation

transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 TRAINING

~~A. The BMS contractor shall provide the following training services:-~~

- ~~1. Provide 40 hours, broke down into 4 hour sessions, covering a minimum of 2 staff shifts, of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.~~
- ~~2. Provide 1 week of factory training for two people.~~
- ~~3. Provide 20 additional hours of on-site training after one year of facility operation.~~
4. The Contractor shall provide a detailed syllabus to the City for review and approval 14 calendar days prior to training.

B. General Requirements

1. The Contractor shall provide O&M manuals to the individuals to be trained 7 calendar days prior to training.
2. The Contractor shall provide a Training Manual that address training specific items that are not contained in the O&M manuals. This may include manufacture specific training documents used to train technicians in the Tridium software, JACE configuration, and operation of meters. Material may include sample projects, tests, or exercises used to demonstrate project specific trouble shooting or service techniques. Materials shall be provided for each individual being trained.
3. The City shall provide sufficient quantity of computers for the number of personal to be trained. Contractor shall assist with the connection of these PCs to the BMS.
4. The Contractor shall be responsible for providing an onsite projection device and screen to be connected to a computer which is on the BMS network for training purposes.
5. Training room will be provided by the City at the intersection of 1869 W PERSHING ROAD.
6. All software related training and equipment overview shall utilize interactive overhead computer screen projection equipment. The Contractor shall utilize the GUI for system training to illustrate control, sequences, and operation of equipment. The Contractor shall provide the capabilities to train a minimum of five (5) operating staff using networked PCs provided by the City which are of similar style and processing capabilities as the specified User Interface Hardware.

C. General Instructional Requirements

1. Training shall be performed by qualified staff with previous training experience. Qualified staff must be Tridium certified and shall be an expert on the configuration, use, and applications associated with the GUI. The Contractor shall have the lead programmer(s) which have been assigned to this job for the development of the GUI databases and applications on site to give an overview and to field project specific questions pertaining to site specific programming and operational issues.
2. All training performed shall reference site specific installation examples whenever possible. Training shall utilize specified manuals, as built documentation, and the on line help utilities.

3. If the City's staff to be trained can not all attend a single scheduled training session due to work schedules or shift work then at the BMS's options the required training hours and topics can be split between two or more days as required to meet the needs of BMS's staff.
 - a. If all hours denoted to training are not used the City reserves the right to apply these hours to perform additional software optimization assistance.

D. Onsite Training Program

1. The Contractor shall provide forty (40) hours of training as defined in this specification.
2. The Contractor shall provide training in accordance with the construction schedule. Training shall occur at a scheduled time encompassing all items identified in these specifications. Continual onsite training throughout the construction project shall not be accepted.
 - a. Preliminary Training Session
 - b. Brief introduction on the open protocol technology and web enterprise connectivity.
 - c. Tridium graphical user interface. Illustrate to BMS's facility engineers how to navigate the new GUI. Provide graphics to illustrate. This shall include:
 - 1) Accessing the system and logging in
 - 2) User names and passwords
 - 3) System navigation (browser commands)
 - 4) Alarming acknowledgment
 - 5) Setpoint adjustment
 - 6) Adjusting overrides, making commands
 - 7) Basic trending and graphing
3. Final Project Training: Upon completion of the system construction the Contractor shall proceed with final training on the following:
 - a. JACE
 - 1) Network controller operation and maintenance.
 - 2) Sign on sign off.
 - 3) Purge and/or dump of historical data.
 - 4) Scheduling.
 - 5) Selection of displays and reports.
 - 6) Commanding of points, keyboard and mouse mode.
 - 7) Modifying English text.
 - 8) Use of dialogue boxes and menus.
 - 9) Modifying warning limits, alarm limits and start stop times.
 - 10) System initialization.
 - b. BMS GUI
 - 1) BMS GUI access via web browser IP address.

- 2) Navigation through system tree and equipment pages.
 - 3) Password assignment/modification.
 - 4) Operator assignment/modification.
 - 5) Operator authority assignment/modification.
 - 6) Modifying setpoints and setting temporary overrides.
 - 7) Alarm notification assignments/modification/acknowledgement.
 - 8) Viewing and Printing Trends
- c. Facility Level Graphical User Interface encompassing at a minimum:
- 1) GUI access via web browser IP address.
 - 2) Navigation through system tree and equipment pages.
 - 3) Password assignment/modification.
 - 4) Operator assignment/modification.
 - 5) Operator authority assignment/modification.
 - 6) Modifying set points and setting temporary overrides.
 - 7) Alarm notification assignments/modification/acknowledgement.
 - 8) Viewing and Printing Trends
- d. Meter Training encompassing the minimum.
- 1) Basic operation of the meters.
 - 2) Reading meter values and changing the display at the meter interface(where applicable)
4. In addition the to the 40 required hours provide an additional 16 hours of on site training time for the BMS's personal to use at their discretion, or to further customize existing control strategies, enhance system graphics, create custom reports, etc.

E. Training Deliverables

- a. At the time of training the contractor shall deliver the following items:
- 1) All system user names and passwords including passwords to admin level rights.
 - 2) Two unrestricted copies of the GUI database. Provide training on how to perform future backups of this database.
 - 3) Approved O&M manuals, Training Material, and As Built documentation.
 - 4) Video of training session shall be provided to the City with in 14 calendar days from the completion of training.

3.4 COMMISSIONING

- A. Fully commission all aspects of the Building Management System work.

1. Acceptance Check Sheet

- a. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.
 - b. Submit the check sheet to the Engineer for approval
 - c. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.
2. VAV box performance verification and documentation:
- a. The BMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 - b. The BMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.
3. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

B. Commissioning Submittals

1. The following data shall be provided to the City for approval. For verification forms pertaining to large equipment the City will submit sample check sheets prior to testing all equipment.
2. The Contractor will receive a written request from the City requesting specific information needed about each piece of commissioned equipment or system. The contractor shall abide by this request.
3. Provide an updated version of the general submittals defined above and indicate as built conditions.
4. Submit Start Up Checklists and manufacturer's start up procedures for all equipment and devices.
5. Submit Start Up Test Agenda and Schedule for review and approval.
6. Submit completed BAS Start Up Reports.
7. Manufactures start up data such as installation, and O&M procedures as requested by the City.
8. Provide field check out sheets completed by installation representatives or manufacturer's factory testing check out forms as requested by the City.
9. Point to Point check out documentation including corrective actions taken for all issues resolved.
10. Proposed project schedule as it relates to the Central Monitoring Facility setup, metering and control device installations, and the Contractor Check Out procedures. The schedule shall include, milestone dates, completion dates, and CCO activities. This schedule shall be provided to the City of Chicago 45 days prior to the first CCO activity taking place.
11. Certification of fully calibrated testing equipment used by the contractor for CCO testing is to be provided.
12. Prior to installation development, submit on sample screen captures demonstrating the basic look, feel, function, and navigation to be achieved at the Building Management System. This shall include sample screen captures of the following:

- a. Home Page
- b. Summary pages
- c. Dash boards
- d. Navigation Tree
- e. Metering / utility monitoring pages
- f. Alarm pages
- g. Major equipment such as AHU's, Central Plants, VAV
- h. Trend Data illustrations
- i. Basic Graphics to be utilized

END OF SECTION 23 09 00

PART 1 - GENERAL**1.1 SYSTEM DESCRIPTION****A. General Requirements**

1. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
2. The specified unit shall be based upon standard components and proven technology using open and published protocols.

B. Sustainability

1. The specified unit shall be manufactured in accordance with ISO 14001.
2. The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).

C. The specified unit shall carry the following EMC approvals:

1. EN55032: 2015
2. EN55024: 2010
3. 2014/35/EU
4. 2014/30/EU
5. 2012/19/EU
6. 2011/65/EU
7. EN 55032 Class A
8. EN 55032 Class B
9. EN 55024
10. FCC Part 15 - Subpart B Class A
11. FCC Part 15 - Subpart B Class B
12. FCC Part 15 - Subpart B Class A + B
13. ICES-003 Class A
14. ICES-003 Class B

D. The specified unit shall meet the following product safety standards:

1. IEC/EN/UL 60950-1

E. The specified unit shall meet the following standards

1. Audio:
 - a. G.711
 - b. G.729
 - c. G.722 (wideband)
 - d. L16 / 16kHz (wideband)
2. Video:
 - a. H.264 (MPEG-4 AVC)

3. Networking:

- a. IEEE 802.3af/802.3at (Power over Ethernet) [applies to products with PoE]
- b. IEEE 802.1X (Authentication)
- c. IPv4 (RFC 791)
- d. QoS
- 4. Mechanical Environment:
 - a. EN90529 IP69K
 - b. IEC/EN 62262 IK10

1.2 QUALITY ASSURANCE

- A. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
 - 1. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
 - 2. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
 - 3. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
 - 4. The specified unit shall be manufactured in accordance with ISO9001.

1.3 WARRANTY

- A. All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years.
- B. The manufacturer shall provide warranty and optional extended warranty for the unit for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

1.4 System Description

- 1. Master Station
 - a. Aiphone IX-MV7-H (~~Existing — Previous Project~~)
- 2. Door Station
 - a. Aiphone IX-DVF-10KP
 - b. Provide to access existing master station
 - 1) Re-Configure master station
 - 2) Duplicate existing functionality for door/gate stations

- 3) Coordinate mounting with bollards provided by others
- 4) Cable for gate actuation.

PART 2 - PRODUCTS

2.1 General

- A. Intercoms shall be IP-based and comply with established network and video standards.
- B. Intercoms shall be powered by the switch utilizing the network cable.
- C. Intercoms shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

2.2 Intercom schedule

- A. Intercom types listed below describing various resolutions, form-factor and features shall be supplied by a single intercom manufacturer.
- B. The intercom manufacture will be as follows:
 1. AI Phone.
 - a. IX-DV(F) -10KP

2.3 Intercom

- A. IP intercom
 1. The intercom shall meet or exceed the following design specifications:
 2. Power Source
 - a. PoE (IEEE 802.3af class 0)
 3. Power Draw
 - a. 5.28 Watts
 4. Camera
 - a. 1/3" CMOS 1.23 megapixel
 5. Min. illumination
 - a. 5 lux
 6. Audio Codec
 - a. G.711 (μ -law, A law), G.722
 7. Video Codec
 - a. H.264/AVC, motion JPEG
 8. Protocols
 - a. IPv4, IPv6, TCP, UDP, SIP, HTTP, HTTPS, RTSP, RTP, RTCP, IGMP, MLD, SMTP, FTP, DHCP, NTP, DNS
 9. Port Security
 - a. IEEE 802.1X

10. Operating Temp
 - a. -40° - 140°F (-40° - 60°C)
11. Protection
 - a. IP54, IK08
12. Dimensions
 - a. 8-1/16" H x 4-1/2" W x 2-1/16" D
13. Mounting
 - a. Coordinated with Bollard supplier.

PART 3 - Execution

3.1 Installation

- A. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
 1. System shall be configured to connect to existing
- B. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- C. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer.
- D. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

END OF SECTION

ABBREVIATIONS

Table of abbreviations for architectural elements like AAF ABOVE ACCESS FLOOR, ACST ACUSTICAL, ADJ ADJACENT, etc.

ABBREVIATIONS

Table of abbreviations for materials and finishes like HW HARDWARE, HM HOLLOW METAL, HORIZ HORIZONTAL, etc.

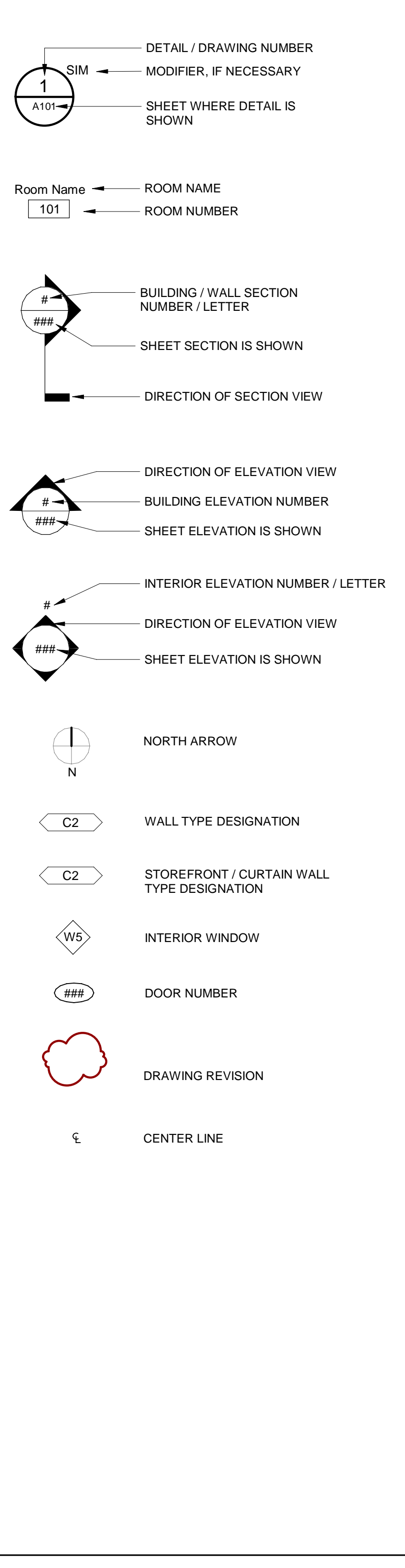
ABBREVIATIONS

Table of abbreviations for structural and mechanical components like T TREAD / TILE, T&B TOP AND BOTTOM, T&G TONGUE AND GROOVE, etc.

GENERAL NOTES - PROJECT

- A. THE CONSTRUCTION DRAWINGS ILLUSTRATE THE DESIGN INTENT OF THE WORK... B. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF ALL APPLICABLE STATE AND/OR LOCAL CODES... C. DO NOT SCALE DRAWINGS... D. FIELD VERIFY ALL DIMENSIONS PRIOR TO START OF WORK...

SYMBOLS



SHEET INDEX

Table listing sheet numbers and names, categorized by GENERAL, LIFE SAFETY, LANDSCAPE, ARCHITECTURE, and IT & SECURITY.

SHEET INDEX

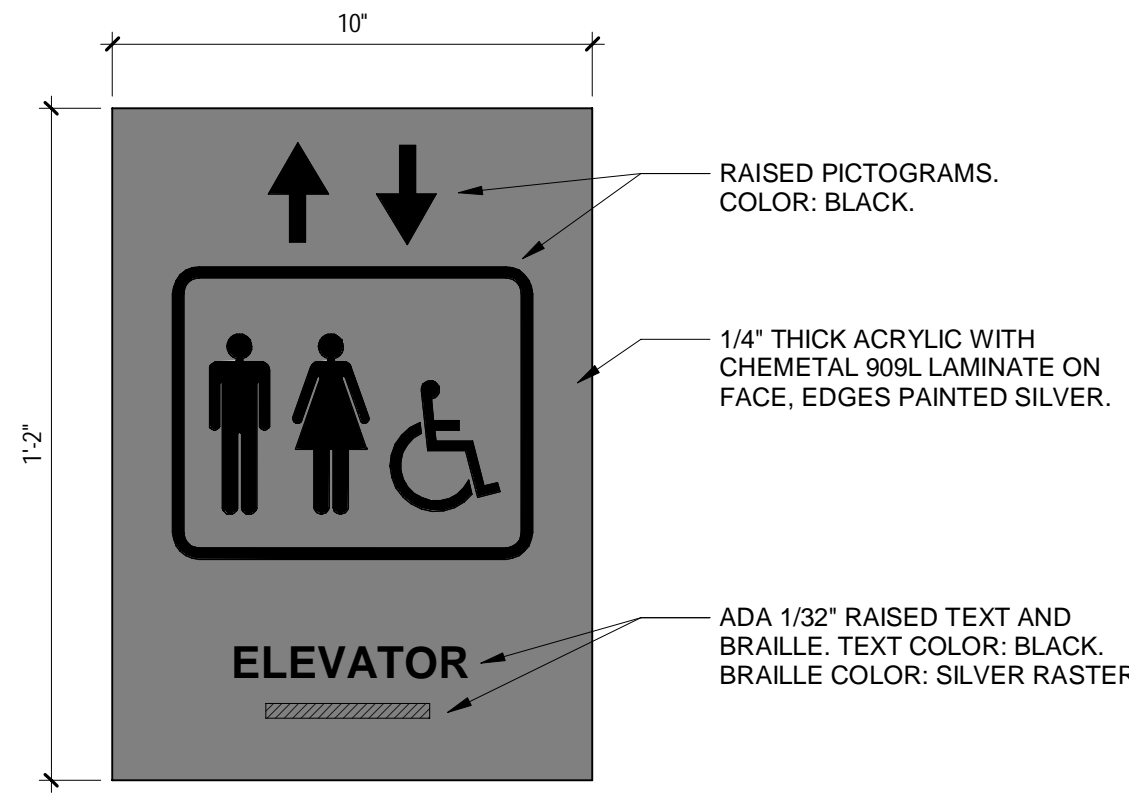
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Project information including AECOM logo, Project name (Emergency Medical Services (EMS) Addition), Client (2FM), Consultants (ARCHITRAVE LIMITED, ABERCROMBIE PLANNING+DESIGN, MILHOUSE ENGINEERING, JACOBS / RYAN ASSOCIATES, LEVEL-1 GLOBAL SOLUTIONS), and Registration details.

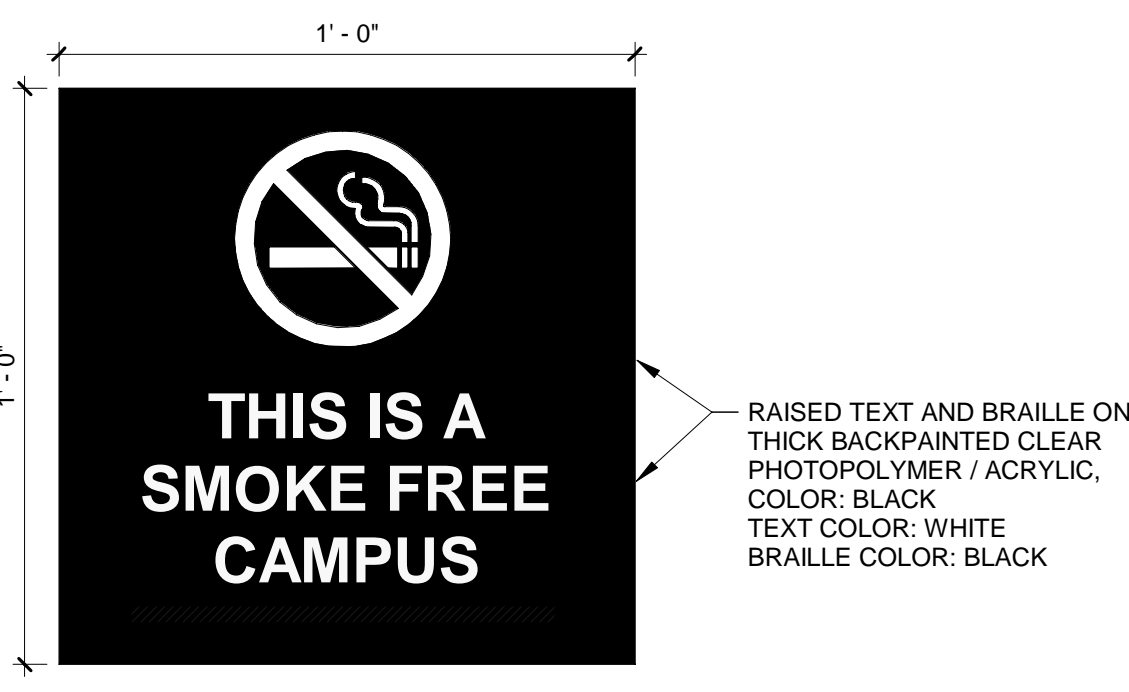
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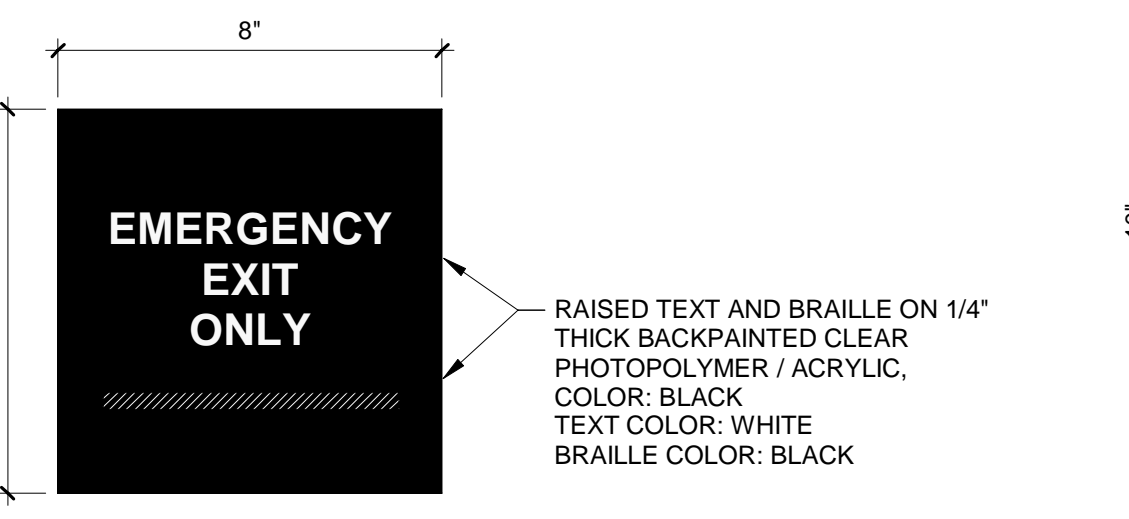
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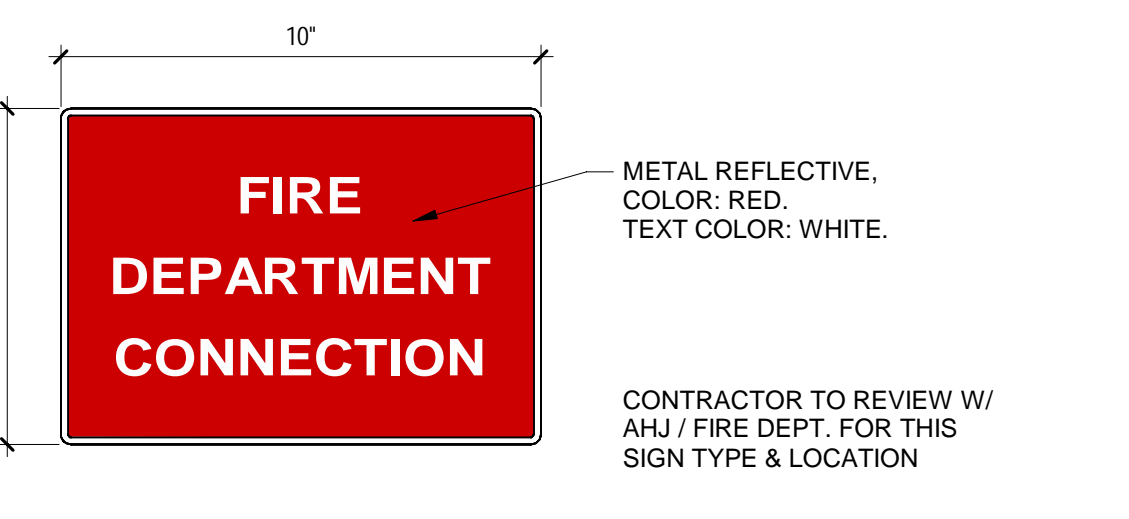
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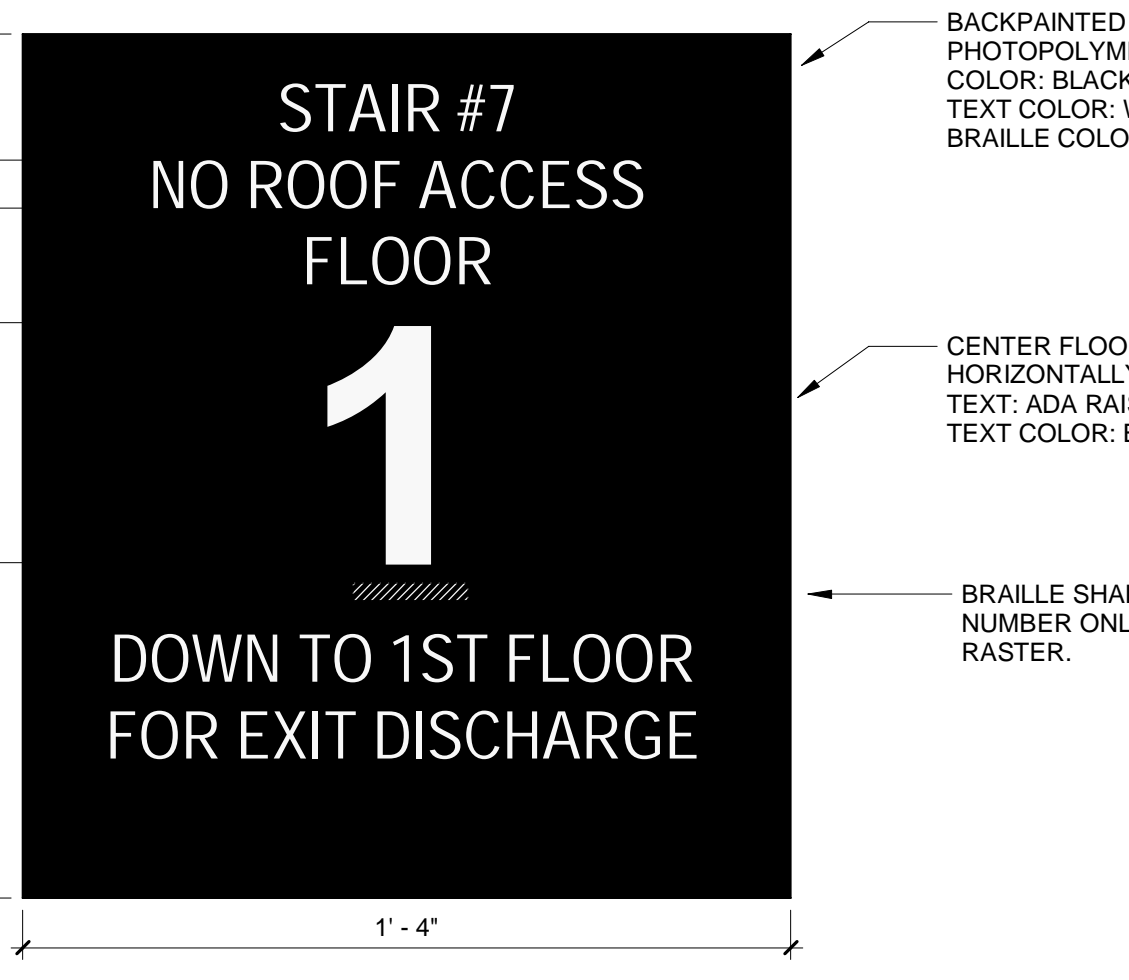
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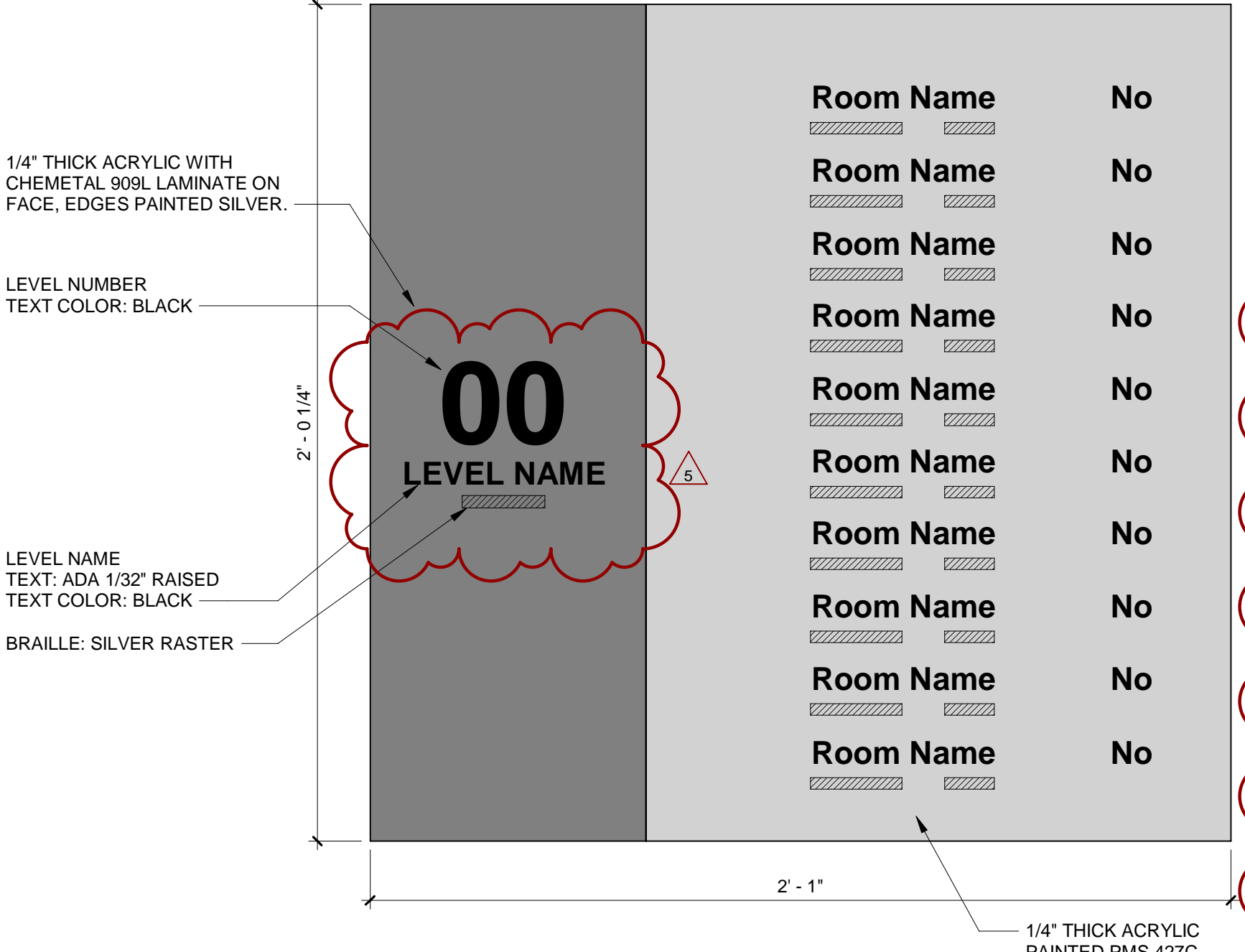
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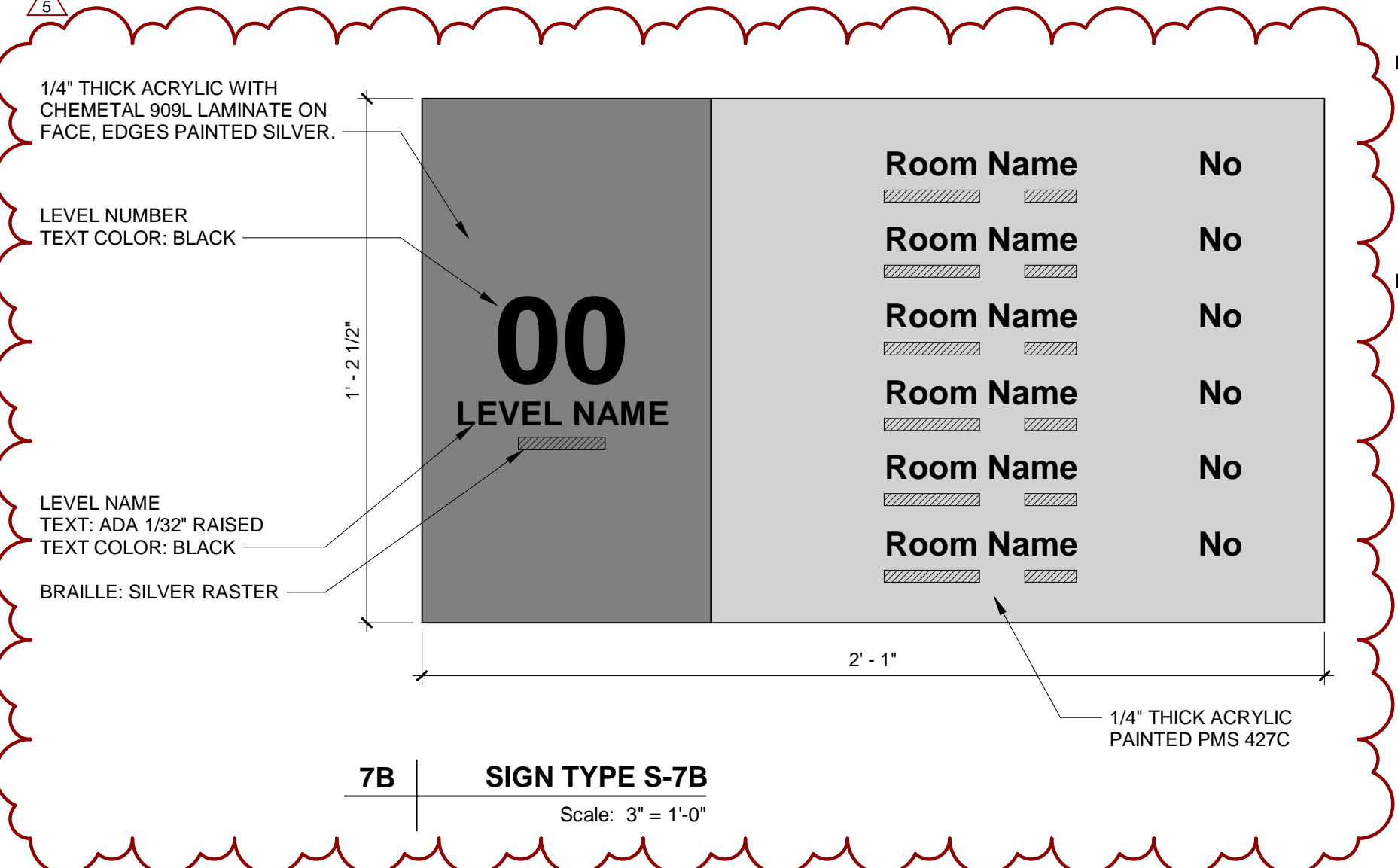
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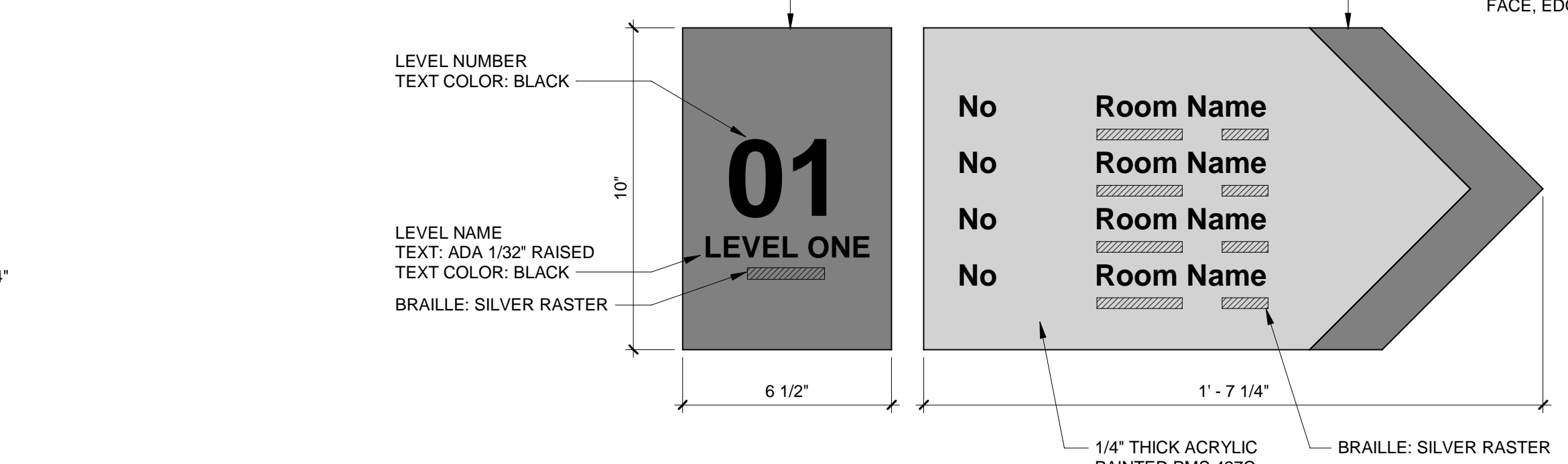
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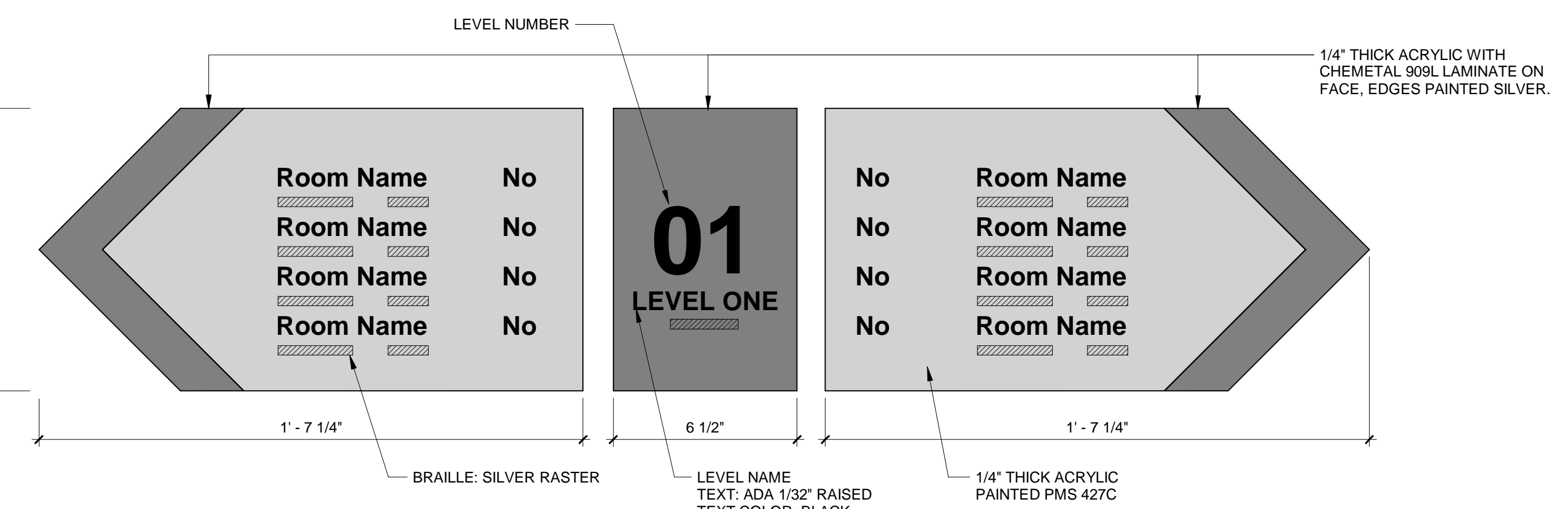
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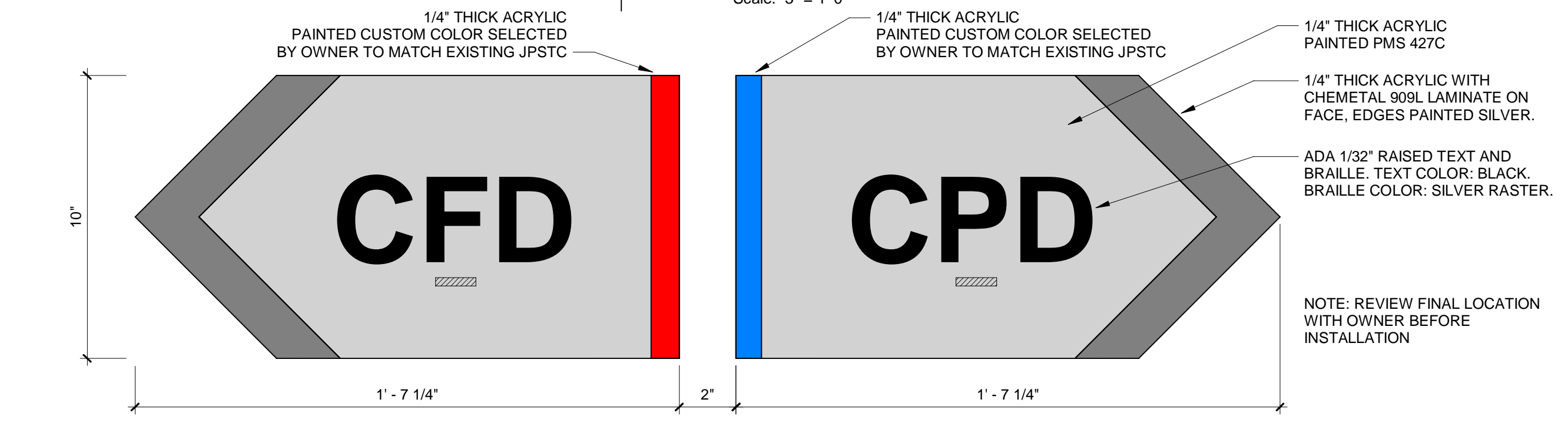
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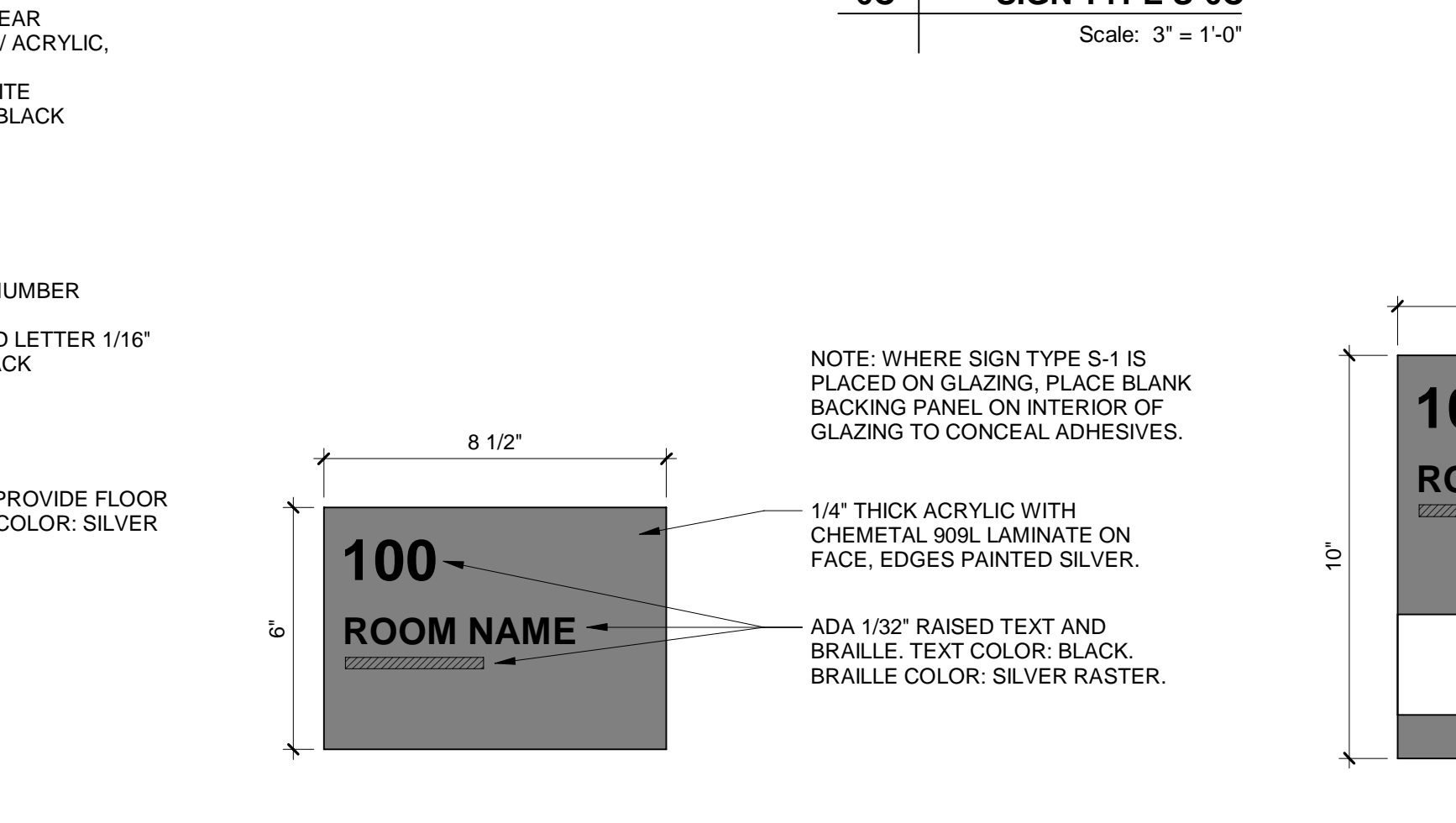
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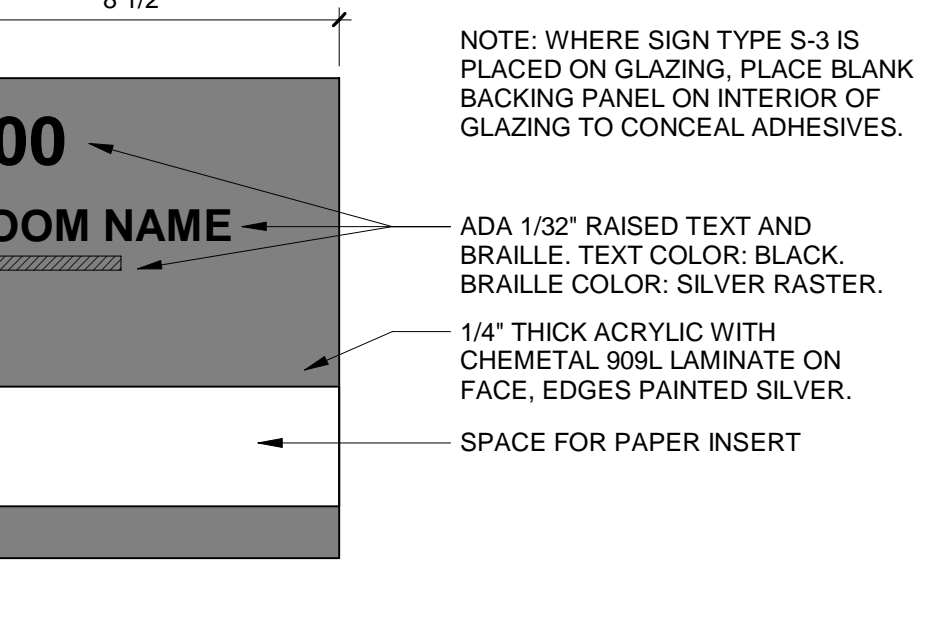
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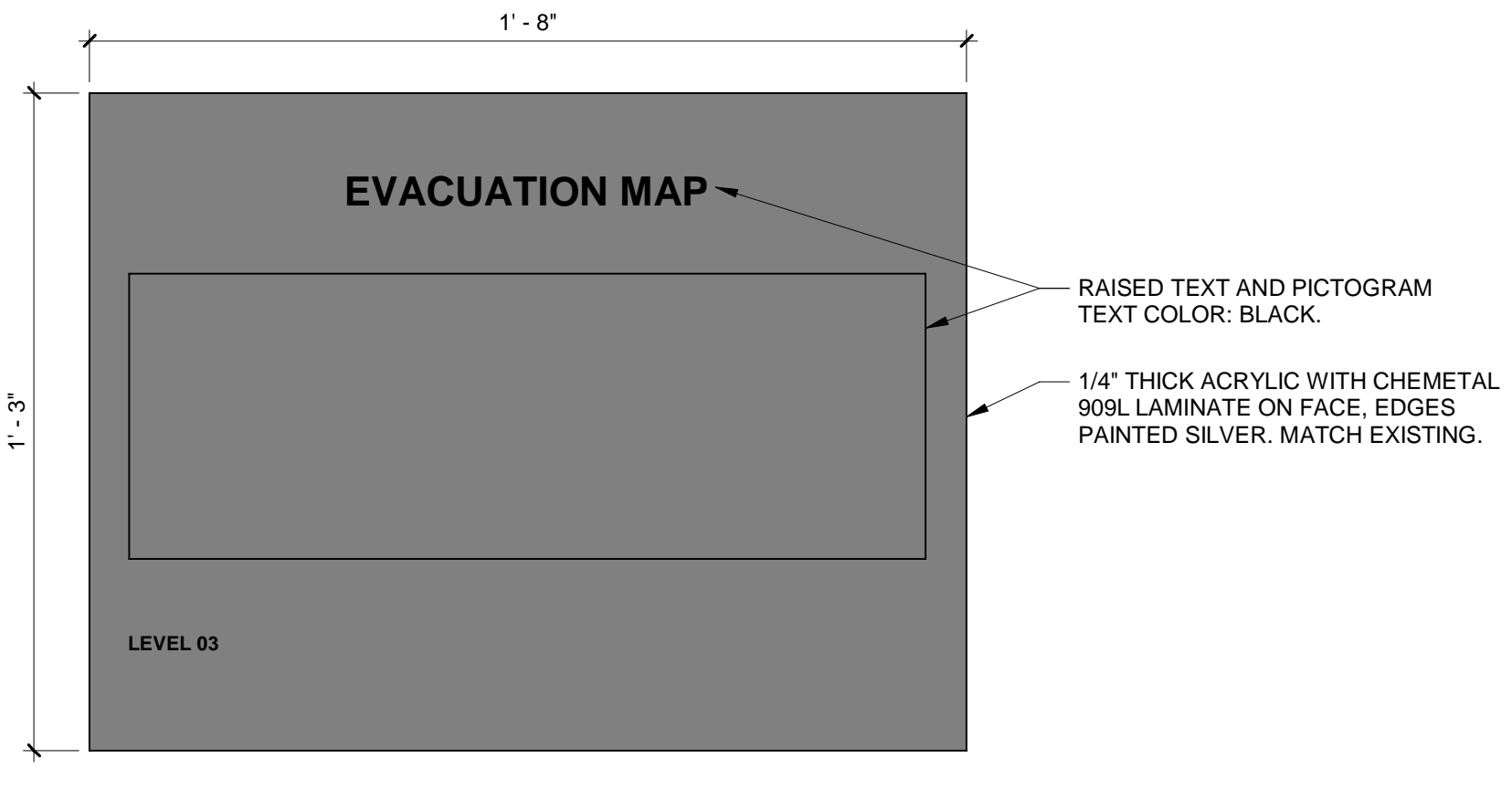
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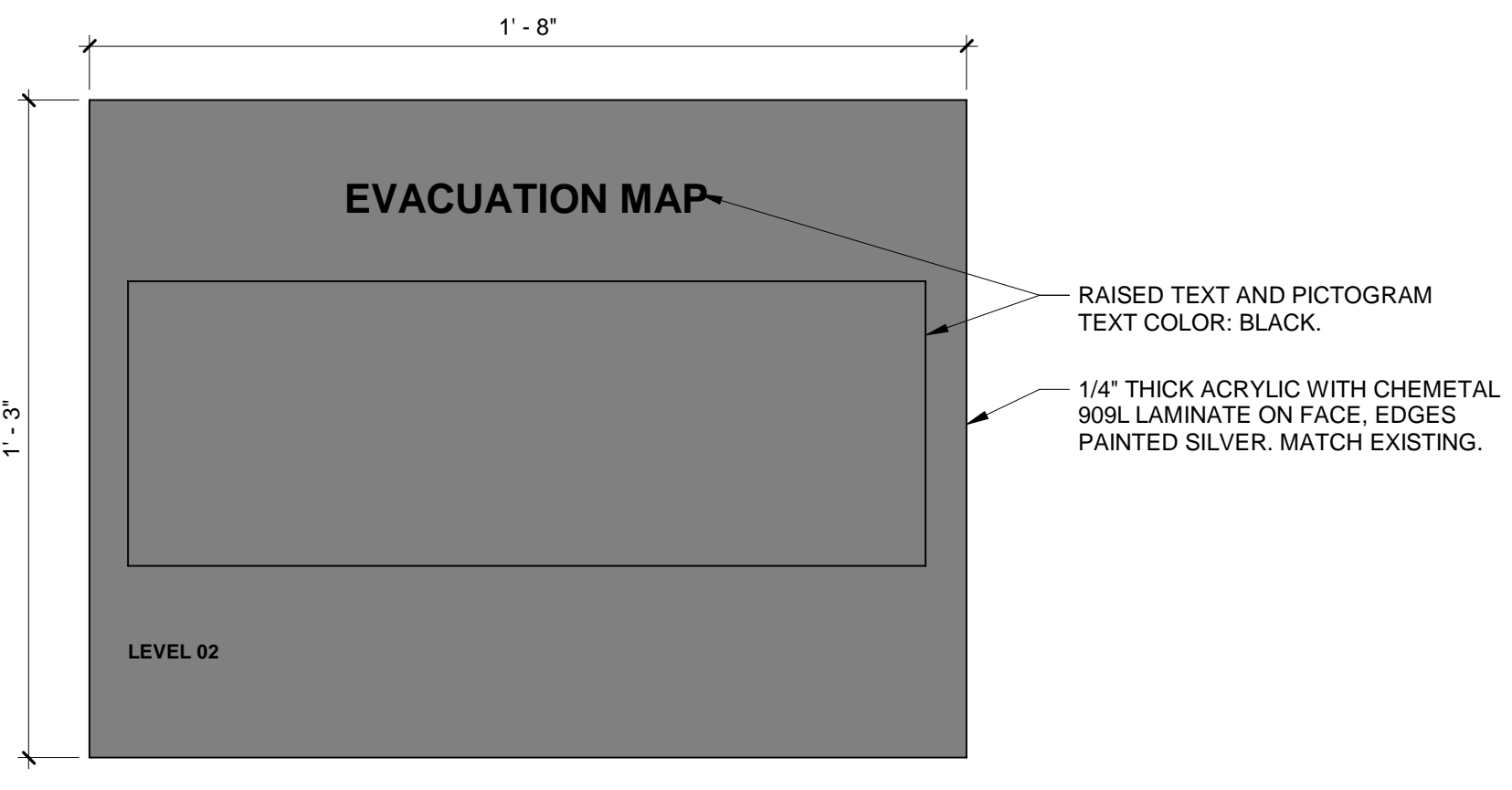
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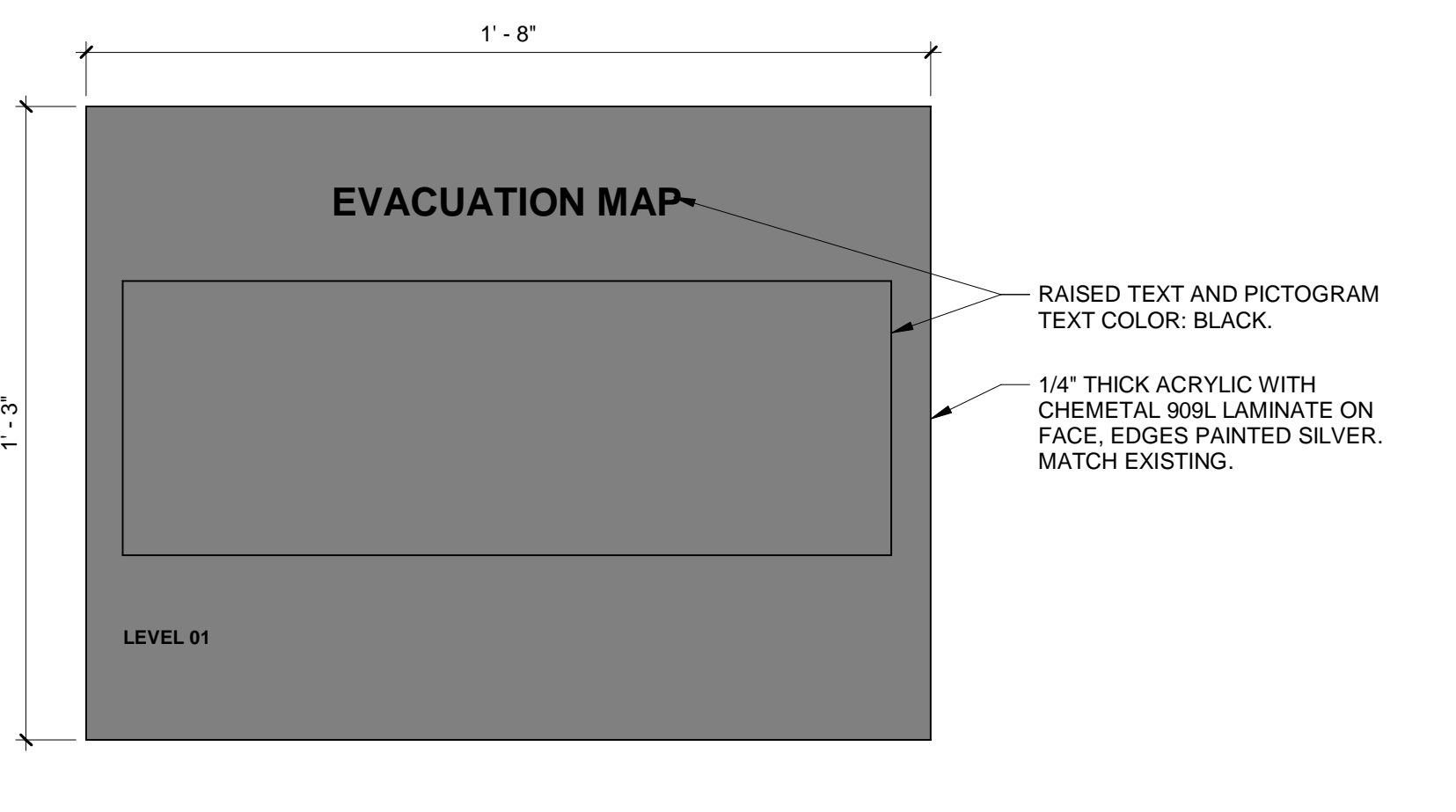
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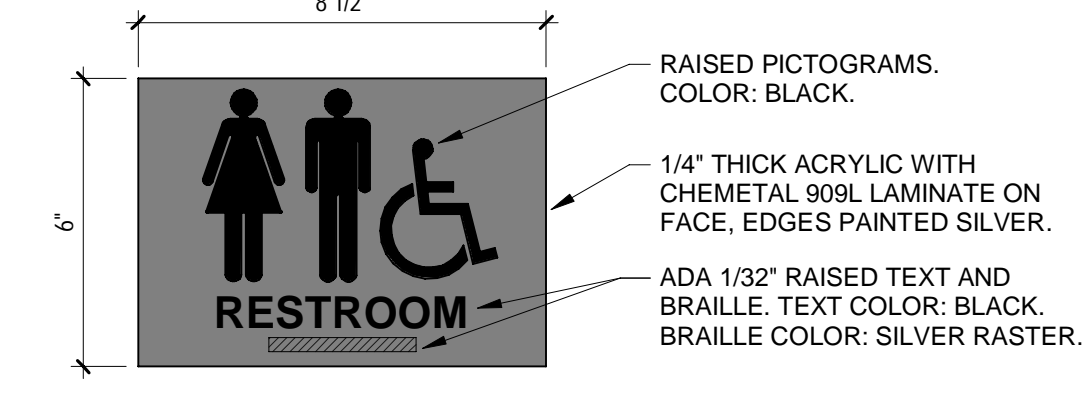
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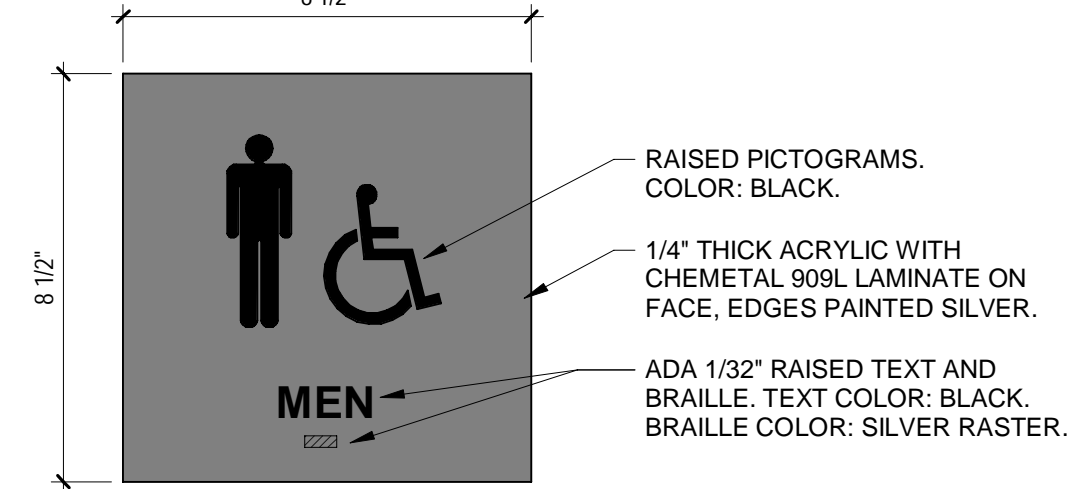
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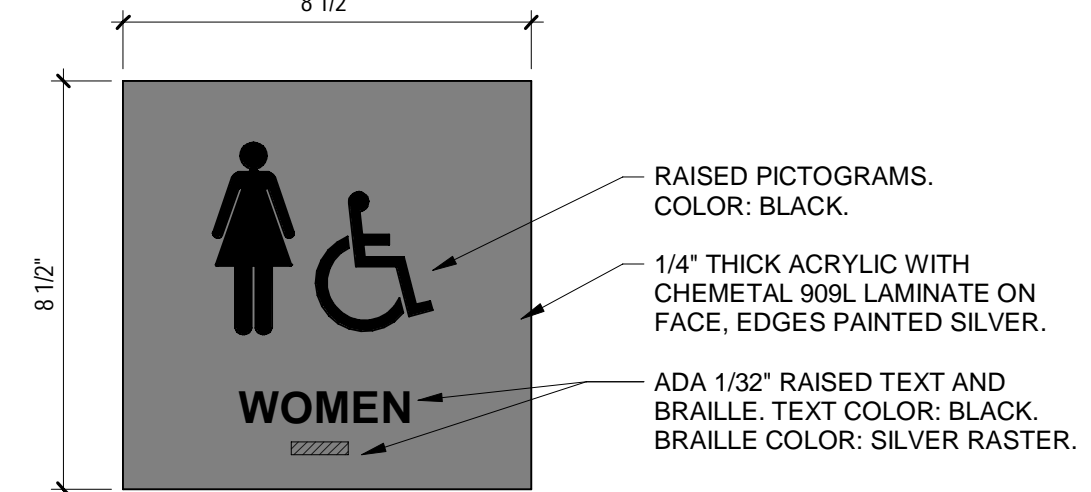
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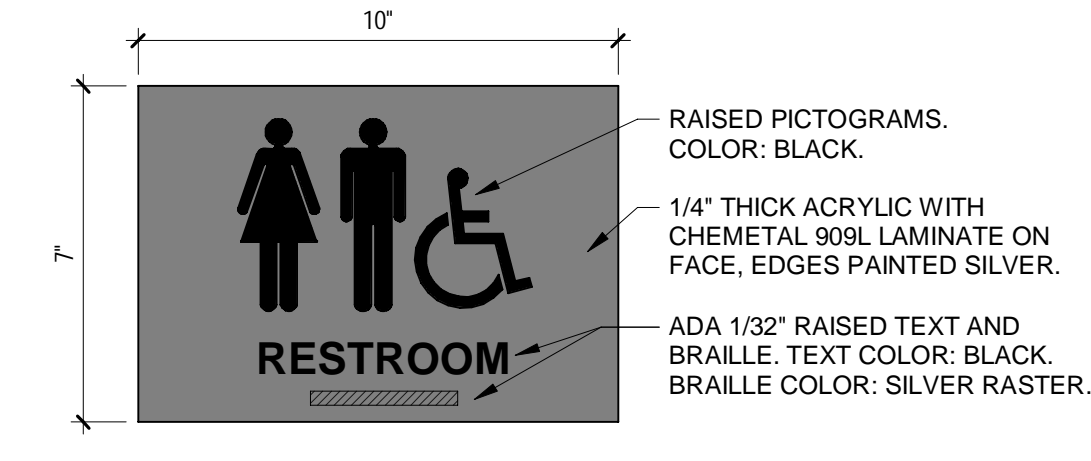
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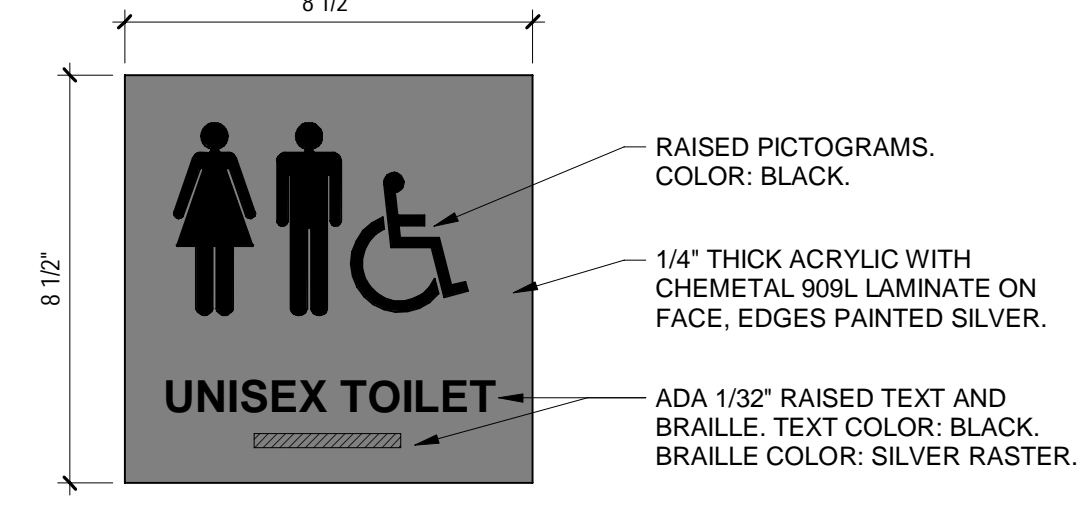
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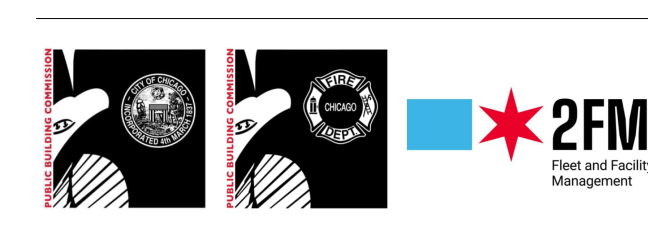
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GENERAL NOTES - SIGNAGE PLANS

- A. ALL SIGNAGE SHALL BE CONTRACTOR FURNISHED AND INSTALLED.
B. ALL SIGNAGE MUST CONFIRM TO AMERICANS WITH DISABILITIES ACT (ADA) AND ARCHITECTURAL BARRIERS ACT (ABA) ACCESSIBILITY GUIDELINES.
C. PERMANENT ROOM SIGNAGE MUST INCLUDE RAISED LETTERS AND BRAILLE SIGNAGE SHALL BE LOCATED AT LATCH SIDE OF DOOR AND MUST BE MOUNTED IN ACCORDANCE WITH ALL CURRENT ADA STANDARDS.
D. WHERE TACTILE SIGN IS PROVIDED AT A SINGLE DOOR, THE SIGN SHALL BE LOCATED ON LATCH SIDE OF DOOR, WHERE TACTILE SIGN IS PROVIDED AT A DOUBLE DOOR, THE SIGN SHALL BE LOCATED ON RIGHT SIDE OF THE RIGHT HAND DOOR.
E. PROVIDE PAPER AND SOFTWARE FOR FOR CREATING TEXT AND SYMBOLS FOR COMPUTERS INDICATED BY OWNER FOR OWNER PRODUCTION OF PAPER INSERTS AFTER INSTALLATION.
F. FURNISH TWO DEVICES TO ASSIST IN REMOVING PAPER INSERTS.
G. PROVIDE MAXIMUM OCCUPANCY SIGNS AS DIRECTED AND COORDINATE MESSAGE CONTENT PRIOR TO ORDER AND INSTALLATION.
H. UPDATE ALL EXISTING PANELS/PROGRAMMING INCLUDING BUT NOT LIMITED TO BUILDING AUTOMATION SYSTEM, ELECTRICAL PANELS, AND FIRE ALARM PANELS, EXISTING PANELS TO BE RE-LABELLED/REPROGRAMMED AS INDICATED IN ROOM NUMBER CHANGES SCHEDULE.
I. ALL BRAILLE TO BE STAINLESS STEEL GRADE II BRAILLE INTEGRAL TO SIGN PLATE; DO NOT USE "BRAILLE TAB".
J. AT EACH ELEVATOR LANDING, PROVIDE RED SIGN WHICH INDICATES IN CASE OF FIRE USE STAIRWAY, MATCH EXISTING JPSTC BUILDING.
K. FIELD VERIFY ALL SIGN QUANTITIES BEFORE FABRICATION.
L. IF ROOM OCCUPANCY IS GREATER THAN 100 PERSONS, PROVIDE MAXIMUM CAPACITY SIGN ISSUED UNDER SECTION 14A-8-802 WHICH READS THE BELOW WORDS. LETTERING WILL BE OF BOLD GOTHIC TYPE IN RED ON A BACKGROUND OF WHITE, NOT LESS THAN ONE INCH IN HEIGHT. THE NUMERALS WILL BE ONE AND ONE-QUARTER INCHES IN HEIGHT.
a. OCCUPANCY MORE THAN PERSONS IS
b. DANGEROUS AND UNLAWFUL
c. BUILDING COMMISSIONER
d. CITY OF CHICAGO.
M. REFER TO SHEET G003 FOR SIGNAGE TYPES.



PROJECT Emergency Medical Services (EMS) Addition 701 N. Kildbourn Avenue, Chicago, IL 60651



CONSULTANTS AECOM ARCHITECTURE, STRUCTURAL, MECHANICAL, PLUMBING, FIRE PROTECTION 303 E. Wacker Dr. #1400 Chicago, IL 60601 312-375-7700

ARCHITRAVE LIMITED ARCHITECTURE 211 W. Wacker Dr. #1650 Chicago, IL 60606 312-642-2600

ABERCROMBIE PLANNING+DESIGN PUBLIC SAFETY DESIGN CONSULTANT 3508 Overton Park Dr W Fort Worth, TX 76109 817-920-9198

INFRASTRUCTURE ENGINEERING CIVIL ENGINEERING One South Wacker #2650 Chicago, IL 60606 312-425-9560

MILHOUSE ENGINEERING ELECTRICAL ENGINEERING 333 S. Wabash Ave #2901 Chicago, IL 60604 312-618-7185

JACOBS / RYAN ASSOCIATES LANDSCAPE ARCHITECTURE 1527 N. Sandburg Terrace Chicago, IL 60610 312-664-3217

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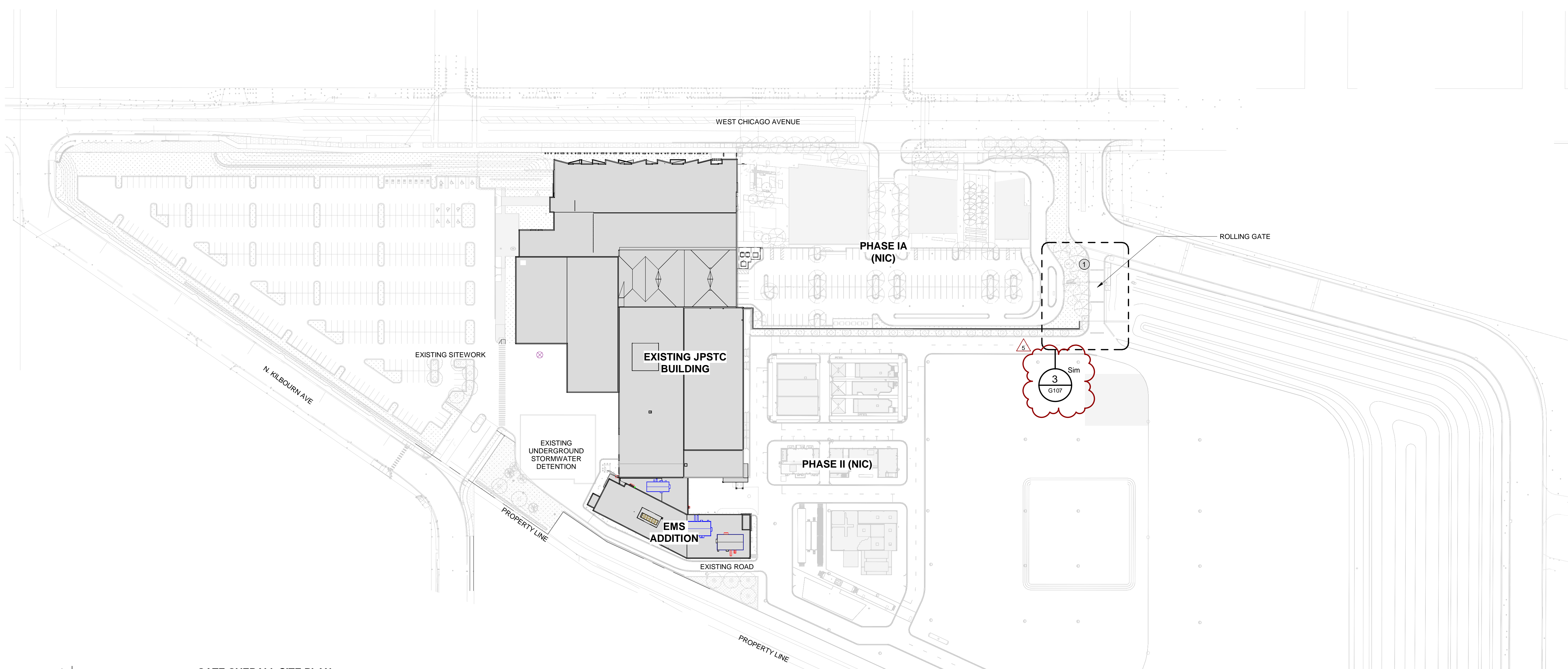
REGISTRATION

ISSUE/REVISION

Table with 3 columns: Issue/Revision number, Date, Description. Includes entries for 07/25/2024 ADD 03, 07/05/2024 ISSUED FOR PERMIT, 06/26/2024 ISSUED FOR BID.

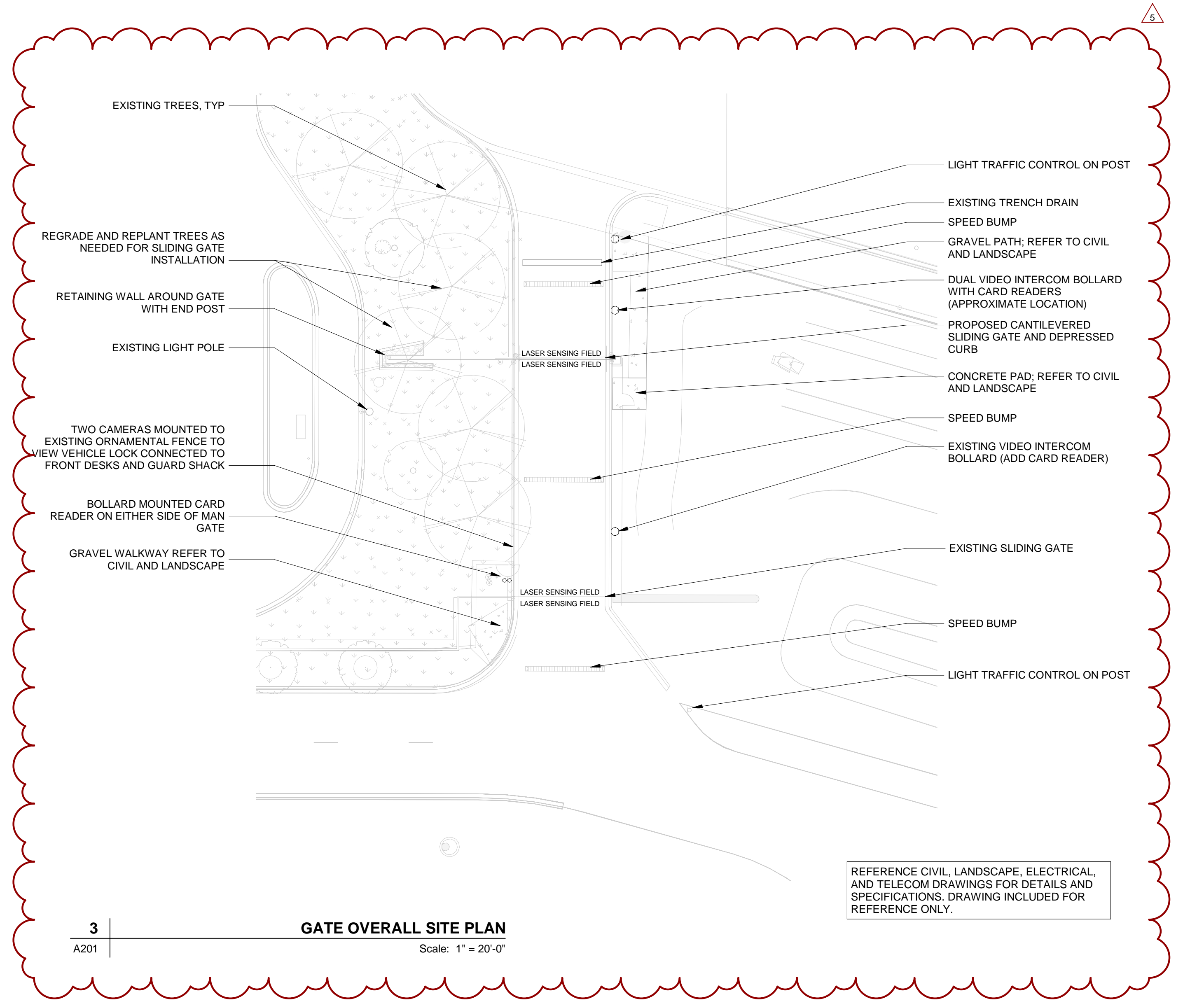
PROJECT NUMBER PBC: #07215 AECOM: 60710711 SHEET TITLE SIGNAGE DETAILS

SHEET NUMBER G003



1 | **GATE OVERALL SITE PLAN**
 A201 | Scale: 1" = 80'-0"

- PHASE 2 - ALLOWANCE**
- ① ROLLING GATE AT CHICAGO AVENUE ENTRY
 PROVIDE AN AUTOMATED ORNAMENTAL ROLLING GATE, MODIFY LANDSCAPING FOR GATE TRAVEL.
 PROVIDE FENCING AND MAN GATE FOR SALLYPORT SET BETWEEN PROPOSED AND EXISTING GATES.

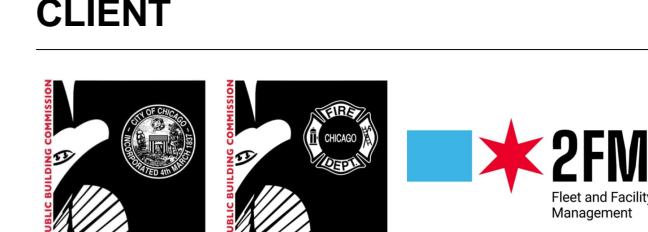


3 | **GATE OVERALL SITE PLAN**
 A201 | Scale: 1" = 20'-0"

REFERENCE CIVIL, LANDSCAPE, ELECTRICAL, AND TELECOM DRAWINGS FOR DETAILS AND SPECIFICATIONS. DRAWING INCLUDED FOR REFERENCE ONLY.



PROJECT
Emergency Medical Services (EMS) Addition
 701 N. Kilbourn Avenue, Chicago, IL 60651



CLIENT
CONSULTANTS

AECOM
 ARCHITECTURE, STRUCTURAL, MECHANICAL, PLUMBING, FIRE PROTECTION
 303 E. Wacker Dr. #1400
 Chicago, IL 60601
 312-375-7700

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 211 W. Wacker Dr. #1650
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 312-642-2600

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 PUBLIC SAFETY DESIGN CONSULTANT
 3508 Overton Park Dr W
 Fort Worth, TX 76109
 817-820-9198

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 CIVIL ENGINEERING
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 312-425-9560

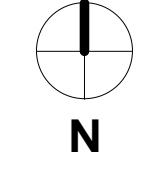
MILHOUSE ENGINEERING
 ELECTRICAL ENGINEERING
 333 S. Wabash Ave #2901
 Chicago, IL 60604
 312-618-7185

JACOBS / RYAN ASSOCIATES
 LANDSCAPE ARCHITECTURE
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 312-664-3217

LEVEL-1 GLOBAL SOLUTIONS
 TECHNOLOGY CONSULTANT
 233 S. Wacker Dr. #4400
 Chicago, IL 60606
 312-202-3300

REGISTRATION

NORTH ARROW



ISSUE/REVISION

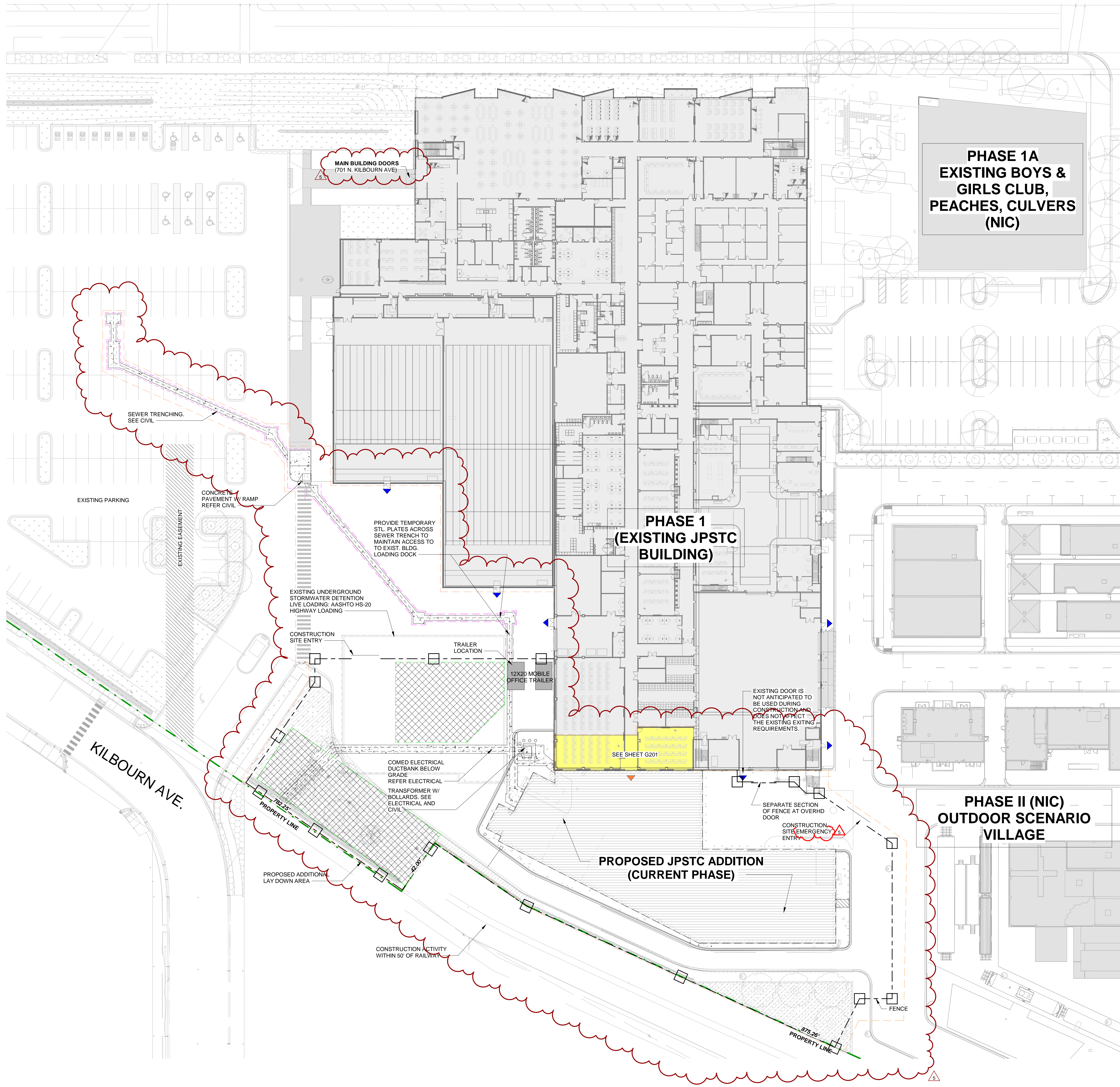
NO.	DATE	DESCRIPTION
5	07/25/2024	ADD 03
2	07/05/2024	ISSUED FOR PERMIT
1	06/26/2024	ISSUED FOR BID
I/R		

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

SHEET TITLE
SLIDING GATE - PLAN AND NARRATIVE

SHEET NUMBER

G107



NOTES:

- A. EXISTING MAIN BUILDING (JPSTC) SHALL REMAIN IN OPERATION DURING CONSTRUCTION. EXISTING EXITWAY TO BE RELOCATED WITH MODIFICATIONS TO THE SIGNAGE AND DOOR HARDWARE IDENTIFIED IN PLAN.
B. CONTRACTOR SHALL PREPARE AND SUBMIT A SITE UTILIZATION PLAN FOR PBC REVIEW AND APPROVAL PRIOR TO WORK. SITE UTILIZATION PLAN SHOULD INCORPORATE ALL FENCING AND GATE REQUIREMENTS, INCLUDING RELOCATION AS REQUIRED THROUGH ALL PHASES OF WORK. TO PERMIT CONSTRUCTION OF THE NEW EMS ADDITION AND ASSOCIATED WORK. PLAN SHALL ACCOMMODATE EGRESS AND ACCESS TO DOORWAYS OF FACILITY IDENTIFIED IN LOGISTICS PLAN.
C. CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS.
D. CONTRACTOR SHALL FURNISH, INSTALL, AND MAINTAIN ANY/ALL TEMPORARY CONSTRUCTION FACILITIES, INCLUDING FENCING AND GATES, IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND CITY OF CHICAGO'S SITE CLEANLINESS ORDINANCE.
E. CONTRACTOR SHALL PERFORM ALL SITE PREPARATION AND DEMOLITION WORK AT THE EXISTING BUILDING, IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
F. CONTRACTOR SHALL FURNISH, INSTALL, AND MAINTAIN TEMPORARY ROOFING TO PROPERLY FACILITATE THE SPECIFIED ROOFING WORK AT THE EXISTING BUILDING. REFER TO DRAWING #AD101 FOR ADDITIONAL INFORMATION.
G. CPD LARGE CLASSROOM 254 AND CPD DIRTY CLASSROOM 284 WILL REMAIN OCCUPIED AND IN USE DURING CONSTRUCTION. PROVIDE TEMPORARY BARRIAGE WALLS. SEE HIGHLIGHTED AREA FOR EXTENTS OF WORK. MORE INFORMATION ON SHEET G201.
H. CONTRACTOR SHALL FURNISH AND INSTALL TEMPORARY EXIT SIGNAGE AND DOOR HARDWARE, IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. REFER TO DRAWING #G201 AND #AD101 FOR ADDITIONAL INFORMATION.
I. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY/ALL TEMPORARY EMERGENCY FILL PLACEMENT WITHIN THE PROJECT WORK AREA. CONTRACTOR SHALL FURNISH AND INSTALL GEOTEXTILE FABRIC UNDER ALL TEMPORARY FILL PLACEMENT LOCATIONS.
J. PROJECT INCLUDES TWO (2) BUILDING PERMITS, CAISSONS ONLY PERMIT (PERMIT #D24019-01) AND NEW BUILDING PERMIT (PERMIT #D24019-02). REFER TO 'REQUIREMENTS WITHIN TWO WEEKS OF AWARD' LISTED BELOW FOR CONTRACTOR'S RESPONSIBILITIES FOR PERMITS APPROVAL.
K. PROPERLY COORDINATE ANY/ALL INSPECTIONS FOR OCCUPANCY APPROVAL BY NO LATER THAN FEBRUARY 28, 2026.
L. CONTRACTOR SHALL SUBMIT ALL CRITICAL SUBMITTALS, INCLUDING CONCRETE CAISSON SUBMITTALS AND PROCEDURES WRITING TWO (2) WEEKS OF ISSUANCE OF THE NOTICE OF AWARD.
M. CONTRACTOR TO PROVIDE SUBMITTALS FOR LONG LEAD ITEMS SUCH AS SHEET METAL, CHILLERS, PUMPS, LIGHTING, MEP EQUIPMENT, ROOFING, PRIMARY SWITCH GEAR, PANELS, TRANSFORMERS AND STEEL, WITHIN TWO WEEKS OF AWARD.
N. CONTRACTOR SHALL PREPARE AND MAINTAIN MATERIAL AND EQUIPMENT LONG LEAD AND SUPPLY CHAIN IMPACT LOGS. CONTRACTOR SHALL SUBMIT LOGS ON A WEEKLY BASIS OR AS DIRECTED BY THE COMMISSION. CONTRACTOR SHALL BE PREPARED TO REVIEW THE LOGS DURING THE WEEKLY PROJECT MEETINGS, OR AS DIRECTED BY THE COMMISSION. CONTRACTOR SHALL BE PREPARED TO DISCUSS ANY/ALL MITIGATION STRATEGIES RELATED TO THIS MATTER.
O. SITE ACCESS AND BADGING REQUIREMENTS - CONTRACTOR RESPONSIBILITIES.
- CONTRACTOR SHALL PREPARE AND MAINTAIN A LIST OF TRADE CONTRACTOR NAMES AND CORRESPONDING COMPANY/ORGANIZATION WORKING ON THE PROJECT SITE AND REQUIRING ACCESS INTO THE EXISTING BUILDING.
- ANY/ALL TRADE CONTRACTORS WORKING INSIDE THE EXISTING BUILDING MUST ENTER AND EXIT THROUGH THE MAIN DOORS LOCATED AT 701 N. KILBOURN AVE.
- CONTRACTOR SHALL MAINTAIN SIGN-IN SHEETS DAILY FOR ANY/ALL TRADE CONTRACTORS WORKING INSIDE THE EXISTING BUILDING.
- TRADE CONTRACTORS MUST PRESENT VALID, UNEXPIRED PHOTO IDS TO THE SECURITY OFFICER/GUARD ON DUTY UPON ARRIVAL TO PERFORM ANY WORK INSIDE THE EXISTING BUILDING.
- IN EXCHANGE FOR THEIR PHOTO ID, TRADE CONTRACTORS WILL BE ISSUED A CONTRACTOR PASS/LANYARD.
- THE TRADE CONTRACTOR PASS/LANYARD MUST BE WORN AT ALL TIMES WHILE ON THE PREMISES INSIDE THE EXISTING BUILDING.
- THE TRADE CONTRACTOR PASS/LANYARD MUST BE RETURNED TO THE SECURITY OFFICER/GUARD UPON DEPARTURE FROM THE EXISTING BUILDING.

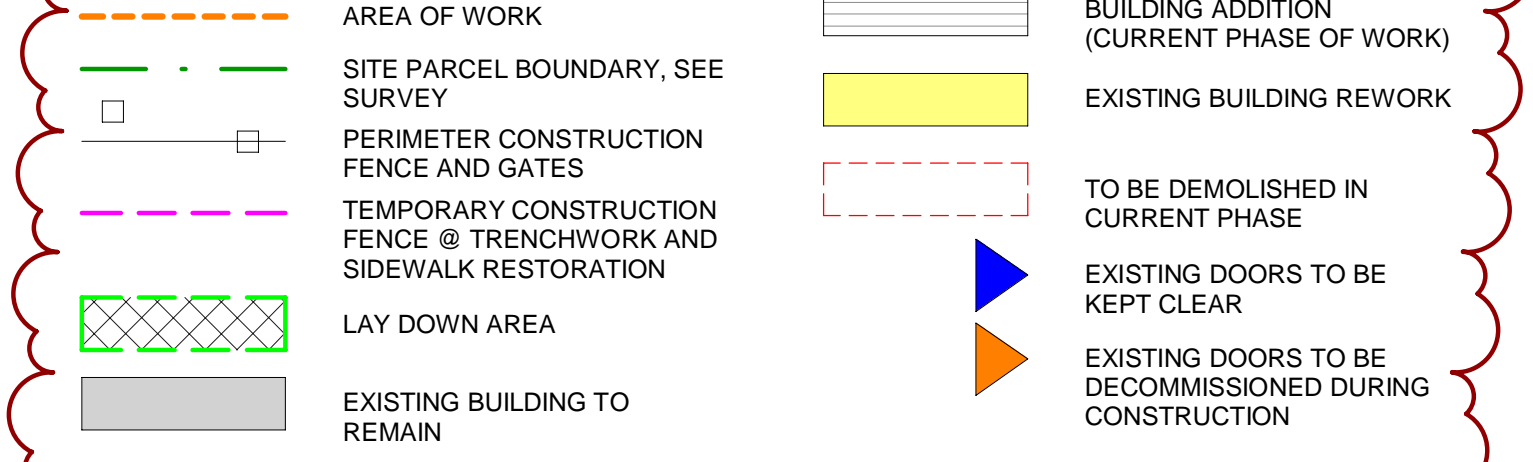
SITE UTILIZATION NOTES:

- A. THIS DRAWING IS DIAGRAMMATIC AND NOT INTENDED TO ILLUSTRATE ALL ASPECTS OF THE WORK IN DETAIL. REFER TO OTHER DRAWINGS, AND PROJECT SPECIFICATIONS FOR ADDITIONAL INFORMATION.
B. WORK AREAS DESIGNATED ON THIS DRAWING SHALL BE USED IN CONJUNCTION W/ SPECIFICATION SECTION 01 14 11 'CONSTRUCTION OPERATIONS AND SITE UTILIZATION PLAN'.
C. THE CONTRACTOR SHALL NOT MOBILIZE TO THE PROJECT SITE UNTIL THEY HAVE RECEIVED WRITTEN PBC APPROVAL OF THE PROJECT SPECIFIC MOBILIZATION + LOGISTICS PLAN.
D. CONTRACTOR SHALL IDENTIFY, MARK AND MAINTAIN ALL UTILITIES IN THE AREA OF WORK UNLESS AND UNTIL REMOVAL IS REQUIRED, SUBJECT TO ANY RESTRICTIONS.
E. THE CONTRACTOR IS RESPONSIBLE FOR ALL MEANS, METHODS, TECHNIQUES, AND SEQUENCES FOR IMPLEMENTATION OF THE WORK WITHIN AREAS DESIGNATED. THIS INCLUDES, BUT IS NOT LIMITED TO, THE DETERMINATION OF THE NEED FOR AND DESIGN OF ANY AND ALL SHORING AND BRACING, UNDERPINNING, DEWATERING, SOIL STABILIZATION, SETTLEMENT MONITORING, TEMPORARY FENCING & GATES, TEMPORARY SIGNAGE, TEMPORARY EMERGENCY LIGHTING, TEMPORARY FACILITIES, PERMITS, ETC.
F. WHERE PROPERTY, STRUCTURES, OR PUBLIC WAY ARE DISTURBED AND/OR DAMAGED AS A RESULT OF THE CONTRACTOR'S MEANS, METHODS, TECHNIQUES, OR TEMPORARY FACILITIES, THE CONTRACTOR IS RESPONSIBLE FOR RESTORATION OF ALL ASPECTS OF THE BUILDING, SITE, AND PUBLIC WAY TO ORIGINAL CONDITION TO THE SATISFACTION OF THE AUTHORIZED COMMISSION REPRESENTATIVE AND USER AGENCIES (PBC).
G. THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY FACILITIES, SITE FENCING, GATES, ETC. NECESSARY FOR IMPLEMENTATION OF THE WORK.

REQUIREMENTS WITHIN TWO WEEKS OF NOTICE OF AWARD:

- A. GENERAL CONTRACTOR'S LETTER:
- WRITTEN ON GC LETTERHEAD.
- GC'S WRITTEN CONFIRMATION OF CONTRACT AWARD (INCLUDE COPY OF 'NOA')
- INCLUDE GC'S LICENSE NUMBER, WITH EXPIRATION DATE.
- INCLUDE CURRENT COPY GC'S INSURANCE CERTIFICATE.
B. EXCAVATION CERTIFICATE:
- EXECUTED BY THE EXCAVATOR, OWNER (PBC), AND SIGNED AND SEALED BY THE AOR.
- INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
C. MASONRY LETTER:
- WRITTEN ON MASON'S LETTERHEAD.
- MASON'S WRITTEN CONFIRMATION OF CONTRACT AWARD.
- INCLUDE MASON'S LICENSE NUMBER, WITH EXPIRATION DATE. THERE ARE 3 TYPES OF MASON'S LICENSES - 'A' (BRICK & CONCRETE), 'B' (BRICK ONLY), AND 'C' (CONCRETE ONLY). IF MASON DOES NOT HAVE AN 'A' LICENSE, THEN SEPARATE LICENSES 'B' AND 'C' WILL BE REQUIRED.
- INCLUDE COPY OF SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
D. HVAC LETTER:
- WRITTEN ON HVAC'S LETTERHEAD.
- HVAC'S WRITTEN CONFIRMATION OF CONTRACT AWARD.
- INCLUDE HVAC'S LICENSE NUMBER, WITH EXPIRATION DATE. ALSO, ATTACH A COPY HVAC'S '1010' BUSINESS LICENSE.
- THE 1010 BUSINESS LICENSE ALLOWS THE HVAC SUBCONTRACTOR TO PERFORM COMMERCIAL WORK.
- INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
E. REFRIGERATION LETTER (IF REFRIGERATION NOT BEING SELF-PERFORMED BY HVAC):
- WRITTEN ON REFRIGERATION'S LETTERHEAD.
- REFRIGERATION'S WRITTEN CONFIRMATION OF CONTRACT AWARD.
- INCLUDE REFRIGERATION'S LICENSE NUMBER, WITH EXPIRATION DATE. ALSO, ATTACH A COPY REFRIGERATION'S 'CFC' CARD.
- THE CFC DESIGNATION STANDS FOR 'CHLOROFLUOROCARBON'.
- INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
F. ELECTRICAL PERMIT APPLICATION:
- COPY REQUIRED.
- EXECUTED BY THE ELECTRICAL SUBCONTRACTOR AND OWNER (PBC).
- INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
G. PLUMBING LETTER:
- WRITTEN ON PLUMBER'S LETTERHEAD.
- PLUMBER'S WRITTEN CONFIRMATION OF CONTRACT AWARD.
- INCLUDE PLUMBING SUBCONTRACTOR'S LICENSE NUMBER, WITH EXPIRATION DATE.
- INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.

GRAPHIC KEY:



MILESTONES

- MILESTONE 1 (PERMITTING & MOBILIZATION)
AUGUST 31, 2024 - OCTOBER 31, 2024
- START NO SOONER THAN SEPTEMBER 16, 2024
SUBSTANTIAL COMPLETION (NEW ADDITION, SITE IMPROVEMENTS, AND FF&E PROCUREMENT)
OCTOBER 31, 2024 - FEBRUARY 28, 2026
- START NO SOONER THAN OCTOBER 31, 2024
MILESTONE 2 (FF&E DELIVERY AND INSTALLATION)
MARCH 1, 2026 - MARCH 31, 2026
- START NO SOONER THAN MARCH 1, 2026
- WORK MAY COMMENCE PRIOR TO MARCH 1, 2026, PENDING ACCEPTANCE OF THE WORK REQUIRED FOR SUBSTANTIAL COMPLETION.



PROJECT
Emergency Medical Services (EMS) Addition
701 N. Kilbourn Avenue, Chicago, IL 60651



CONSULTANTS
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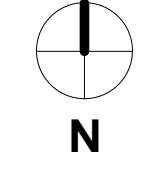
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TECHNOLOGY CONSULTANT
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REGISTRATION

NORTH ARROW



ISSUE/REVISION

Table with 4 columns: Issue/Revision number, Date, Description, and Project Number. Row 1: 5, 07/25/2024, ADD 03, PBC: #07215 AECOM: 6071011. Row 2: 2, 07/05/2024, ISSUED FOR PERMIT. Row 3: 1, 06/26/2024, ISSUED FOR BID.

PROJECT NUMBER

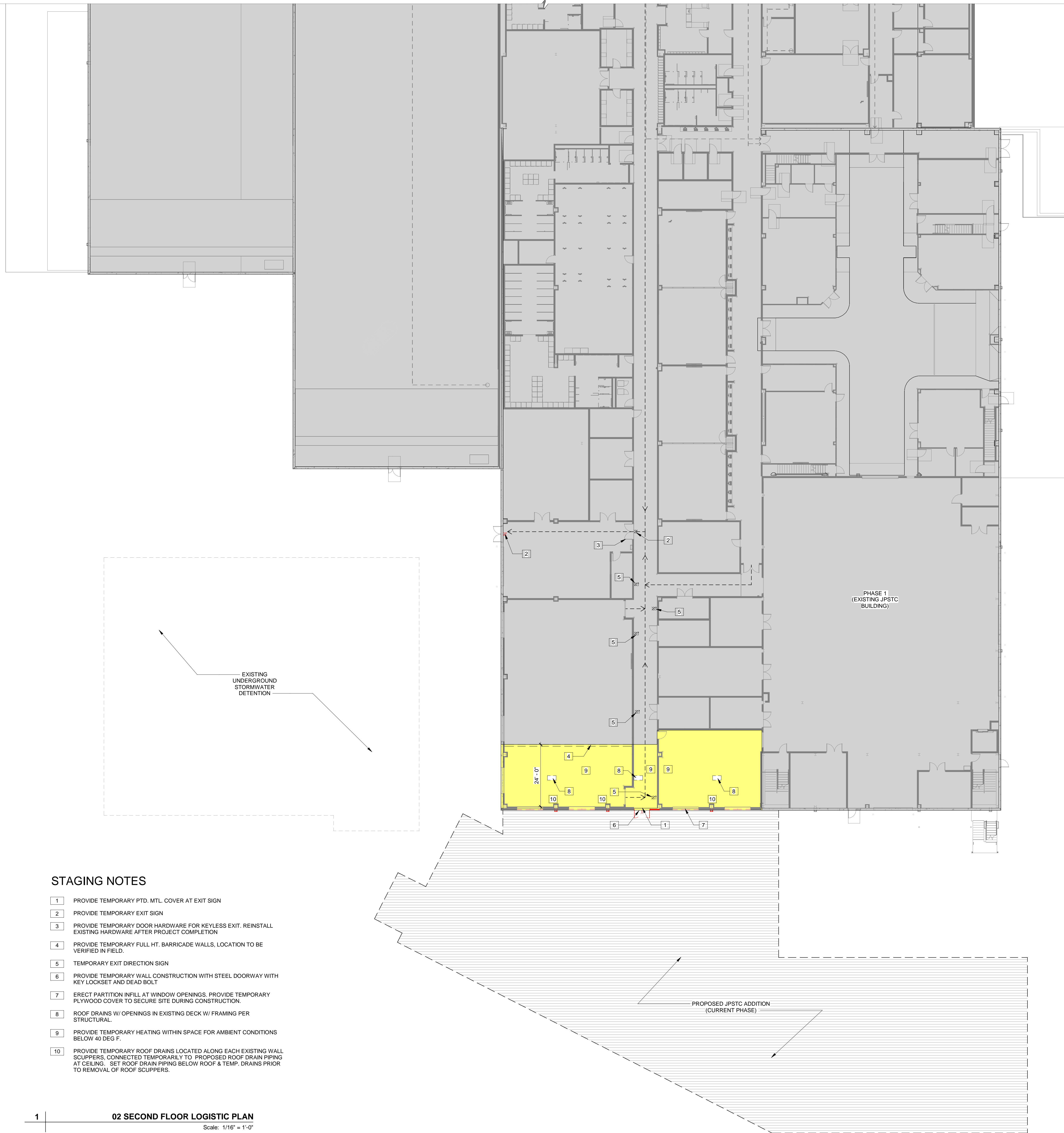
PBC: #07215 AECOM: 6071011

SHEET TITLE

SITE PHASING AND LOGISTICS PLAN

SHEET NUMBER

G200



STAGING NOTES

- 1 PROVIDE TEMPORARY PTD. MTL. COVER AT EXIT SIGN
- 2 PROVIDE TEMPORARY EXIT SIGN
- 3 PROVIDE TEMPORARY DOOR HARDWARE FOR KEYLESS EXIT. REINSTALL EXISTING HARDWARE AFTER PROJECT COMPLETION
- 4 PROVIDE TEMPORARY FULL HT. BARRICADE WALLS, LOCATION TO BE VERIFIED IN FIELD.
- 5 TEMPORARY EXIT DIRECTION SIGN
- 6 PROVIDE TEMPORARY WALL CONSTRUCTION WITH STEEL DOORWAY WITH KEY LOCKSET AND DEAD BOLT
- 7 ERECT PARTITION INFILL AT WINDOW OPENINGS. PROVIDE TEMPORARY PLYWOOD COVER TO SECURE SITE DURING CONSTRUCTION.
- 8 ROOF DRAINS W/ OPENINGS IN EXISTING DECK W/ FRAMING PER STRUCTURAL.
- 9 PROVIDE TEMPORARY HEATING WITHIN SPACE FOR AMBIENT CONDITIONS BELOW 40 DEG F.
- 10 PROVIDE TEMPORARY ROOF DRAINS LOCATED ALONG EACH EXISTING WALL SCUPPERS, CONNECTED TEMPORARILY TO PROPOSED ROOF DRAIN PIPING AT CEILING. SET ROOF DRAIN PIPING BELOW ROOF & TEMP. DRAINS PRIOR TO REMOVAL OF ROOF SCUPPERS.

NOTES:

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- B. CONTRACTOR SHALL PREPARE AND SUBMIT A SITE UTILIZATION PLAN FOR PBC REVIEW AND APPROVAL PRIOR TO WORK. SITE UTILIZATION PLAN SHOULD INCORPORATE ALL FENCING AND GATE REQUIREMENTS, INCLUDING RELOCATION AS REQUIRED THROUGH ALL PHASES OF WORK. TO PERMIT CONSTRUCTION OF THE NEW EMS ADDITION AND ASSOCIATED WORK. PLAN SHALL ACCOMMODATE EGRESS AND ACCESS TO DOORWAYS OF FACILITY IDENTIFIED IN LOGISTICS PLAN.
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- N. CONTRACTOR SHALL PREPARE AND MAINTAIN MATERIAL AND EQUIPMENT LONG LEAD AND SUPPLY CHAIN IMPACT LOGS. CONTRACTOR SHALL SUBMIT THE LOGS ON A WEEKLY BASIS OR AS DIRECTED BY THE COMMISSION. CONTRACTOR SHALL BE PREPARED TO REVIEW THE LOGS DURING THE WEEKLY PROJECT MEETINGS, OR AS DIRECTED BY THE COMMISSION. CONTRACTOR SHALL BE PREPARED TO DISCUSS ANY/ALL MITIGATION STRATEGIES RELATED TO THIS MATTER.
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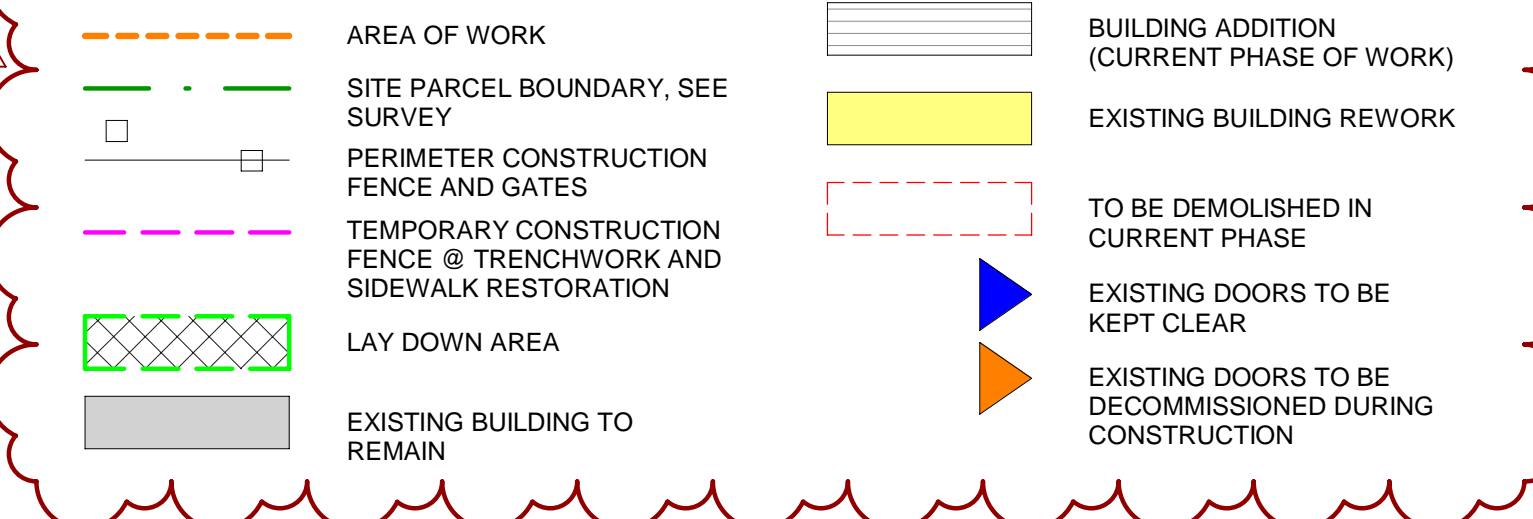
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- F. THE CONTRACTOR IS RESPONSIBLE FOR ALL MEANS, METHODS, TECHNIQUES, AND SEQUENCES FOR IMPLEMENTATION OF THE WORK WITHIN AREAS DESIGNATED. THIS INCLUDES, BUT IS NOT LIMITED TO, THE DETERMINATION OF THE NEED FOR (AND DESIGN OF) ANY AND ALL SHORING, UNDERPINNING, UNDERPINNING, SOIL STABILIZATION, SETTLEMENT MONITORING, TEMPORARY FENCING & GATES, TEMPORARY SIGNAGE, TEMPORARY EMERGENCY LIGHTING, TEMPORARY FACILITIES, PERMITS, ETC.
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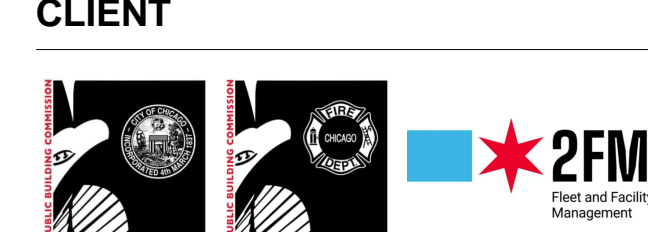
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 - WRITTEN ON GC LETTERHEAD.
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 - INCLUDE GC'S LICENSE NUMBER, WITH EXPIRATION DATE.
 - INCLUDE CURRENT COPY GC'S INSURANCE CERTIFICATE.
- B. EXCAVATION CERTIFICATE:
 - EXECUTED BY THE EXCAVATOR, OWNER (PBC), AND SIGNED AND SEALED BY THE AOR.
 - INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
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 - INCLUDE COPY OF SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
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 - THE CFC DESIGNATION STANDS FOR 'CHLOROFLUOROCARBON'.
 - INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
- F. ELECTRICAL PERMIT APPLICATION:
 - COPY REQUIRED.
 - EXECUTED BY THE ELECTRICAL SUBCONTRACTOR AND OWNER (PBC).
 - INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.
- G. PLUMBING LETTER:
 - WRITTEN ON PLUMBER'S LETTERHEAD.
 - PLUMBER'S WRITTEN CONFIRMATION OF CONTRACT AWARD.
 - INCLUDE PLUMBING SUBCONTRACTOR'S LICENSE NUMBER, WITH EXPIRATION DATE.
 - INCLUDE COPY SUBCONTRACTOR'S CURRENT INSURANCE CERTIFICATE.

GRAPHIC KEY:



PROJECT
Emergency Medical Services (EMS) Addition
 701 N. Kilbourn Avenue, Chicago, IL 60651



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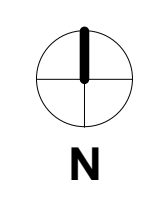
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REGISTRATION

NORTH ARROW



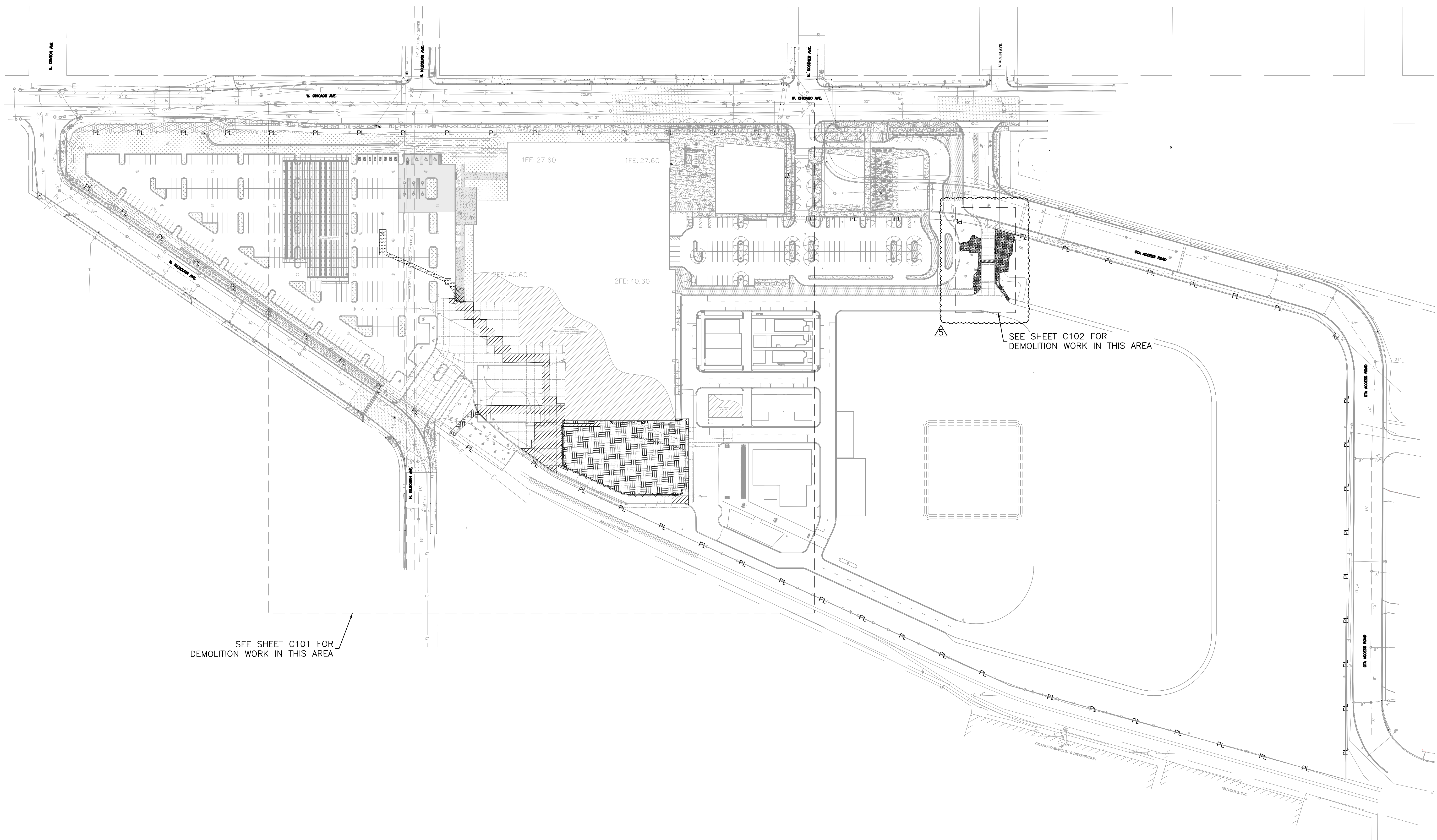
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U/R	PROJECT	DESCRIPTION

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

SHEET TITLE
LOGISTICS BUILDING PLAN

SHEET NUMBER
G201



DEMOLITION LEGEND

	JPSTC PROPERTY LINE
	PARCEL 3 PROPERTY LINE
	HMA PAVEMENT & BASE REMOVAL
	CONCRETE PAVEMENT & BASE REMOVAL
	CONCRETE SIDEWALK & BASE REMOVAL
	CLEAR & GRUB, EXCAVATION & FILL PER PLANS
	CURB & GUTTER REMOVAL
	SEWER REMOVAL
	REMOVAL

SEE SHEET C101 FOR DEMOLITION WORK IN THIS AREA

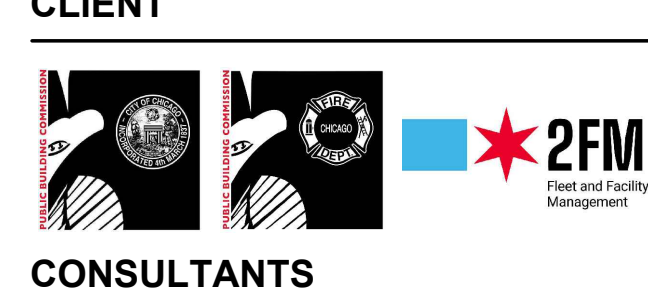
SEE SHEET C102 FOR DEMOLITION WORK IN THIS AREA

NOTES:

1. THE CONTRACTOR SHALL VERIFY AND COMPARE TO ALL EXISTING SURVEY POINTS BEFORE BEGINNING ANY CONSTRUCTION AND REPORT ANY DISCREPANCIES TO THE ARCHITECT IMMEDIATELY.
2. CONDUCT SITE DEMOLITION OPERATIONS ENSURING MINIMUM INTERFERENCE WITH STREETS, WALKS, AND OTHER ADJACENT FACILITIES.
3. REMOVAL WORK INCLUDES BUT IS NOT LIMITED TO PAVING, CURBS, GUTTERS, GRAVEL, CONCRETE BLOCKS, CONCRETE BARRIER WALLS, WOOD, FENCES, POSTS, UTILITY POLES, UTILITY STRUCTURES AND PIPES, GUARD RAIL, RAILROAD TIES, TIRES, METAL ETC. OR OTHER STRUCTURES. REMOVAL OF ALL THE EXISTING SITE ITEMS WITHIN PROJECT SITE INCLUDING BUT NOT LIMITED TO GRAVEL, CONCRETE BLOCKS, CONCRETE BARRIER WALLS, TIRES, RAILROAD TIES, WOOD, METAL ETC. ARE NOT SHOWN ON THE PLANS AND THE CONTRACTOR SHALL VISIT THE SITE BEFORE BIDDING AND ASCERTAIN THE EXTENT OF REMOVALS AND PROPOSED WORK. BURNING ON OWNER'S PROPERTY IS NOT PERMITTED.
4. REMOVE ALL DEMOLISHED MATERIALS (UNLESS NOTED OTHERWISE) FROM PROJECT SITE REGULARLY AND DISPOSE OF LEGALLY. THE CONTRACTOR SHALL COMPLY WITH CONTRACT DOCUMENTS, FEDERAL, STATE, AND LOCAL ORDINANCES WITH REGARDS TO REMOVAL AND DISPOSAL OF MATERIALS FOR ITEMS TO BE DEMOLISHED/REMOVED.
5. THE CONTRACTOR SHALL HAND DIG WITHIN 2' OF KNOWN UTILITIES BEFORE USING POWER EQUIPMENT. THE CONTRACTOR SHALL USE EXTREME CAUTION WHILE EXCAVATING NEAR THE SUBSURFACE FACILITIES/UTILITIES. ALL EXISTING FACILITIES/UTILITIES OR COMPLETED NEW CONSTRUCTIONS AND INSTALLATIONS NOT INDICATED FOR DEMOLITION, IF DAMAGED AS A RESULT OF ON GOING CONSTRUCTION WORK ON THIS PROJECT SHALL BE REPLACED OR REPAIRED BY THE CONTRACTOR AT NO COST TO THE OWNER.
6. THE CONTRACTOR SHALL COORDINATE ALL DEMOLITION/EXCAVATION WITH THE PROJECT PLANS AND CORRESPONDING DETAILS. WITHIN THE PROJECT SITE, EXISTING ABANDONED CONCRETE FOUNDATIONS AND UTILITIES, IF IN CONFLICT WITH PROPOSED FACILITIES/UTILITIES SHALL BE REMOVED.
7. SAWCUT, REMOVE, AND REPLACE PART OF CONCRETE PAVEMENT PANEL AND BASE. PROVIDE NEW CONCRETE PAVEMENT JOINT PER JOINTING PLAN.
8. NOT ALL THE POSTS FOR THE STAIRCASE AND PORCH STRUCTURE ATTACHED TO THE STAIRCASE ARE SHOWN. PROTECT EXISTING STAIRS, CONCRETE STAIR LANDING, AND STAIRCASE/PORCH FOUNDATIONS AND POSTS TO REMAIN.
9. SAWCUT ALL EXISTING CONCRETE PAVEMENT UP TO THE NEAREST JOINT, EXCEPT WHERE OTHERWISE NOTED.
10. THE CONTRACTOR TO CONTACT AND COORDINATE WITH STORMTRAP AT 815-941-4549 BEFORE PERFORMING ANY EXCAVATION OR CONSTRUCTION OVER AND AROUND THE EXISTING UNDERGROUND STORMTRAP DETENTION SYSTEM. THE CONTRACTOR SHALL USE EQUIPMENT/METHODS WHICH WILL NOT RESULT IN THE MAXIMUM WEIGHT AND GROUND PRESSURE BEING EXCEEDED PER STORMTRAP STANDARDS.
11. REMOVE AND LEGALLY DISPOSE OF ALL TREES AND SCRUB VEGETATION WITHIN JPSTC PROPERTY.
12. THE CONTRACTOR SHALL PROTECT ALL EXISTING TREES NOT CALLED OUT FOR REMOVAL THROUGHOUT THE PROJECT SITE. IF DAMAGED, THE CONTRACTOR SHALL REPLACE THE DAMAGED TREE WITH THE SAME SIZE AND SPECIES WITHOUT ANY COST TO THE OWNER.
13. EXISTING UTILITIES TO BE ABANDONED, SHALL BE REMOVED AT LOCATIONS IF IN CONFLICT WITH PROPOSED FACILITIES OR UTILITIES. SEE DETAIL 1 SHEET C908 FOR SEWER STRUCTURES AND PIPES TO BE ABANDONED.
14. THE HOLES CREATED DUE TO REMOVAL WORK SHALL BE FILLED WITH CA-6 BACKFILL AND COMPACTED TO 95% MODIFIED PROCTOR DENSITY.
15. EXCAVATION SHOULD START ONLY AFTER THE IRRIGATION LINES HAVE BEEN DRAINED, THE VALVES ARE SHUT OFF, AND THE SYSTEM IS CAPPED PER MEP/LANDSCAPE PLANS. EXISTING ABANDONED IRRIGATION LINES SHOULD BE REMOVED IF FOUND WITHIN THE LIMITS OF THE PROPOSED UTILITY TRENCHING OR WITHIN EXCAVATION FOR PROPOSED WORK.
16. REMOVE AND SALVAGE EXISTING ARM GATE WITH CONCRETE FOUNDATION AND ASSOCIATED CABLES/EQUIPMENT FOR REINSTALLATION PER SITE PLAN AND TECHNOLOGY SITE PLAN. ABANDON EXISTING SIGNAL DETECTOR LOOP.



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REGISTRATION



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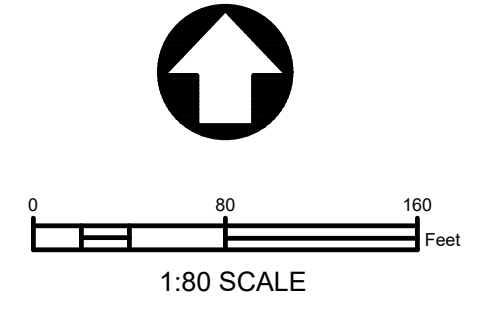
PROJECT NUMBER
 PBC-#07215 AECOM: 60710711

SHEET TITLE

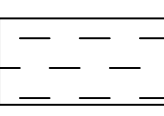
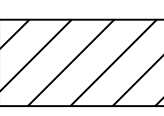
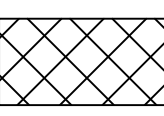
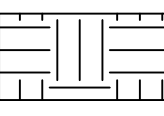
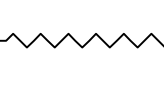
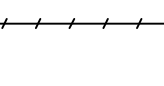

OVERALL DEMOLITION PLAN

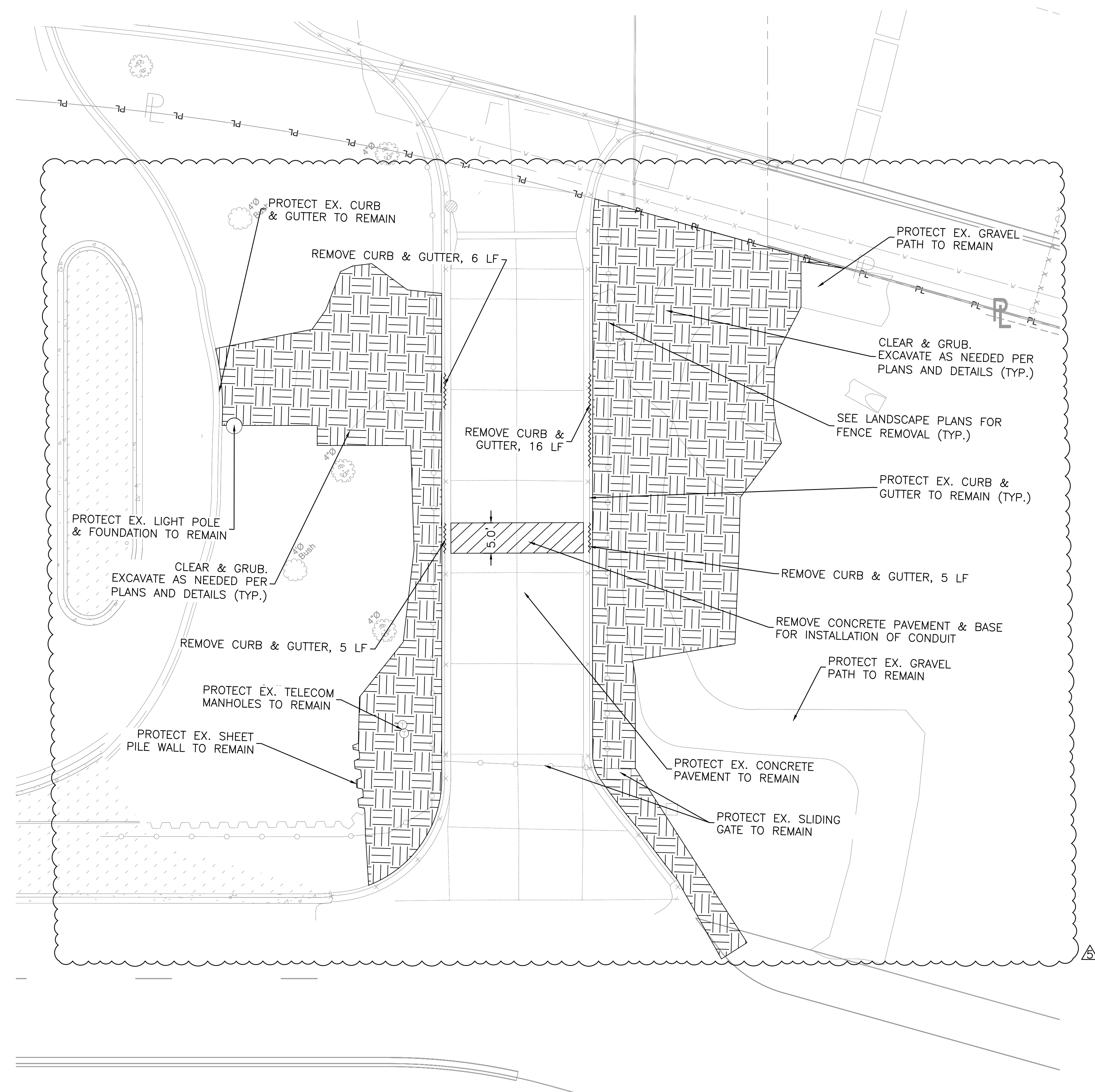
SHEET NUMBER

C100



DEMOLITION LEGEND

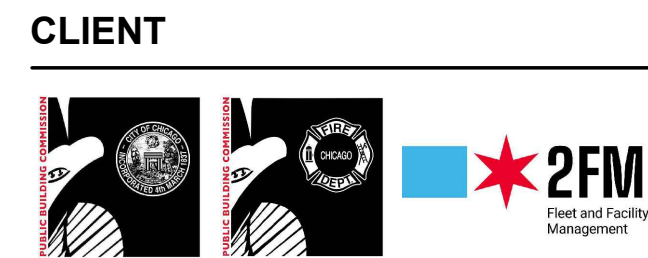
- PL — JPSTC PROPERTY LINE
- - - - - PARCEL 3 PROPERTY LINE
-  HMA PAVEMENT & BASE REMOVAL
-  CONCRETE PAVEMENT & BASE REMOVAL
-  CONCRETE SIDEWALK & BASE REMOVAL
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-  CURB & GUTTER REMOVAL
-  SEWER REMOVAL
-  REMOVAL



SEE SHEET C100 FOR NOTES.



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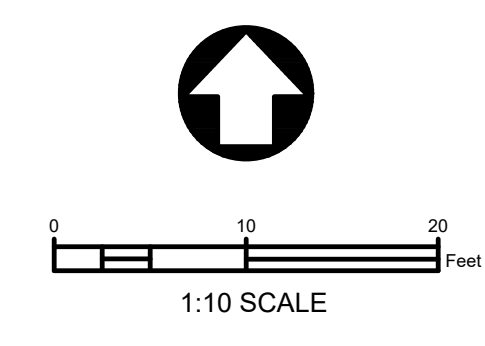
PBC-#07215 AECOM: 60710711

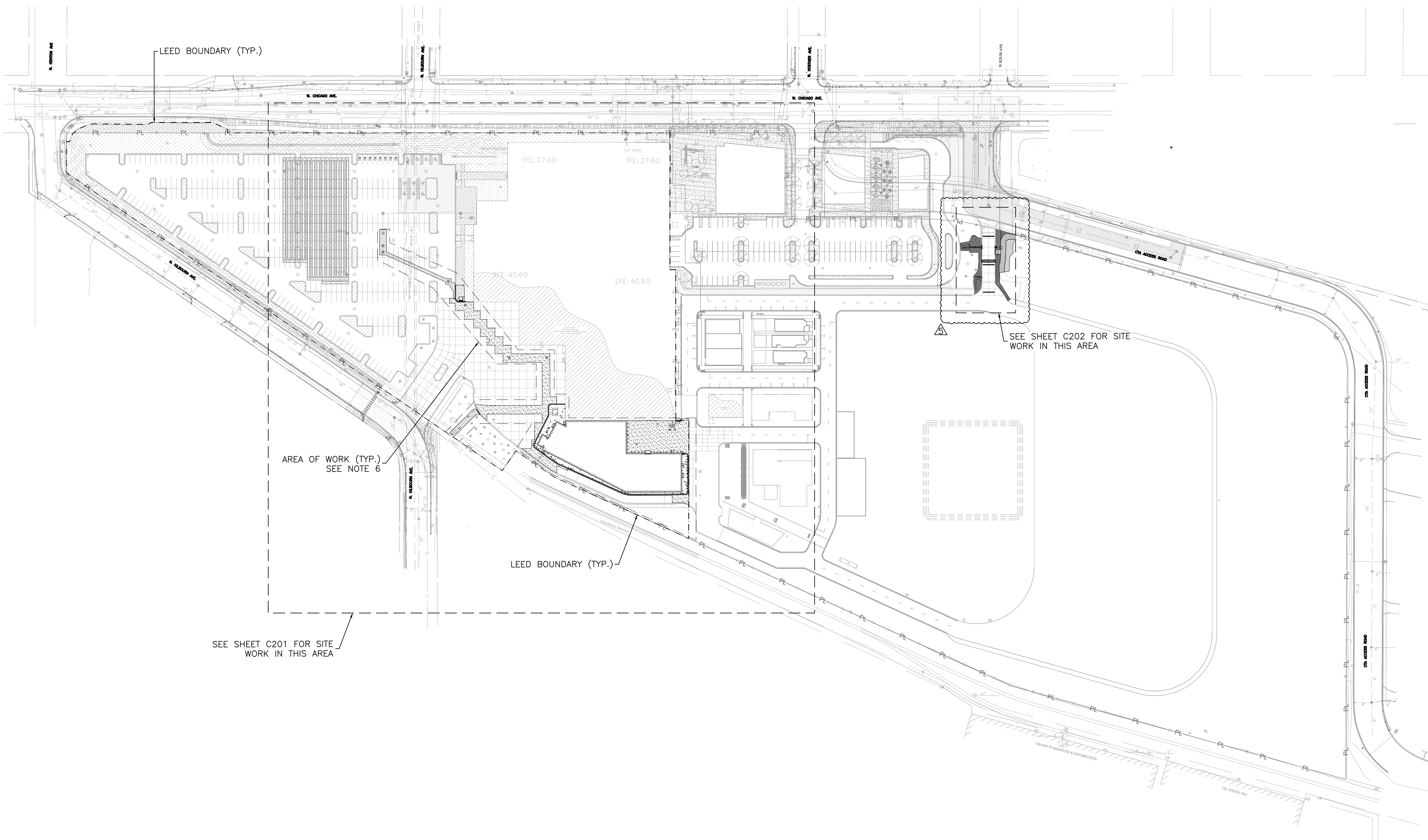
SHEET TITLE

DEMOLITION PLAN

SHEET NUMBER

C102





SITE LEGEND

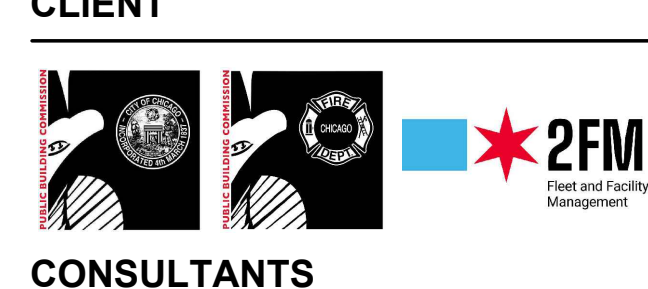
- PL — JPSTC PROPERTY LINE
- PARCEL 3 PROPERTY LINE
- LEED BOUNDARY
- [Hatched Box] BUILDING (SEE ARCHITECTURAL PLANS)
- [Dotted Box] CONCRETE PAVEMENT & BASE (SEE DETAIL 7 SHEET C901)
- [Dotted Box] CONCRETE SIDEWALK & BASE (SEE DETAILS 1 SHEET C901)
- [Dotted Box] ASPHALT PAVEMENT & BASE (SEE DETAIL 6 SHEET C901)
- [Double Line] CONCRETE CURB & GUTTER BV.12 (SEE DETAIL 2 SHEET C901)
- [Hatched Box] CONCRETE DEPRESSED CURB & GUTTER
- [Double Line] 6" CONCRETE BARRIER CURB (SEE DETAIL 5 SHEET C901)
- [Box with X] 2' CURB CUT FOR ROLLING GATES
- [Box with Dots] DETECTABLE WARNING TILE
- [Dotted Box] LAWN, PLANTINGS AND TREES (SEE LANDSCAPE PLANS)

- NOTES:**
1. FOR PROPOSED LAWN/PLANTINGS AND TREE DETAILS, SEE LANDSCAPE PLANS.
 2. FOR FENCING SEE LANDSCAPE PLANS.
 3. DIMENSIONS AND RADII SHOWN AT CURBS ARE TO THE FACE OF CURB.
 4. ARCHITECT CAN PROVIDE ELECTRONIC CAD FILES OF SITE PAVING PLANS FOR CONSTRUCTION STAKING AND LAYOUT ON SITE, IF REQUIRED BY THE CONTRACTOR.
 5. AREA OF WORK LIMITS ARE APPROXIMATE.
 6. FOR CONCRETE AT DOORWAYS SEE STRUCTURAL PLANS.
 7. ANY PARKING STALL STRIPING THAT IS REMOVED OR DAMAGED PARTIALLY DUE TO SEWER TRENCHING SHALL BE REMOVED IN FULL LENGTH AND RESTRIPE TO MATCH EXISTING STRIPING. ANY NEARBY PARKING STALL STRIPINGS THAT HAVE FADED/DAMAGED DUE TO CONSTRUCTION WORK SHALL BE REMOVED IN FULL LENGTH AND RESTRIPE.
 8. FOR CONCRETE PAD FOR TRANSFORMER SEE DETAIL 3 SHEET C905. PROVIDE YELLOW-PAINTED 4" DIA. BOLLARDS AROUND CONCRETE PAD. SEE DETAIL 9 SHEET C907.
 9. COMPACT CA-6/GRAVEL TO 95% MODIFIED PROCTOR DENSITY.

RETAINING WALL COORDINATE POINTS	X	Y
1	1147188.36	1904726.40
2	1147175.03	1904723.21
3	1147175.20	1904718.00
4	1147188.61	1904718.43



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REGISTRATION



KEY PLAN

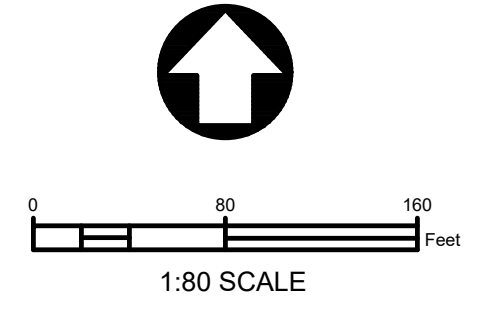
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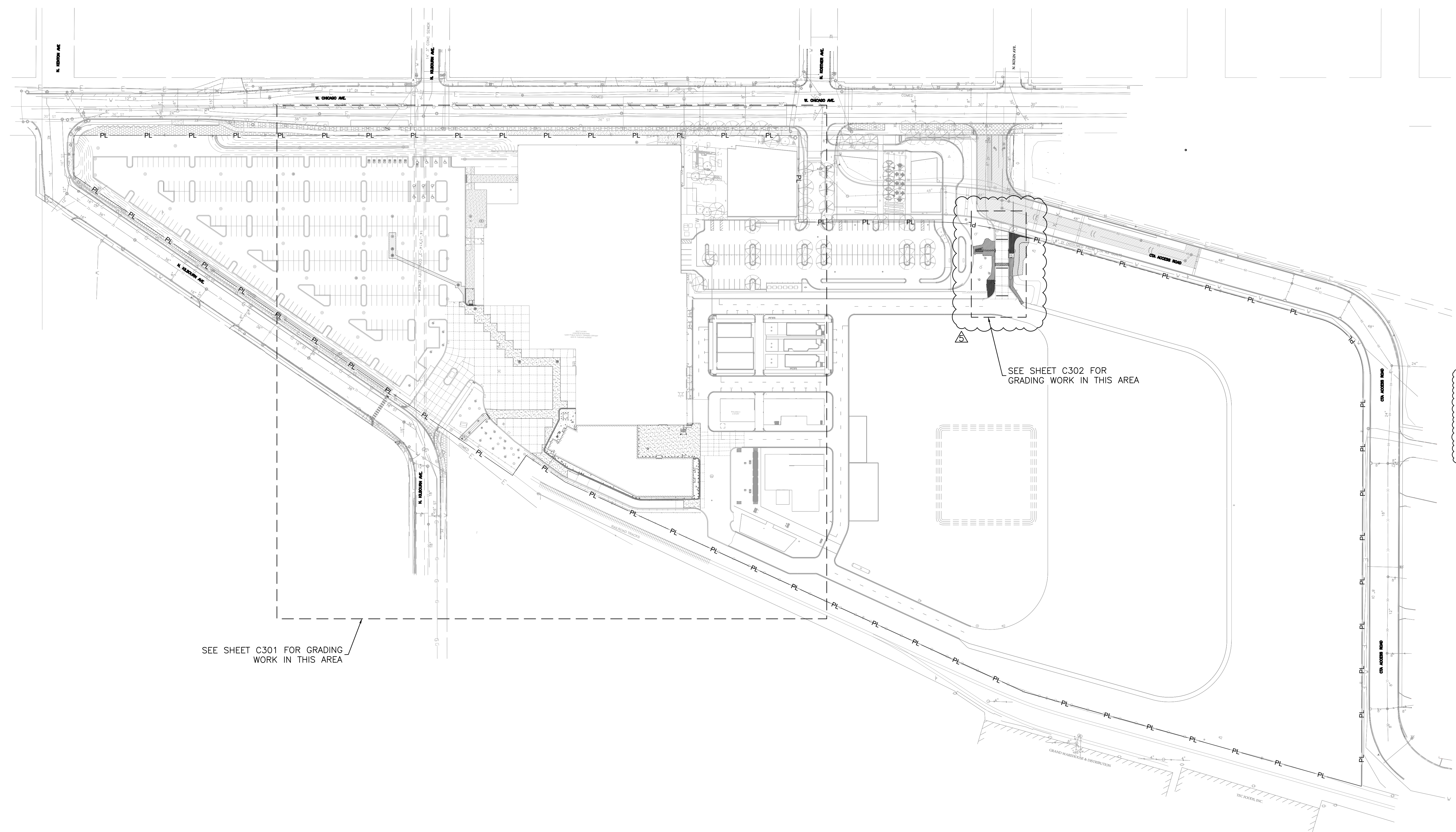
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SHEET TITLE
OVERALL SITE PLAN

SHEET NUMBER
C200



CH E 300.42
 Updated: HG
 Checked: HG
 Designer: CS



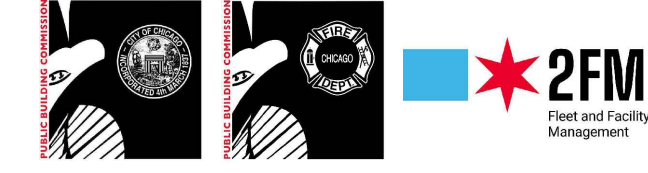
- ### GRADING LEGEND
- PL — JPSTC PROPERTY LINE
 - - - - - PARCEL 3 PROPERTY LINE
 - XX.XX TOP OF CURB EL.
 - XX.XX GUTTER/BOTTOM OF CURB EL.
 - TWXX.XX TOP OF WALL EL.
 - BWXX.XX BOTTOM OF WALL EL.
 - RXX.XX RIM EL.
 - SXX.XX SWALE BED EL.
 - 1.50% PAVEMENT SLOPE ARROW
 - ME MATCH EXISTING EL.
 - HWL HIGH WATER LEVEL
 - FFE FINISHED FLOOR EL.
 - ADJ RXX.XX ADJUST RIM EL. TO XX.XX
 - MANHOLE
 - CATCH BASIN
 - CLEAN OUT
 - SLOPE/FLOW DIRECTION
 - TCXX.XX TOP OF CURB EL.
 - PXX.XX CON. PAVEMENT EL.
 - SWXX.XX SIDEWALK EL.
 - BCXX.XX BACK OF CURB EL.
 - TCXX.XX TOP OF CURB EL.

- NOTES:
1. SEE SURVEY/EXISTING CONDITIONS PLANS FOR EXISTING ELEVATIONS. THE CONTRACTOR MUST CHECK THE ELEVATIONS NOTED ON THE PLANS BEFORE STARTING GRADING WORK FOR THE CONSTRUCTION. ANY DISCREPANCIES IN THE ELEVATIONS SHOULD BE IMMEDIATELY NOTIFIED TO THE ARCHITECT.
 2. ALL PROPOSED SPOT ELEVATIONS SHOWN ON THE GRADING PLANS ARE FINISHED GRADES.
 3. FINISHED GRADES SHALL MATCH EXISTING UNLESS OTHERWISE NOTED.
 4. FOR ADJUSTMENT OF FRAME/RIM ELEVATION SEE DETAIL 4 SHEET C903.
 5. THE CONTRACTOR TO SURVEY EXISTING PAVEMENT ELEVATION AT PROPOSED MANHOLE STRUCTURES MH12, MH13, MH14, MH15, MH16, & MH17. PROVIDE PROPOSED RIM ELEVATION OF THE AFOREMENTIONED STRUCTURES TO MATCH WITH THE SURVEYED PAVEMENT ELEVATIONS AT RESPECTIVE MANHOLE LOCATIONS.
 6. ADJUST STRUCTURES TO GRADE AS NEEDED TO MATCH PROPOSED GRAVEL PATH/AREA.



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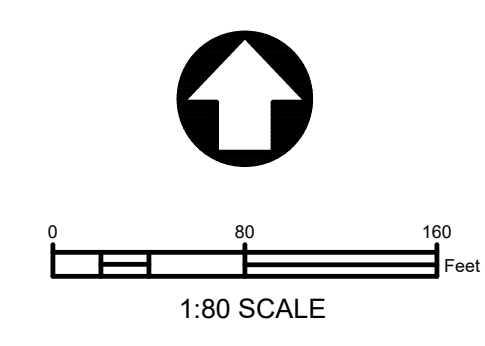
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SHEET TITLE

OVERALL GRADING PLAN

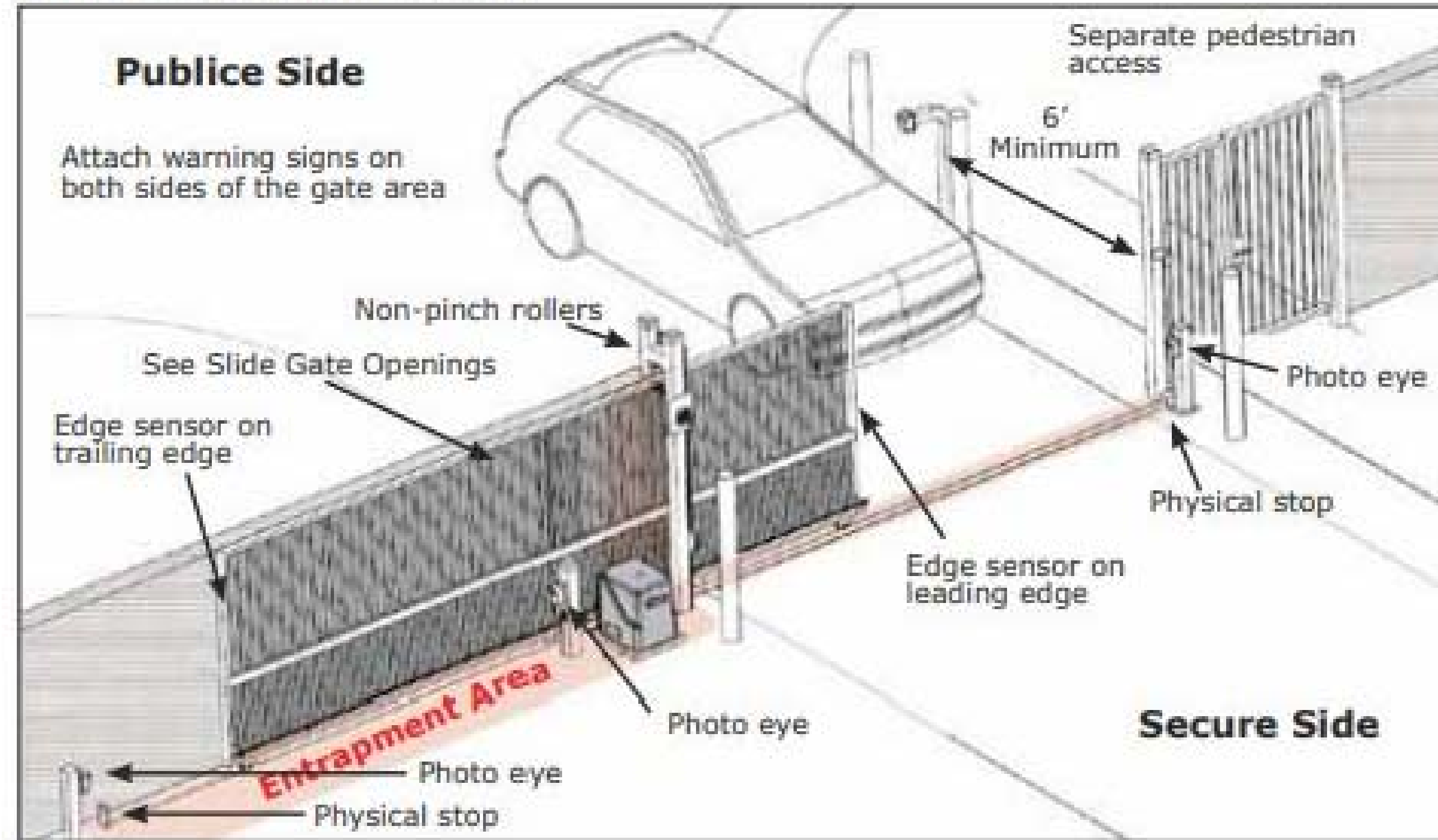
SHEET NUMBER

C300

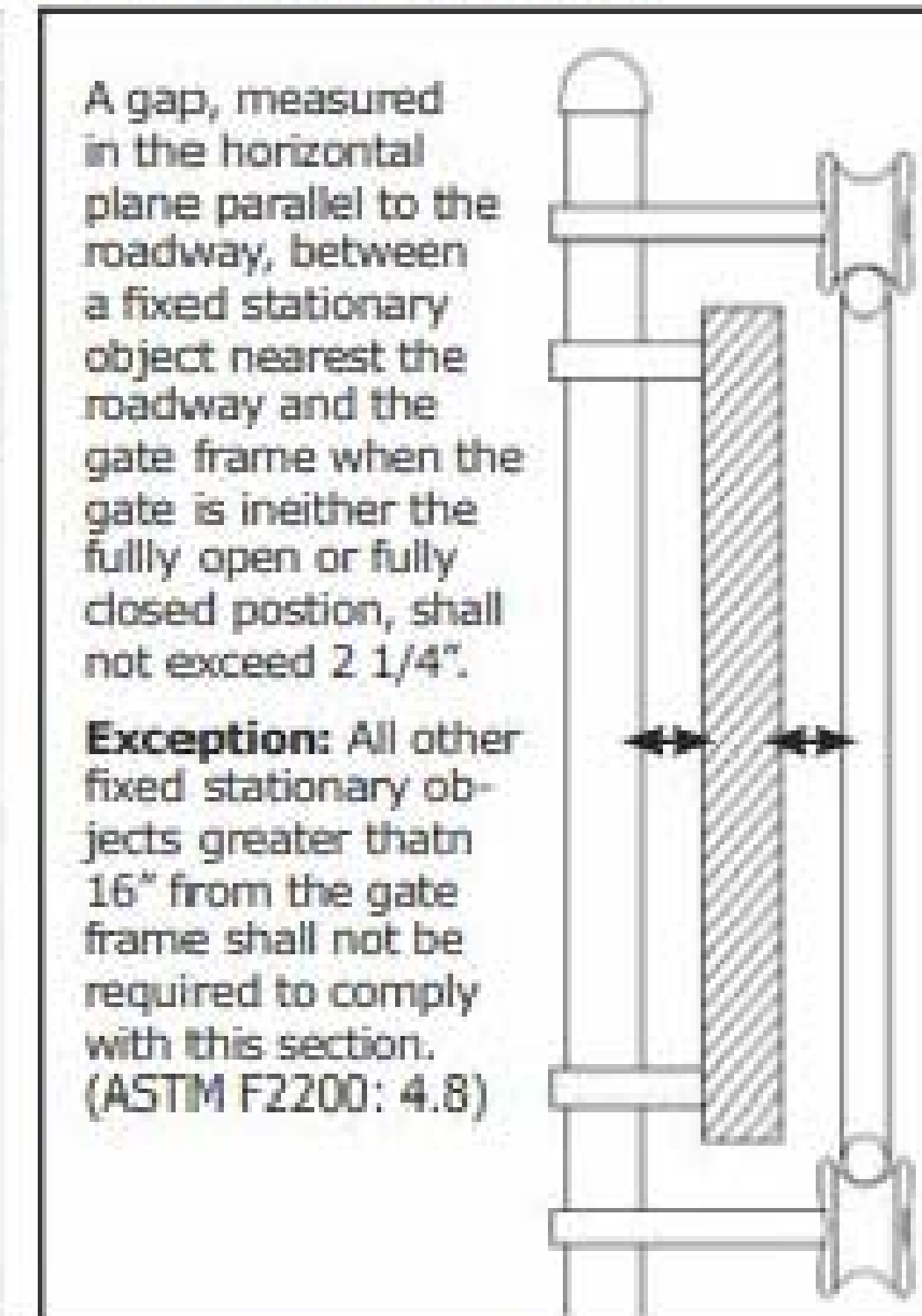


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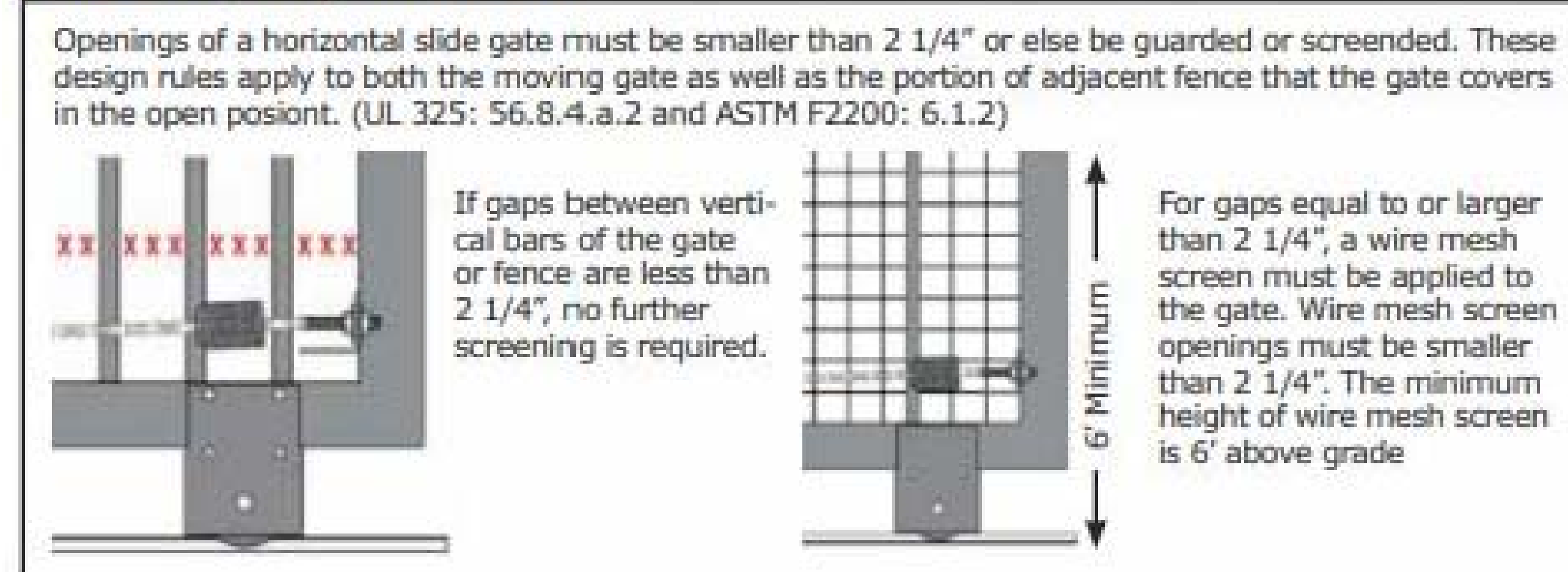
Slide Gate Requirements



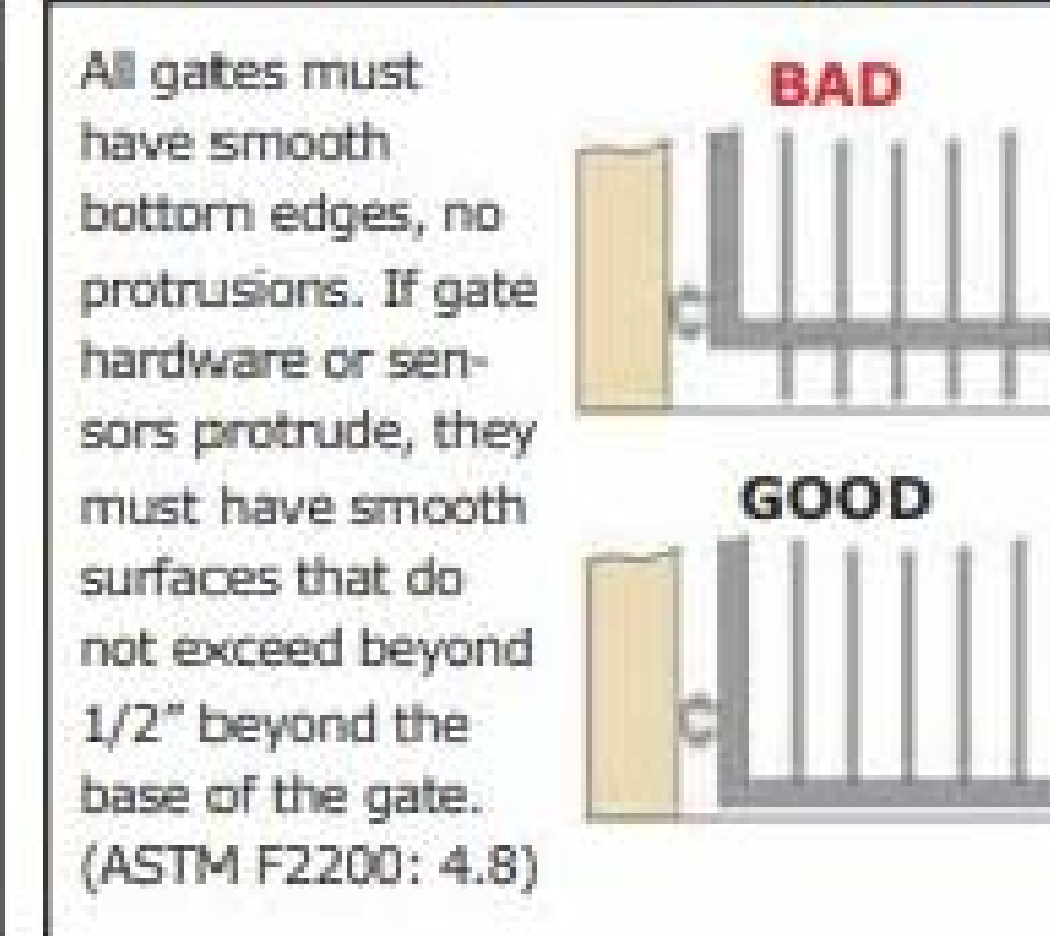
Slide Gate Spacing



Slide Gate Requirements



Base of Slide & Swing Gate



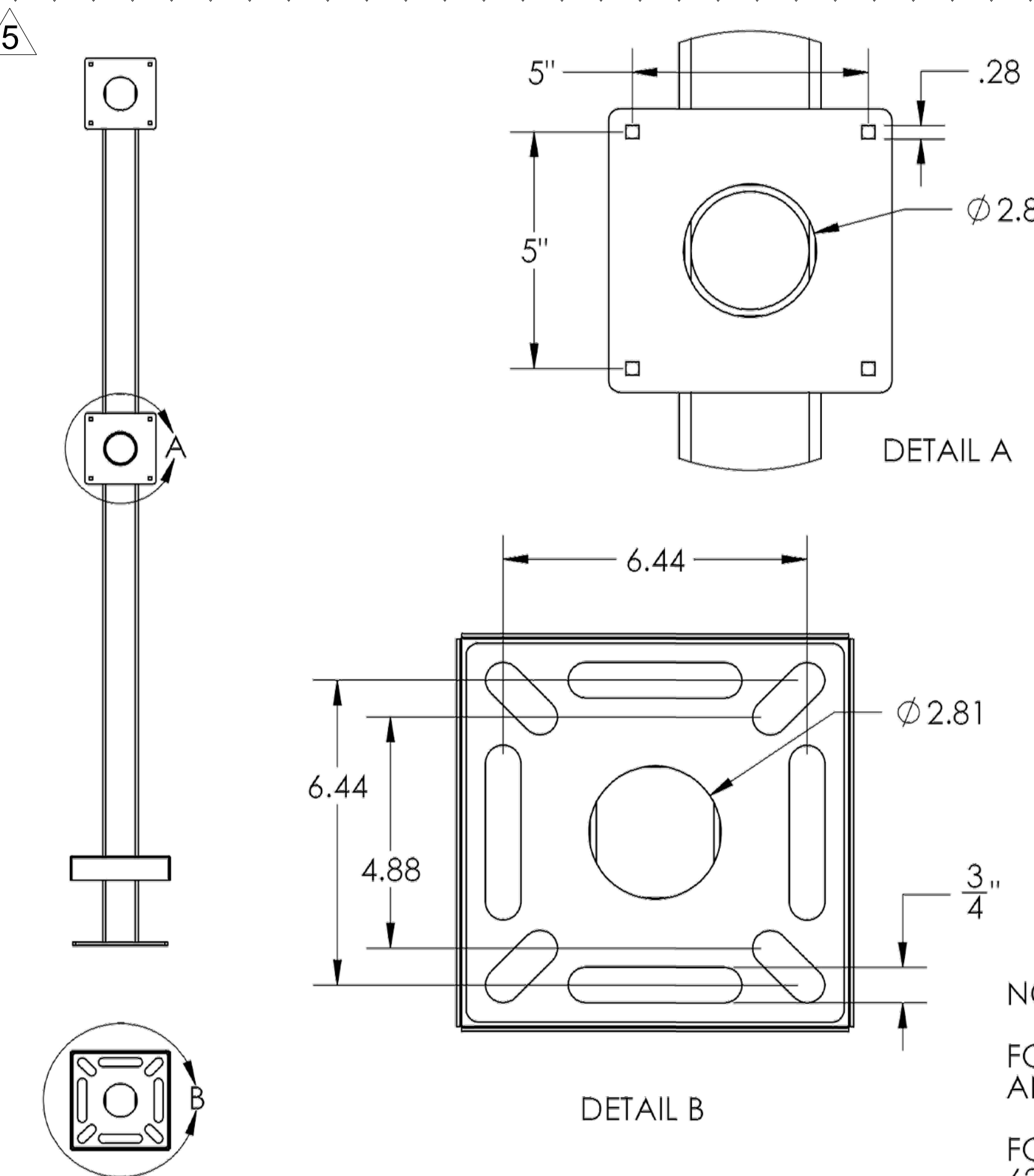
UL 325 Standards		
Item	Pass/Fail	Comments
Gate operator is at the current UL 325 Standard	Pass / Fail	
Warning signs are attached on both sides of gate area	Pass / Fail	
Each entrapment zone is covered by two safety devices		
1. Closing Entrapment Area	Pass / Fail	
2. Opening Entrapment Area	Pass / Fail	
3. Other Entrapment Area	Pass / Fail	

ASTM F2200 Standards - Gate Construction Evaluation		
Item	Pass/Fail	Comments
All Gates Types		
Gates have smooth bottom edges, no protrusions	Pass / Fail	
All access controls at least 6' from gate	Pass / Fail	
Barbed tape at least 8' above grade	Pass / Fail	
Barbed wire at least 6' above grade	Pass / Fail	
Separate pedestrian gate that is out of reach of the moving gate	Pass / Fail	

Slide Gates Only		
Roller covers on cantilever wheels	Pass / Fail	
If pickets are spaced equal to, or greater than 2 1/4" apart, meshing is installed up to 6' above grade	Pass / Fail	
Gate does not move on it's own when power is turned off	Pass / Fail	
Gap between gate and stationary fence posts less than 2 1/4"	Pass / Fail	
Positive stops at both the fully open, and closed positions	Pass / Fail	
Receiver guides recessed behind the receiver post if below 8"	Pass / Fail	
Catch post installed to prevent gate from falling if disconnected from supporting hardware	Pass / Fail	
Other	Pass / Fail	

1 AUTOMATIC GATE SAFETY CHECKLIST - UL 325 AND ASTM F2200 STANDARDS FOR AUTOMATIC SLIDE GATE
SCALE: NTS

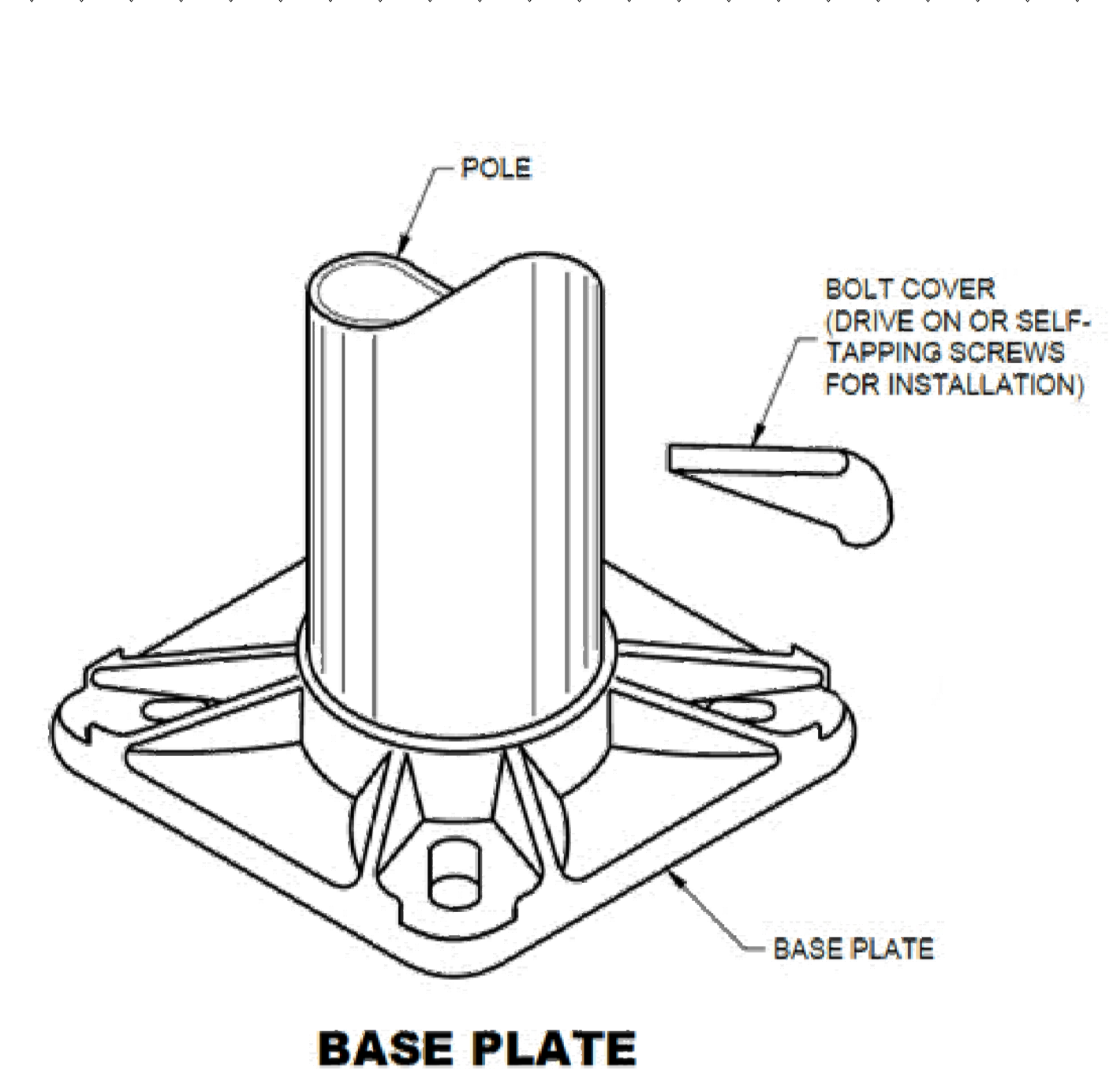
2 PEDESTRIAN GATE CHECKLIST
SCALE: NTS



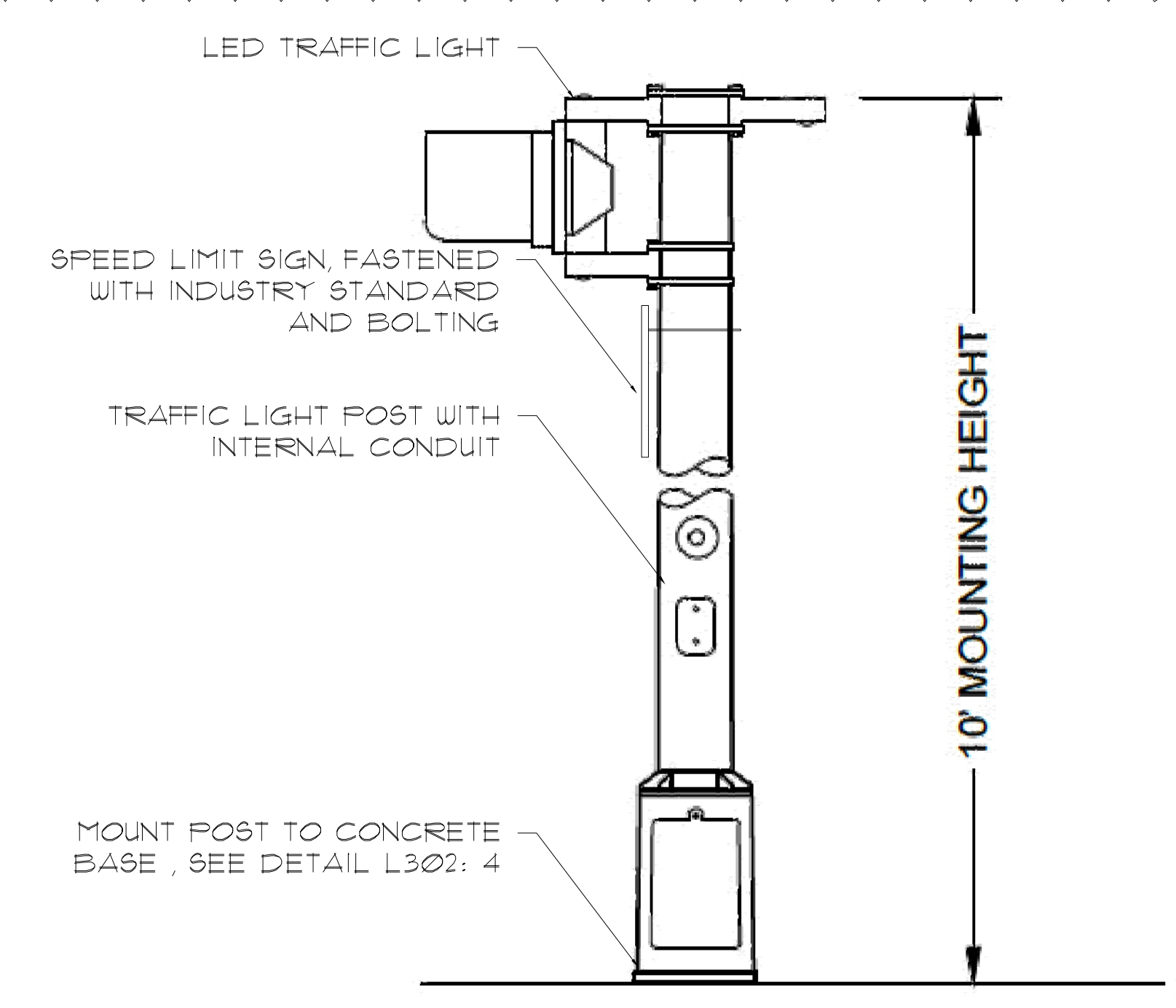
3 DOUBLE HEADED CARD READER DETAIL
SCALE: NTS

NOTES:
1. 1/2" Ø MOUNTING HARDWARE IS RECOMMENDED FOR 5X5 BASEPLATE MODELS. L-BOLT-500, STUD-ANCHOR-500.
2. 5/8" Ø MOUNTING HARDWARE IS RECOMMENDED FOR 8X8 AND 12X12 BASEPLATE MODELS. L-BOLT-625, STUD-ANCHOR-625.

4 POST MOUNTING DETAIL
SCALE: NTS



5 TRAFFIC LIGHT POST DETAIL
SCALE: NTS



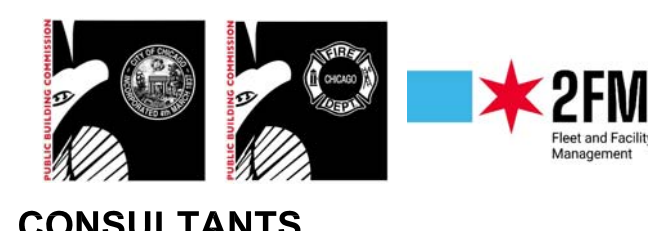
5 TRAFFIC LIGHT POST DETAIL
SCALE: NTS

NOTES:
1. SEE NOTES ON SHEET L301.

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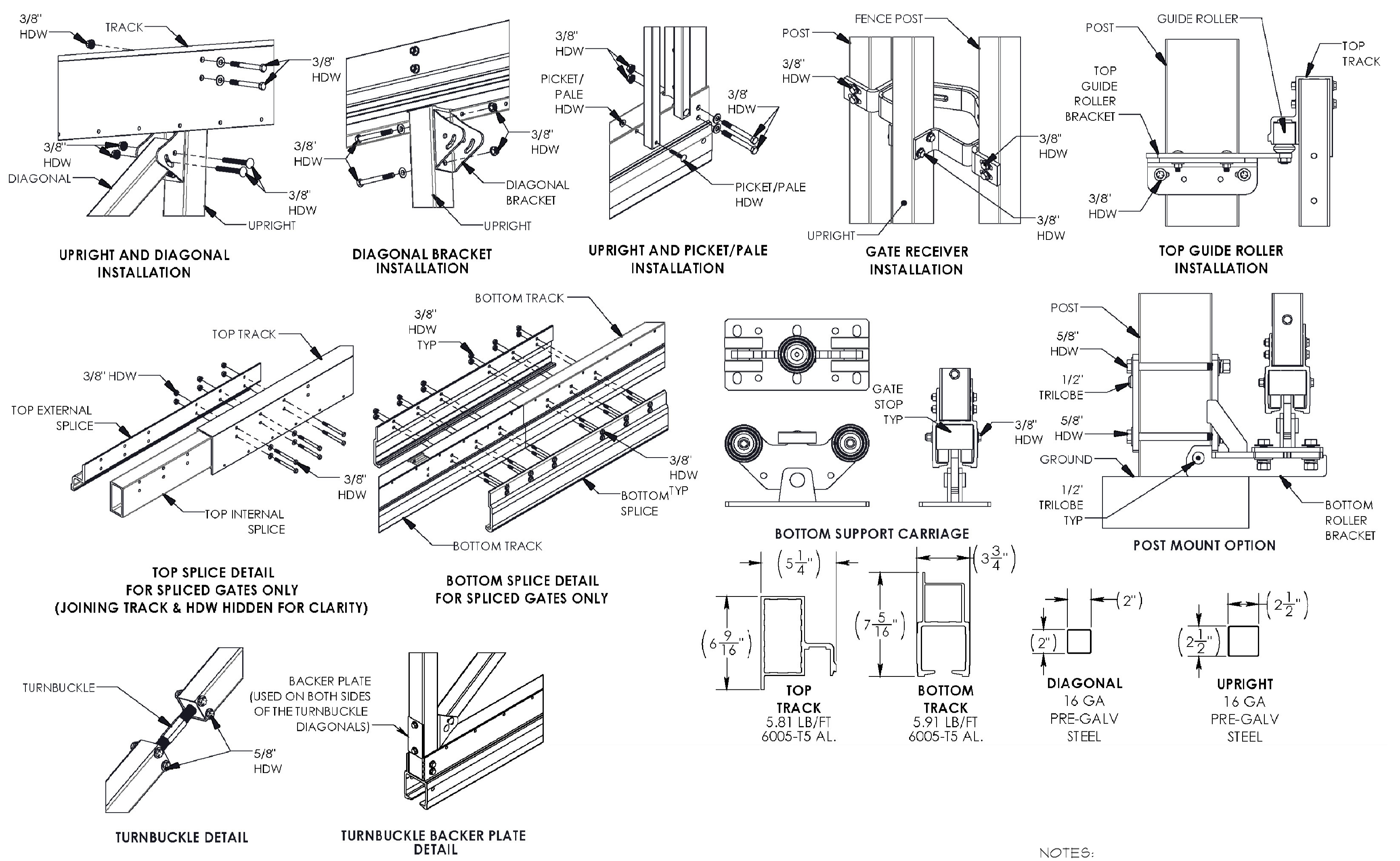
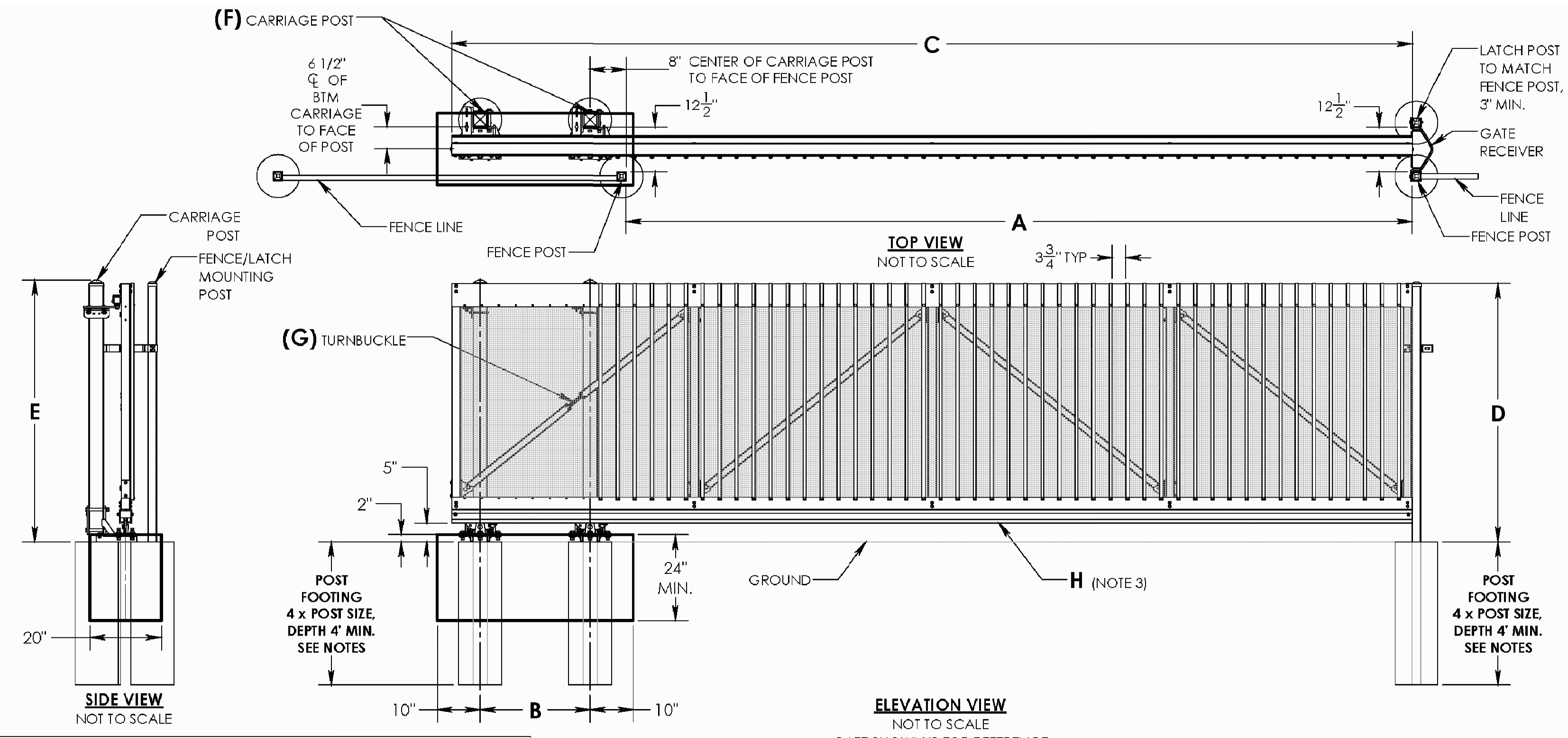
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IR	DATE	DESCRIPTION
5	07/25/2024	ADD 03
3	07/12/2024	ADD 01
2	07/05/2024	ISSUED FOR PERMIT
1	06/26/2024	ISSUED FOR BID

PROJECT NUMBER
PBC: #07215 AECOM: 60710711

SHEET TITLE
SLIDING GATE STANDARD DETAILS

SHEET NUMBER
L302



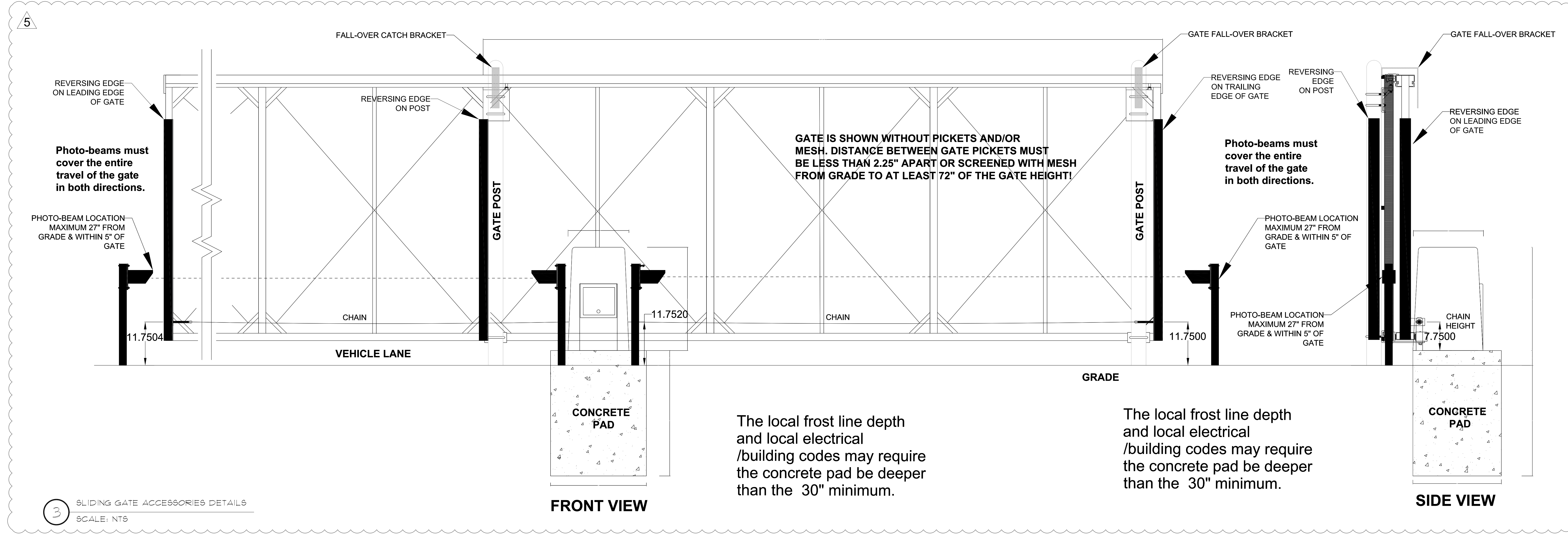
NOMINAL GATE SIZE
6'H X 22'-24"W

GATE INFORMATION CHART		
A	CLEAR OPENING	22'-24"
B	CARRIAGE/POST SPACING C/C	49" +0.00"/-1.00"
C	OVERALL GATE LENGTH	358-3/4"
D	HEIGHT TO TOP OF PICKETS	72"
E	POST HEIGHT	74"
F	CARRIAGE POST SIZE	4"
G	NO. OF TURNBUCKLES	1
H	NO. OF SPLICES	1

- NOTES:**
- BOTH SLAB AND POST MOUNT OPTION SHOWN.
 - TOP OF SLAB WILL BE 2" ABOVE GROUND.
 - SPLICE REQUIRED ON LARGE GATES.
 - SEE INSTALLATION INSTRUCTIONS FOR ANCHOR DETAIL.
 - FOOTING DEPTHS ARE MINIMUM OR BASED ON LOCAL CONDITIONS.
 - GATE SHALL BE MOUNTED TO RETAINING WALL.
 - INCLUDE SCREENING FOR GATE THAT COMPLIES WITH UL/ASTMF STANDARDS.

1 6' HT. ORNAMENTAL METAL SLIDING GATE DETAILS
 SCALE: NTS

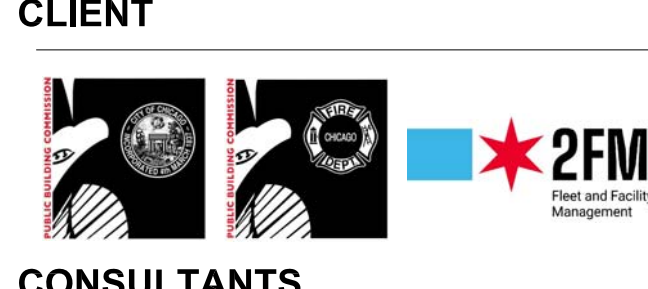
2 SLIDING GATE DETAILS
 SCALE: NTS



3 SLIDING GATE ACCESSORIES DETAILS
 SCALE: NTS



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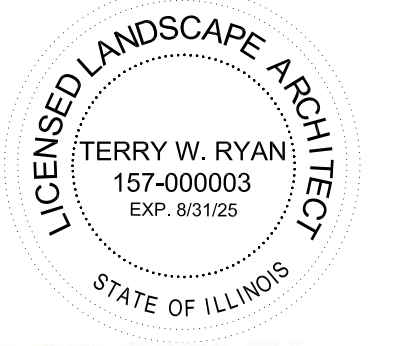
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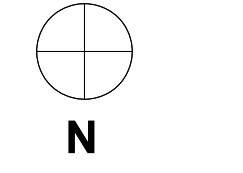
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NORTH ARROW



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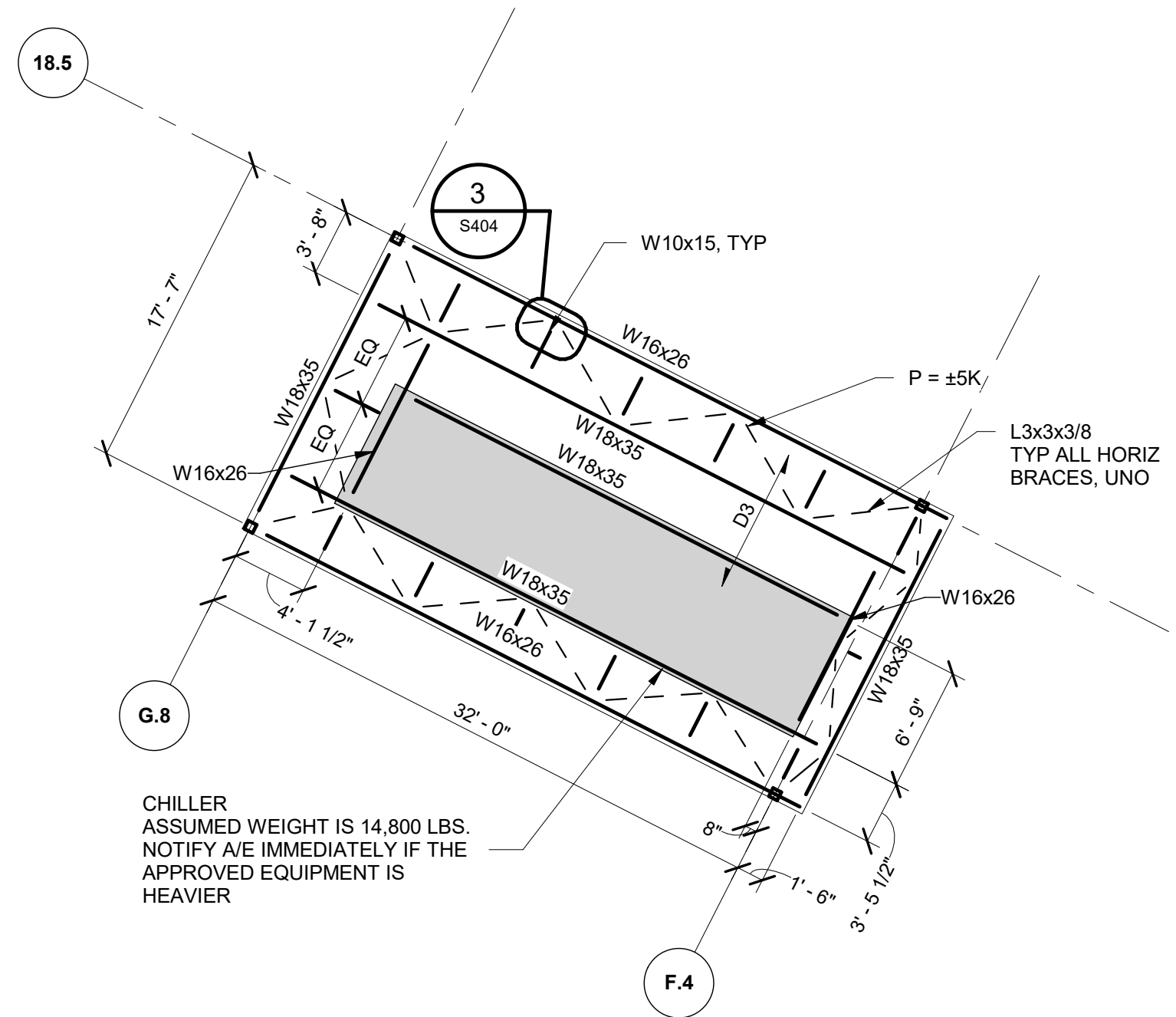
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1	06/26/2024	ISSUED FOR BID

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

SHEET TITLE
 SLIDING GATE DETAILS

SHEET NUMBER
 L303

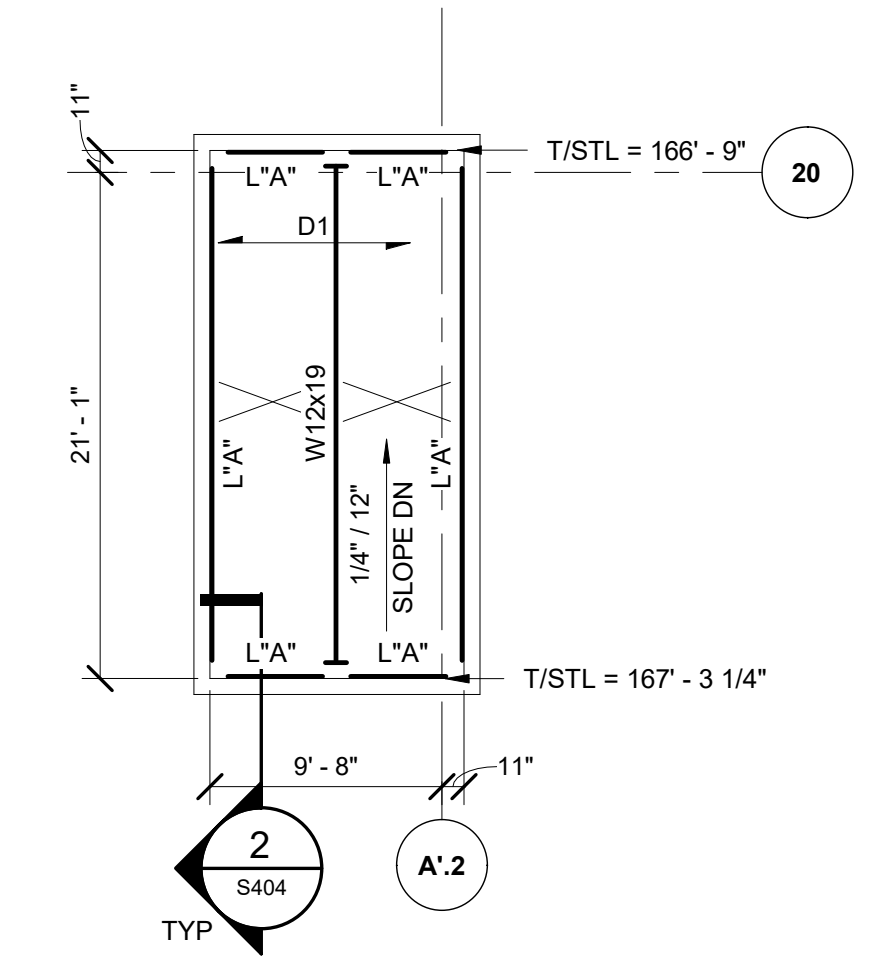
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1 CHILLER PLATFORM FRAMING PLAN - AREA EMS
Scale: 1/8" = 1'-0"

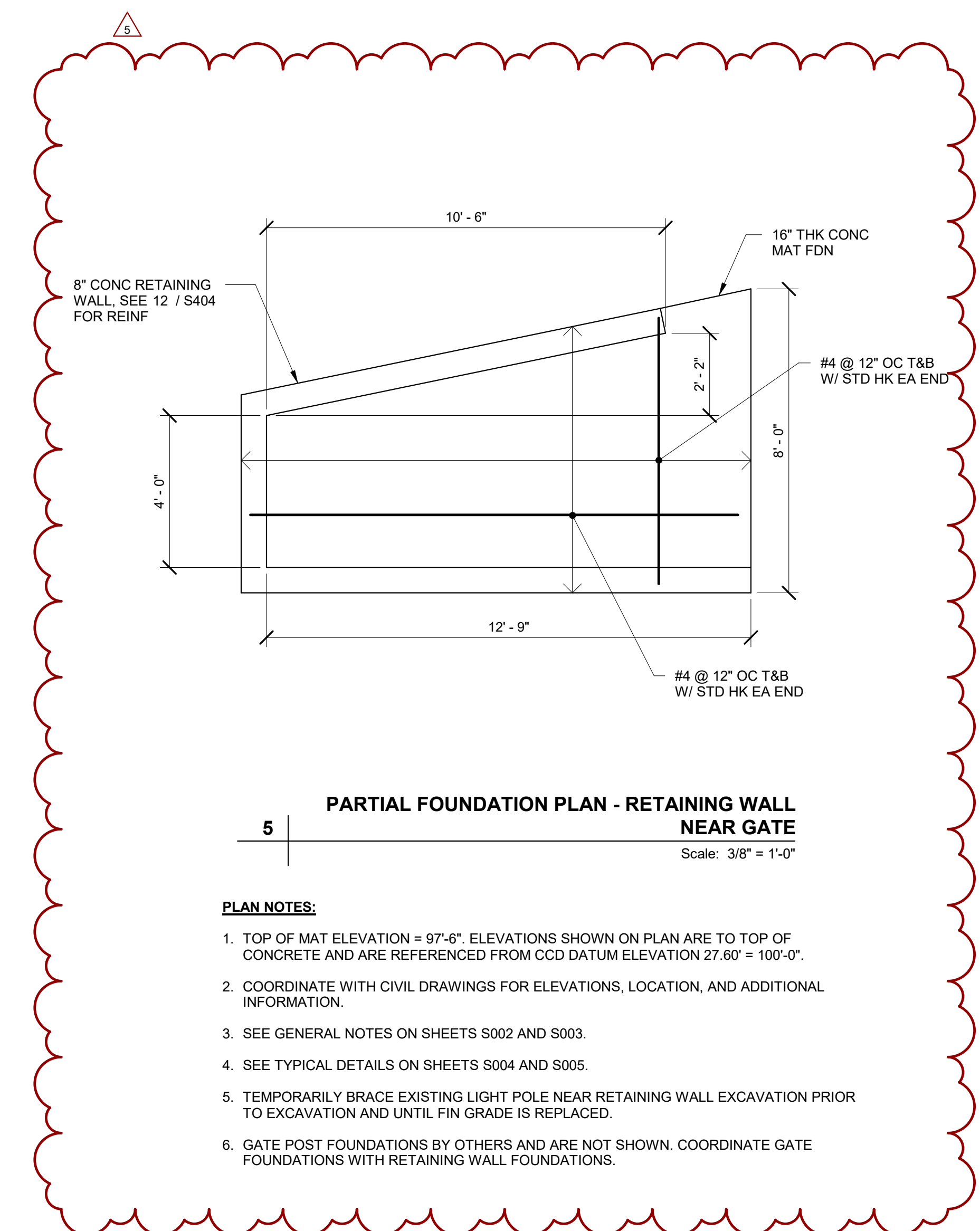
- PLAN NOTES:**
- TOP OF STEEL ELEVATION = 163'-6". ELEVATIONS SHOWN ON PLAN ARE TO TOP OF STEELJOIST BEARING ELEVATION AND ARE REFERENCED FROM CCD DATUM ELEVATION 27.60' = 100'-0".
 - PLATFORM CONSTRUCTION UNO (D3): 1 1/2"x3/16" TYPE 19-4 STANDARD STEEL GRATING, GALVANIZED, ATTACH TO STEEL BEAMS PER GENERAL NOTES. TOP OF GRATING ELEVATION = 163'-7 1/2". EXTEND GRATING TO EXTERIOR EDGE OF BEAM FLANGE.
 - ALL STEEL SHALL BE HOT-DIPPED GALVANIZED.
 - COORDINATE WITH ALL DRAWINGS FOR LOCATION OF OPENINGS, SLEEVES, CONDUITS, DRAINS, DEPRESSIONS, EQUIPMENT PADS, ETC.
 - BEAMS ARE EQUALLY SPACED BETWEEN COLUMN OR INTERSECTING GIRDERS, UNO.
 - SEE GENERAL NOTES ON SHEETS S002 AND S003.
 - SEE TYPICAL DETAILS ON SHEETS S006 AND S007.
 - SEE ARCHITECTURAL DRAWINGS FOR HANDRAIL AND ACCESS LADDER.

- LEGEND:**
- ☒ - INDICATES ROOF OPENING, SEE DETAIL 6/S006. COORDINATE WITH MECHANICAL DRAWINGS.
 - ▶ - INDICATES MOMENT CONNECTION ON PLAN. MOMENT CONNECTION SYMBOLS WITH THE LETTER "MS" BESIDE IT INDICATES A MOMENT CONNECTION THAT DOES NOT REQUIRE COLUMN STIFFENER PLATES.
 - D1 - INDICATES SLAB OR DECK SPAN DIRECTION.
 - - INDICATES KNEE BRACE, SEE DETAIL 17/S007.
 - X— - INDICATES CROSS BRACING, SEE DETAIL 3/S006.
 - - COORDINATE DIMENSION TO ALIGN WITH CHILLER SUPPLIER (SPRING ISOLATOR LOCATIONS).
 - L "A" - INDICATES L6x4x3/8 LVL W/ 3/4" DIA EXPANSION ANCHORS AT 2'-0" OC.



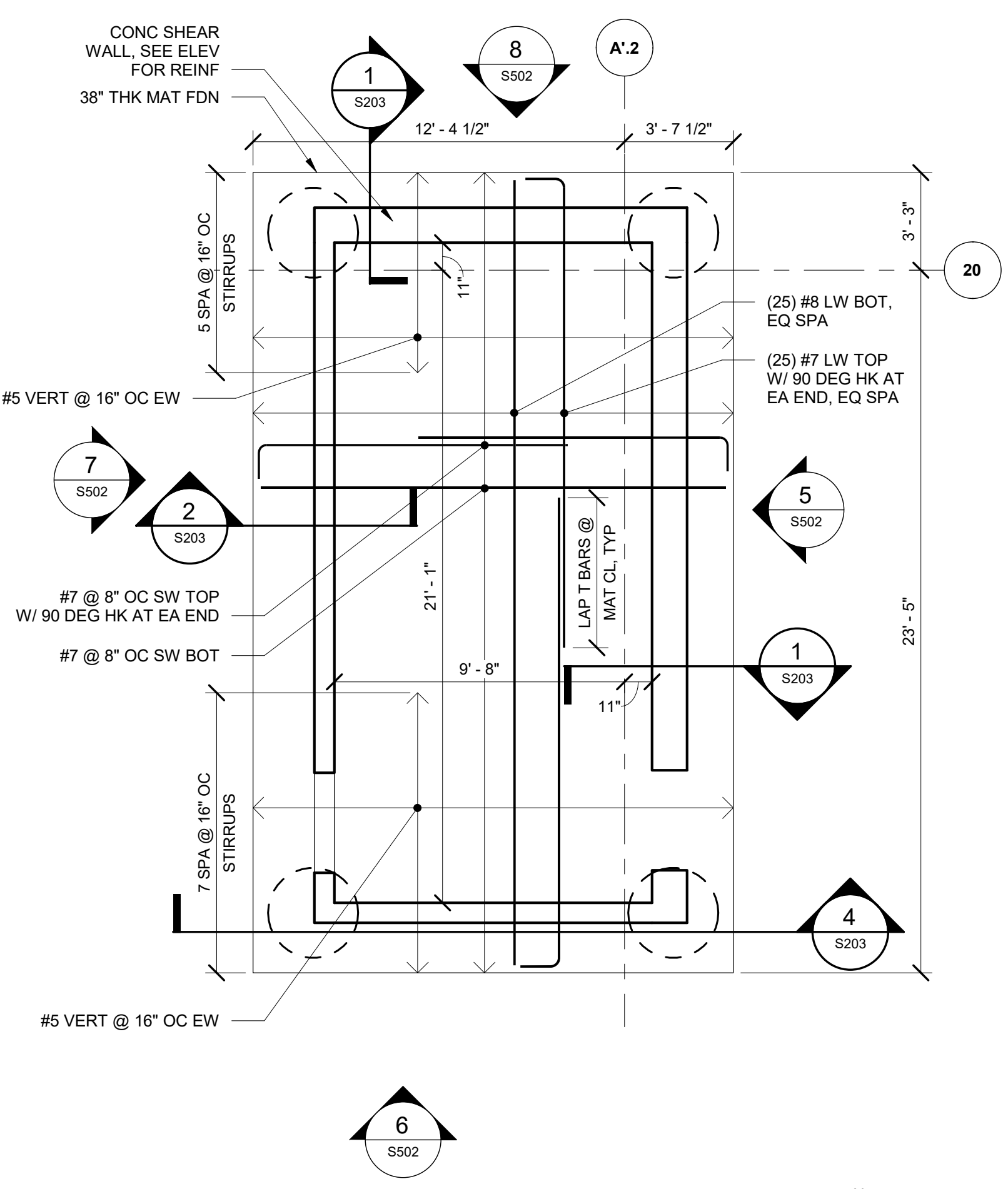
2 STAIR ROOF FRAMING PLAN - AREA EMS
Scale: 1/8" = 1'-0"

- PLAN NOTES:**
- TOP OF STEEL ELEVATION = 166'-9". ELEVATIONS SHOWN ON PLAN ARE TO TOP OF STEEL ELEVATION AND ARE REFERENCED FROM CCD DATUM ELEVATION 27.60' = 100'-0".
 - (+/-) INDICATES CHANGE IN ELEVATION FROM TOP OF STEEL REFERENCE ELEVATION.
 - ROOF CONSTRUCTION UNO (D1): 3"x20 GAGE GALVANIZED STEEL DECK ATTACHED TO STEEL BEAMS PER GENERAL NOTES.
 - COORDINATE WITH ALL DRAWINGS FOR LOCATION OF OPENINGS, SLEEVES, CONDUITS, DRAINS, DEPRESSIONS, EQUIPMENT PADS, ETC.
 - BEAMS ARE EQUALLY SPACED BETWEEN WALLS, UNO.
 - SEE GENERAL NOTES ON SHEETS S002 AND S003.
 - SEE TYPICAL DETAILS ON SHEETS S006 AND S007.



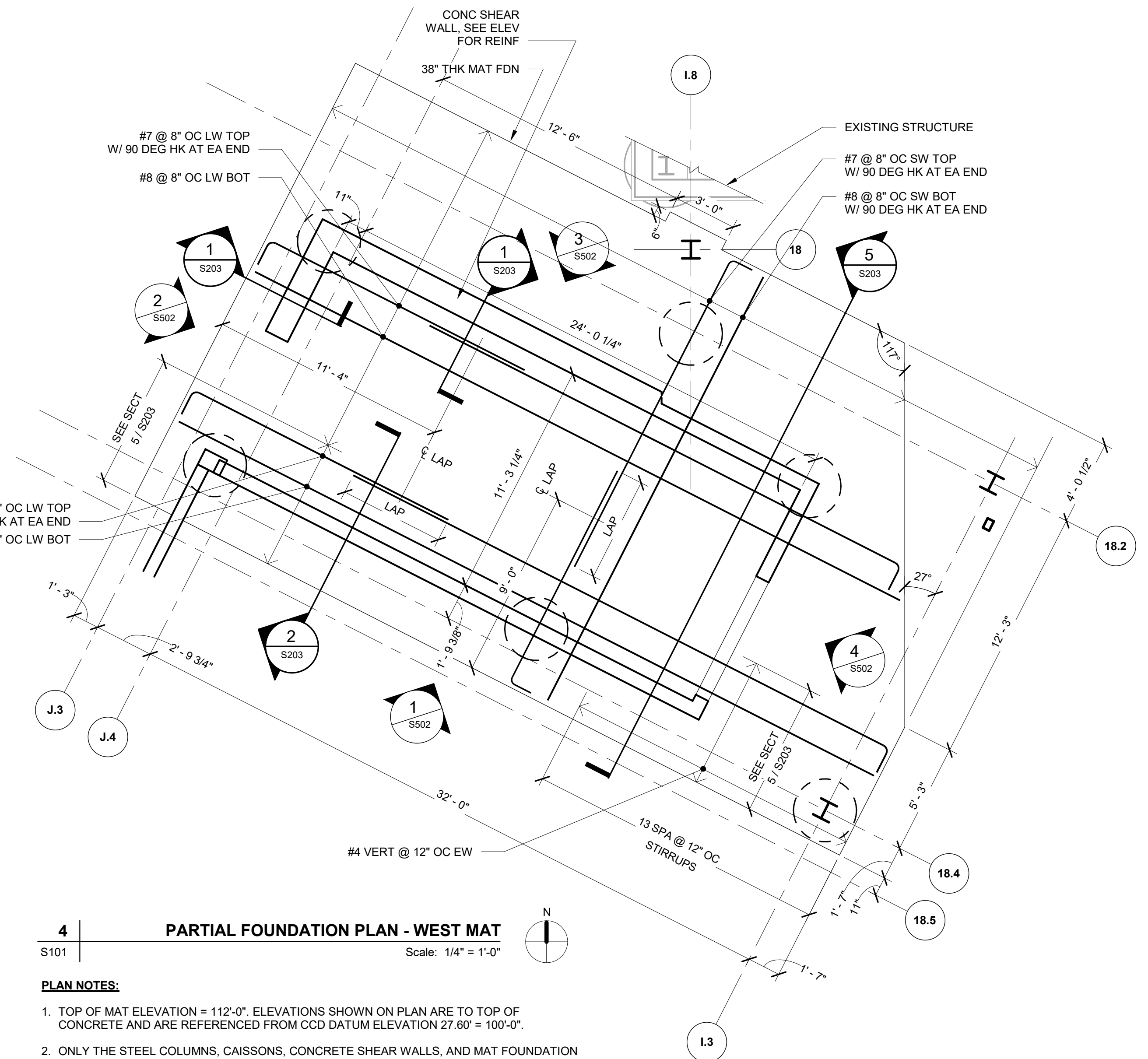
5 PARTIAL FOUNDATION PLAN - RETAINING WALL NEAR EAST
Scale: 3/8" = 1'-0"

- PLAN NOTES:**
- TOP OF MAT ELEVATION = 97'-6". ELEVATIONS SHOWN ON PLAN ARE TO TOP OF CONCRETE AND ARE REFERENCED FROM CCD DATUM ELEVATION 27.60' = 100'-0".
 - COORDINATE WITH CIVIL DRAWINGS FOR ELEVATIONS, LOCATION, AND ADDITIONAL INFORMATION.
 - SEE GENERAL NOTES ON SHEETS S002 AND S003.
 - SEE TYPICAL DETAILS ON SHEETS S004 AND S005.
 - TEMPORARILY BRACE EXISTING LIGHT POLE NEAR RETAINING WALL EXCAVATION PRIOR TO EXCAVATION AND UNTIL FIN GRADE IS REPLACED.
 - GATE POST FOUNDATIONS BY OTHERS AND ARE NOT SHOWN. COORDINATE GATE FOUNDATIONS WITH RETAINING WALL FOUNDATIONS.



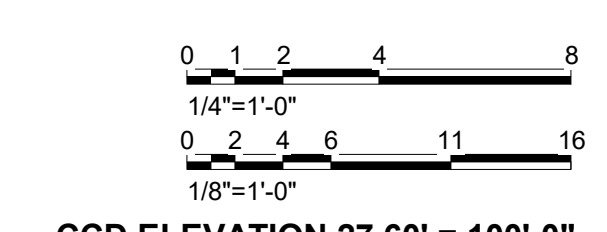
3 PARTIAL FOUNDATION PLAN - EAST MAT
Scale: 1/4" = 1'-0"

- PLAN NOTES:**
- TOP OF MAT ELEVATION = 112'-0". ELEVATIONS SHOWN ON PLAN ARE TO TOP OF CONCRETE AND ARE REFERENCED FROM CCD DATUM ELEVATION 27.60' = 100'-0".
 - ONLY THE CAISSONS, CONCRETE SHEAR WALLS, AND MAT FOUNDATION ARE SHOWN ON PLAN FOR CLARITY. REFERENCE S101 FOR ADDITIONAL INFORMATION.
 - NO OPENINGS, SLEEVES, CONDUITS, ETC. SHALL BE PLACED IN THE MAT FOUNDATION WITHOUT REVIEW AND APPROVAL BY THE EOR.
 - SEE GENERAL NOTES ON SHEETS S002 AND S003.
 - SEE TYPICAL DETAILS ON SHEETS S004 AND S005.
 - SEE SHEETS S201, S202, AND S203 FOR PIER, GRADE BEAM, WALL, CAISSON DETAILS, MAT DETAILS AND SCHEDULES.
A. REFERENCE MAT DETAILS FOR BAR LAYERING.
 - SEE SHEAR WALL ELEVATIONS AND DETAILS ON SHEETS S502 AND S503.



4 PARTIAL FOUNDATION PLAN - WEST MAT
Scale: 1/4" = 1'-0"

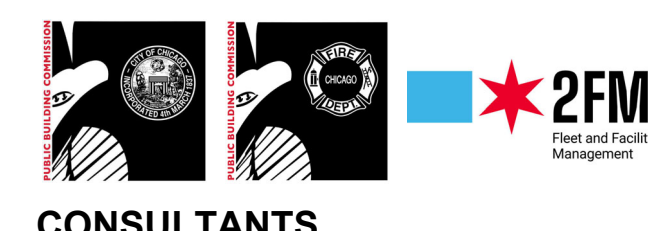
- PLAN NOTES:**
- TOP OF MAT ELEVATION = 112'-0". ELEVATIONS SHOWN ON PLAN ARE TO TOP OF CONCRETE AND ARE REFERENCED FROM CCD DATUM ELEVATION 27.60' = 100'-0".
 - ONLY THE STEEL COLUMNS, CAISSONS, CONCRETE SHEAR WALLS, AND MAT FOUNDATION ARE SHOWN ON PLAN FOR CLARITY. REFERENCE S101 FOR ADDITIONAL INFORMATION.
 - NO OPENINGS, SLEEVES, CONDUITS, ETC. SHALL BE PLACED IN THE MAT FOUNDATION WITHOUT REVIEW AND APPROVAL BY THE EOR.
 - SEE GENERAL NOTES ON SHEETS S002 AND S003.
 - SEE TYPICAL DETAILS ON SHEETS S004 AND S005.
 - SEE SHEETS S201, S202, AND S203 FOR PIER, GRADE BEAM, WALL, CAISSON DETAILS, MAT DETAILS AND SCHEDULES.
A. REFERENCE MAT DETAILS FOR BAR LAYERING.
 - SEE SHEAR WALL ELEVATIONS AND DETAILS ON SHEETS S502 AND S503.



CCD ELEVATION 27.60' = 100'-0"



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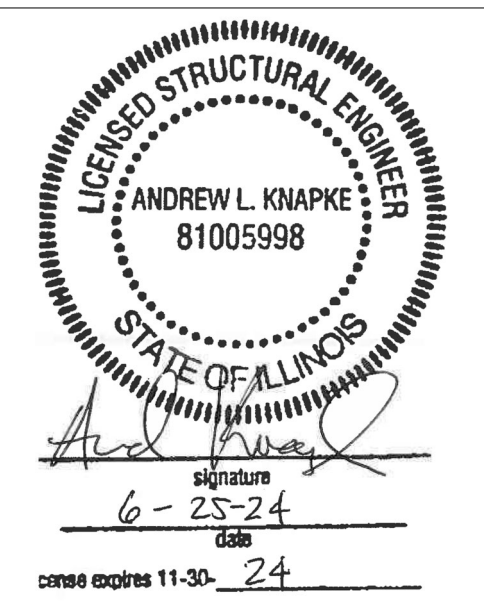
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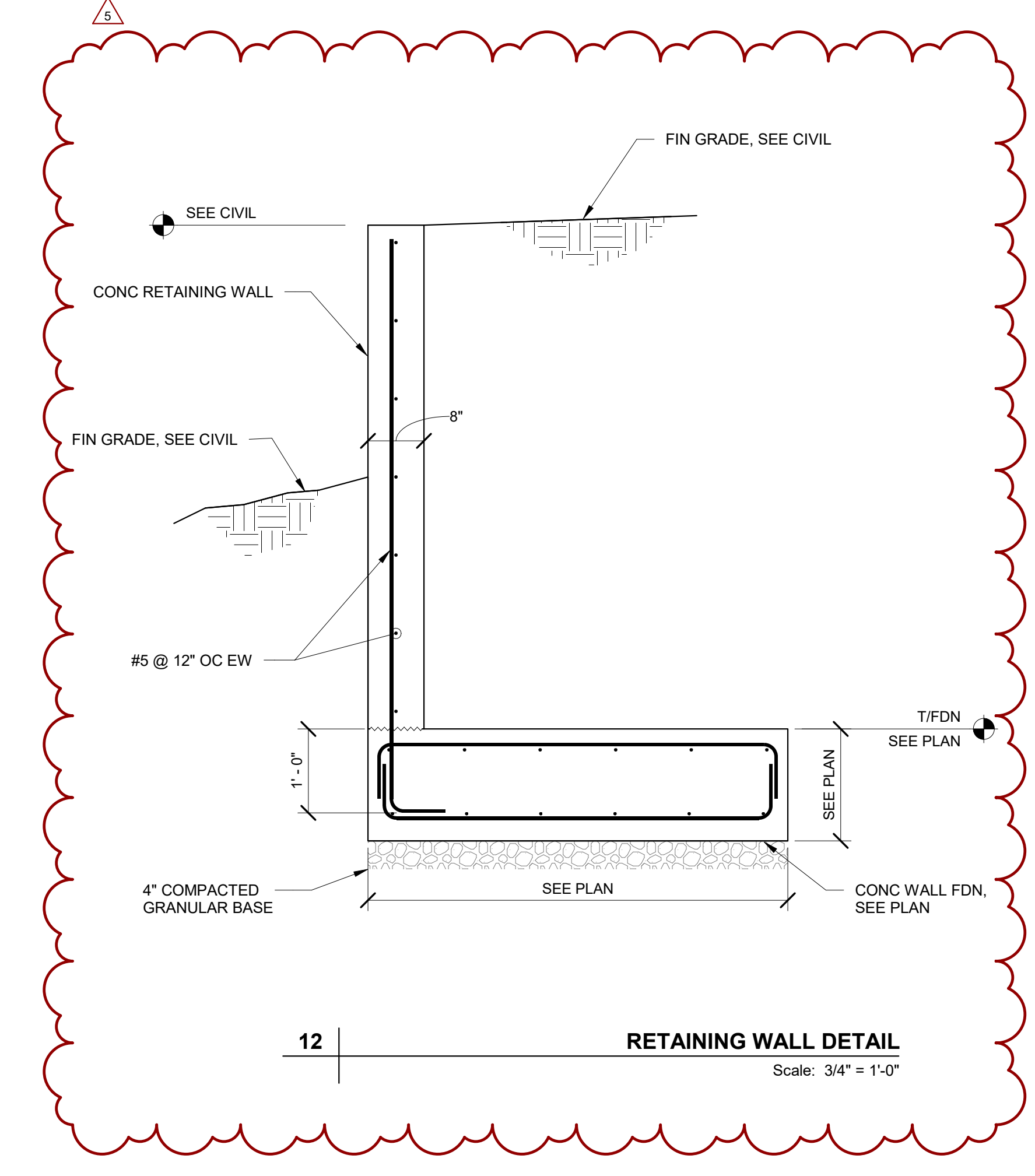
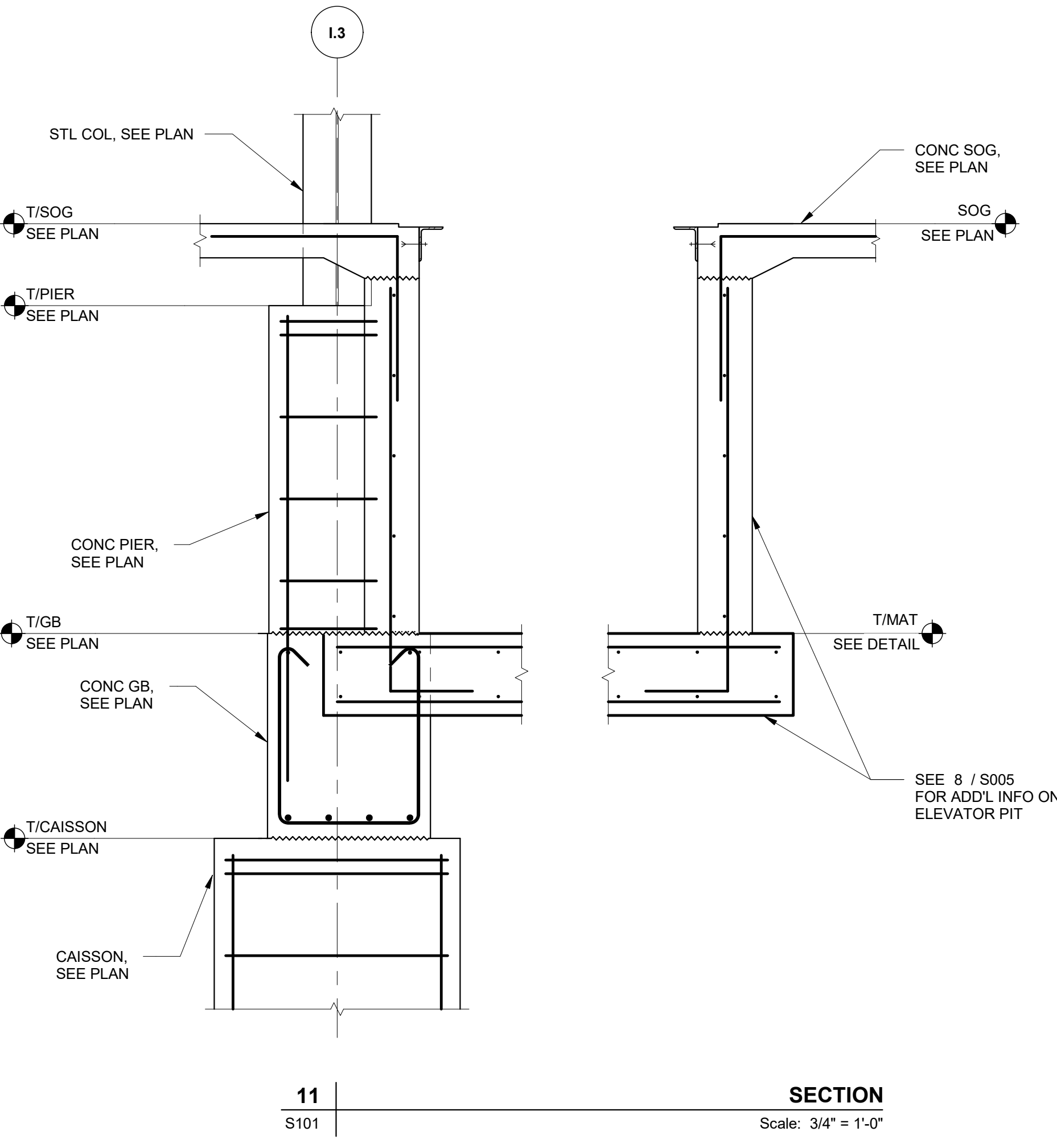
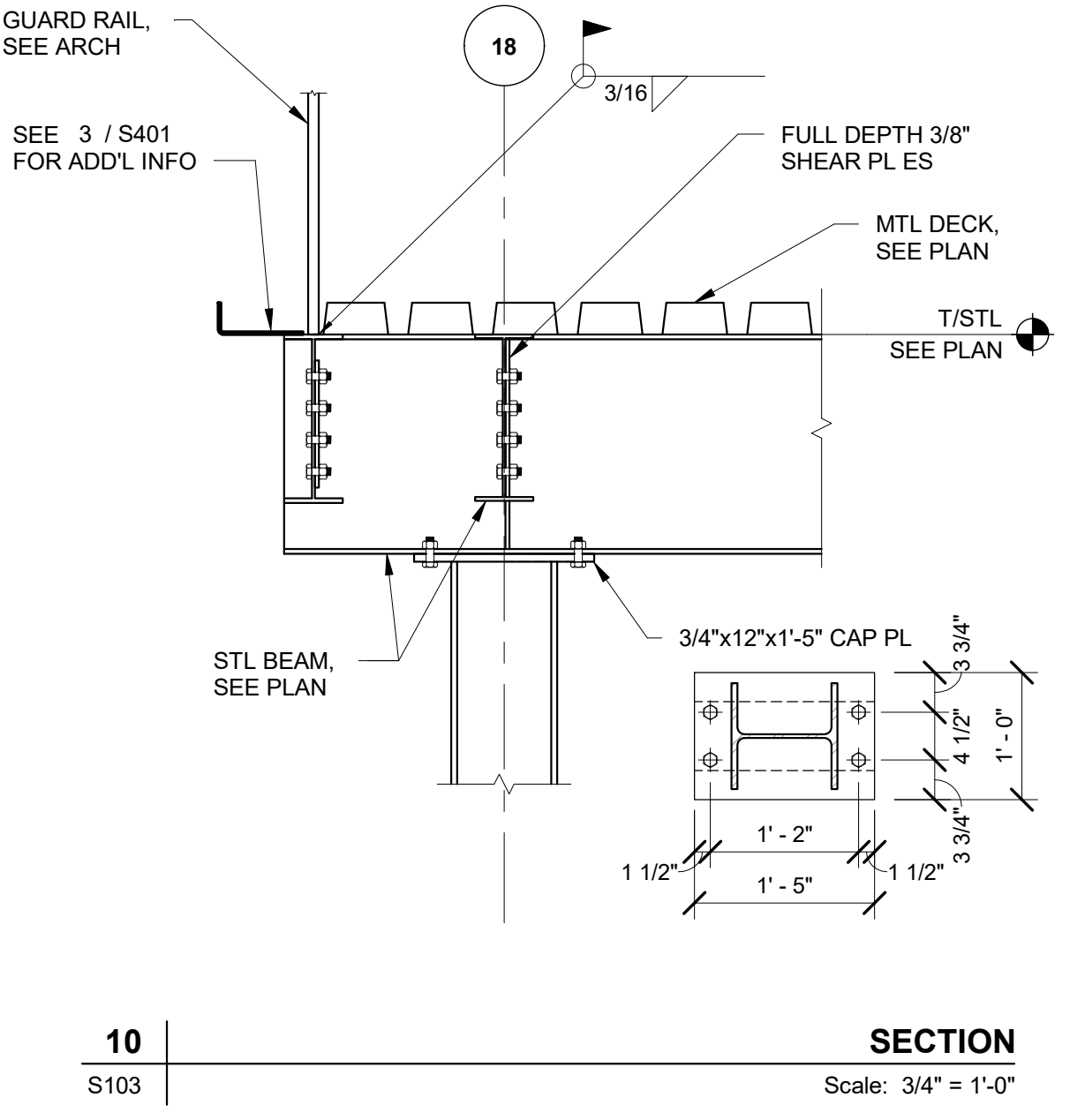
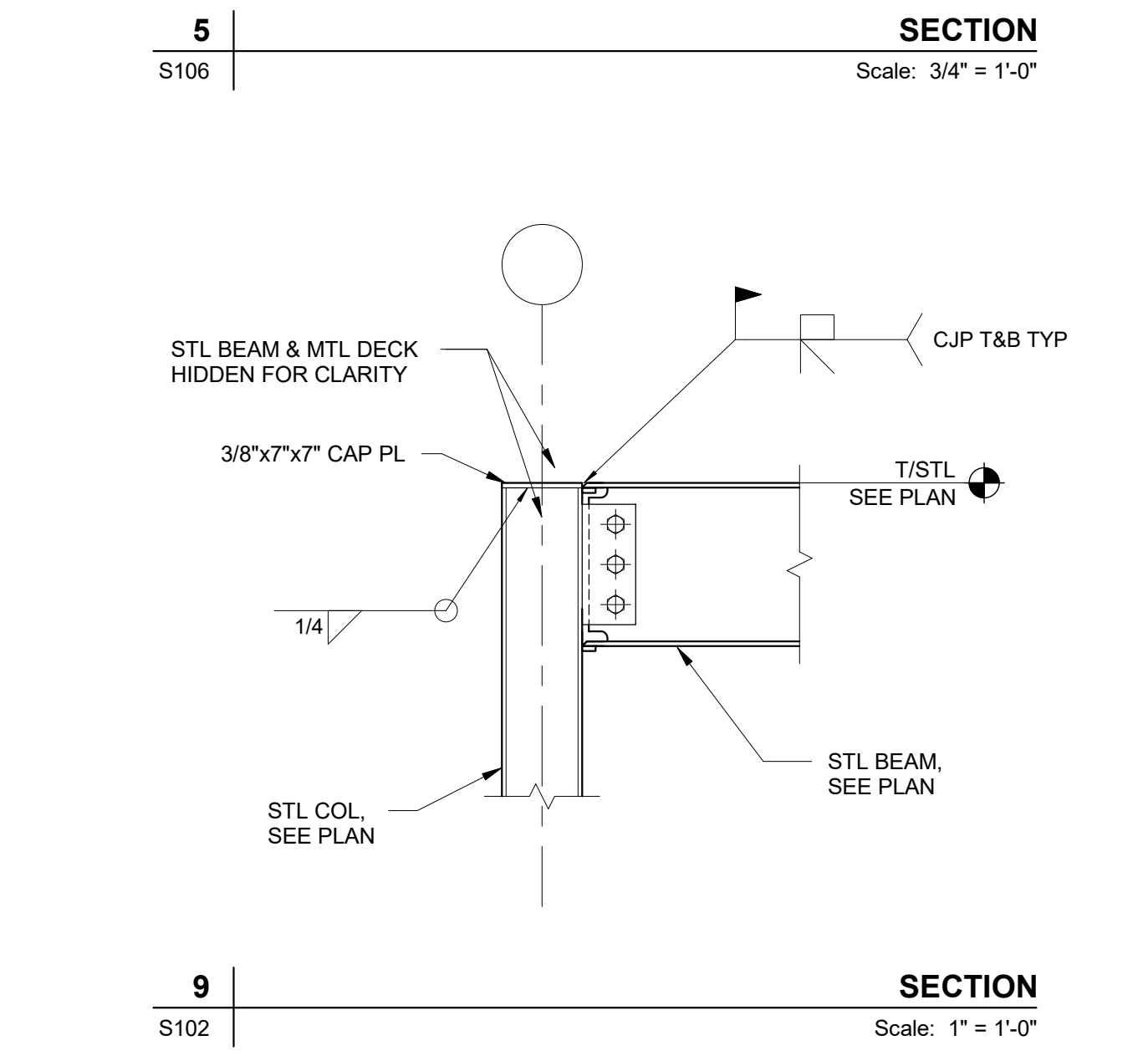
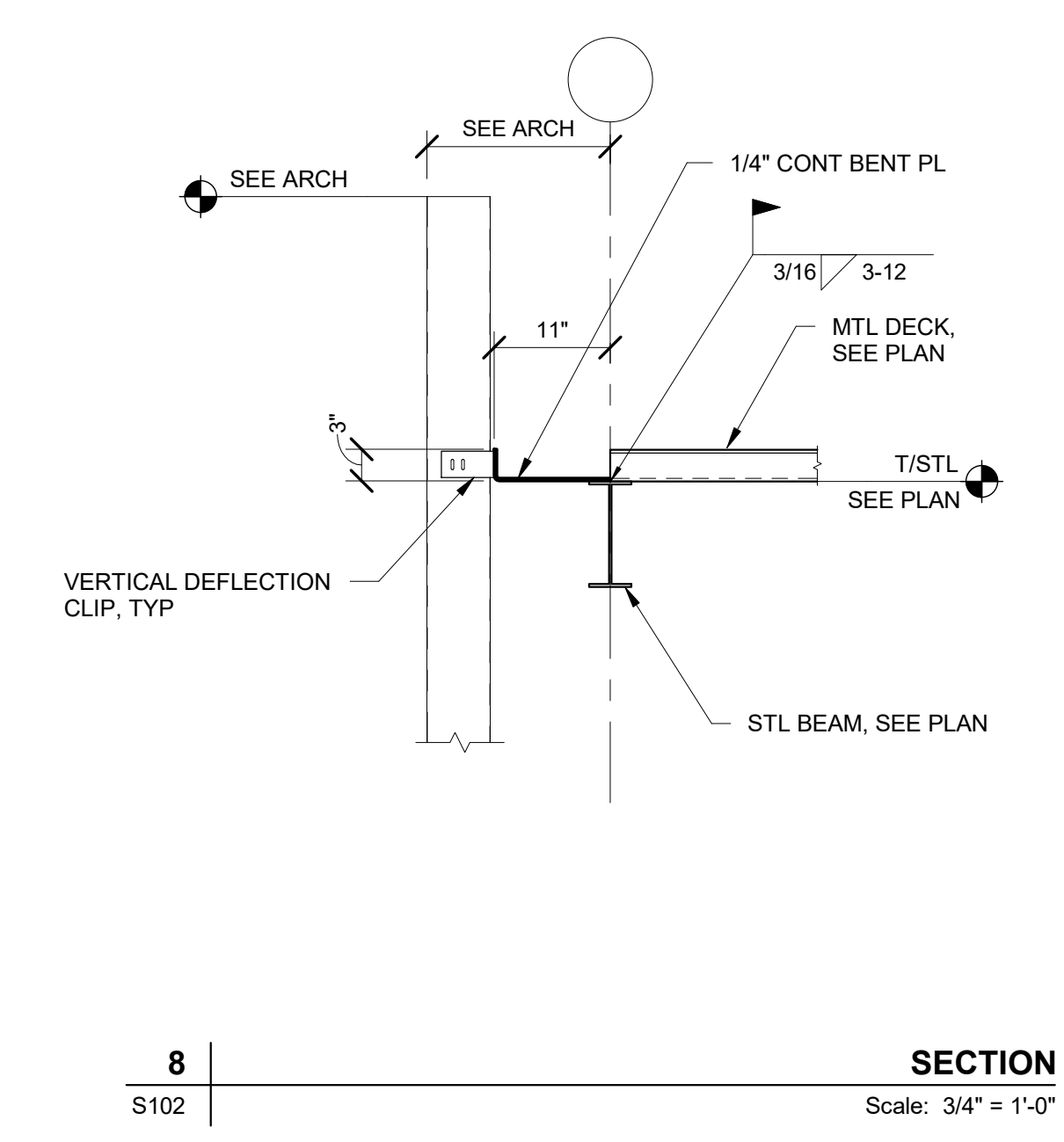
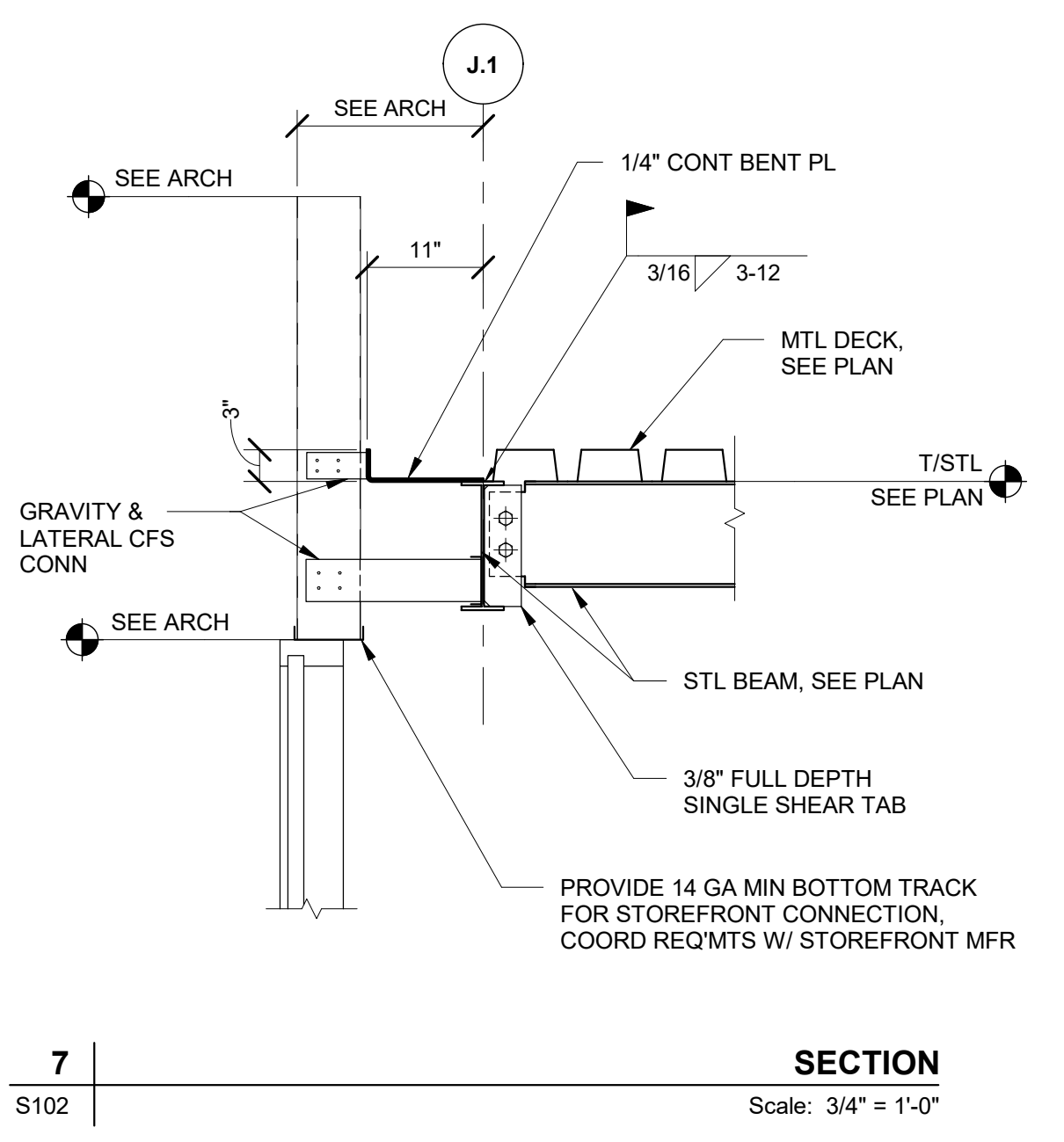
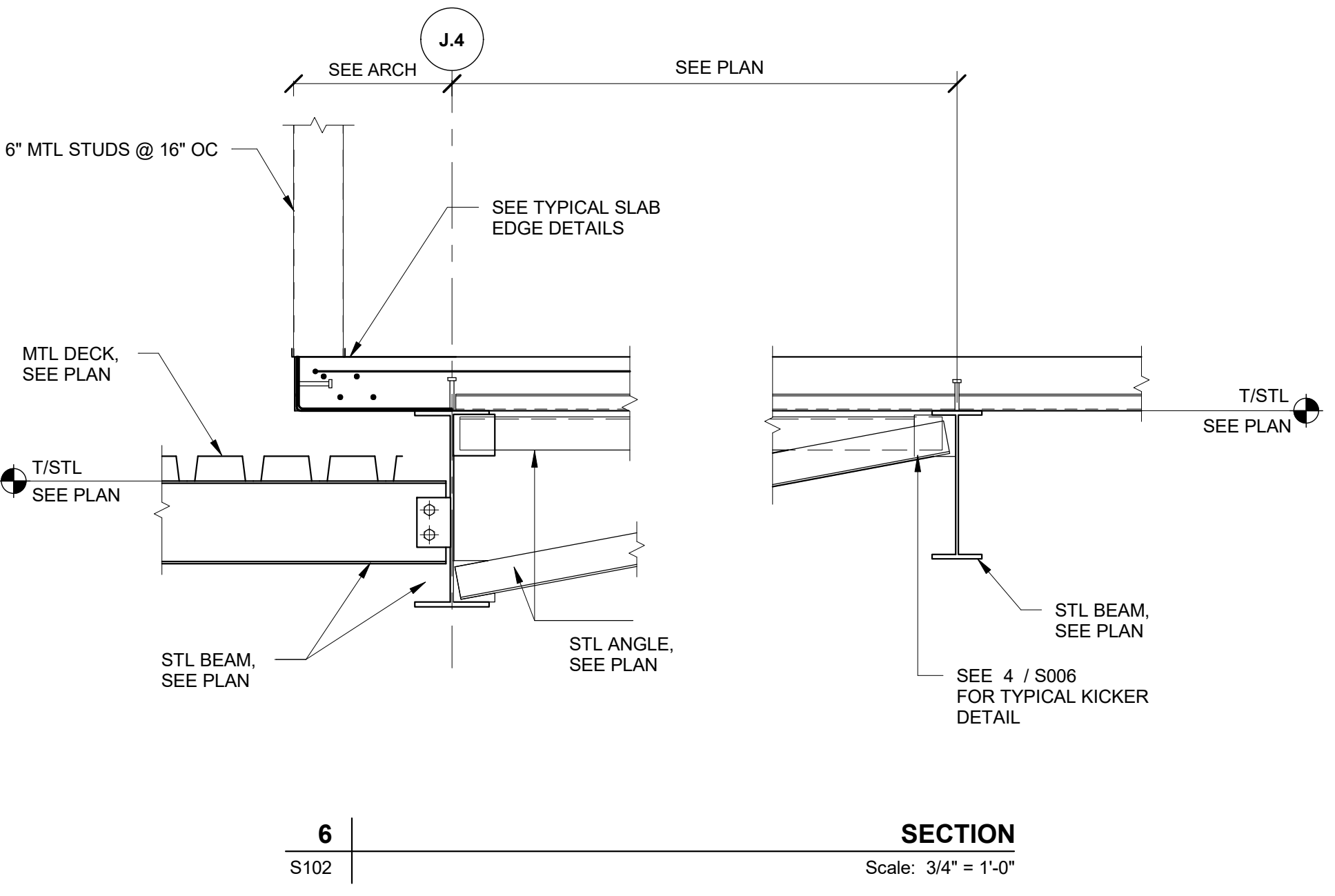
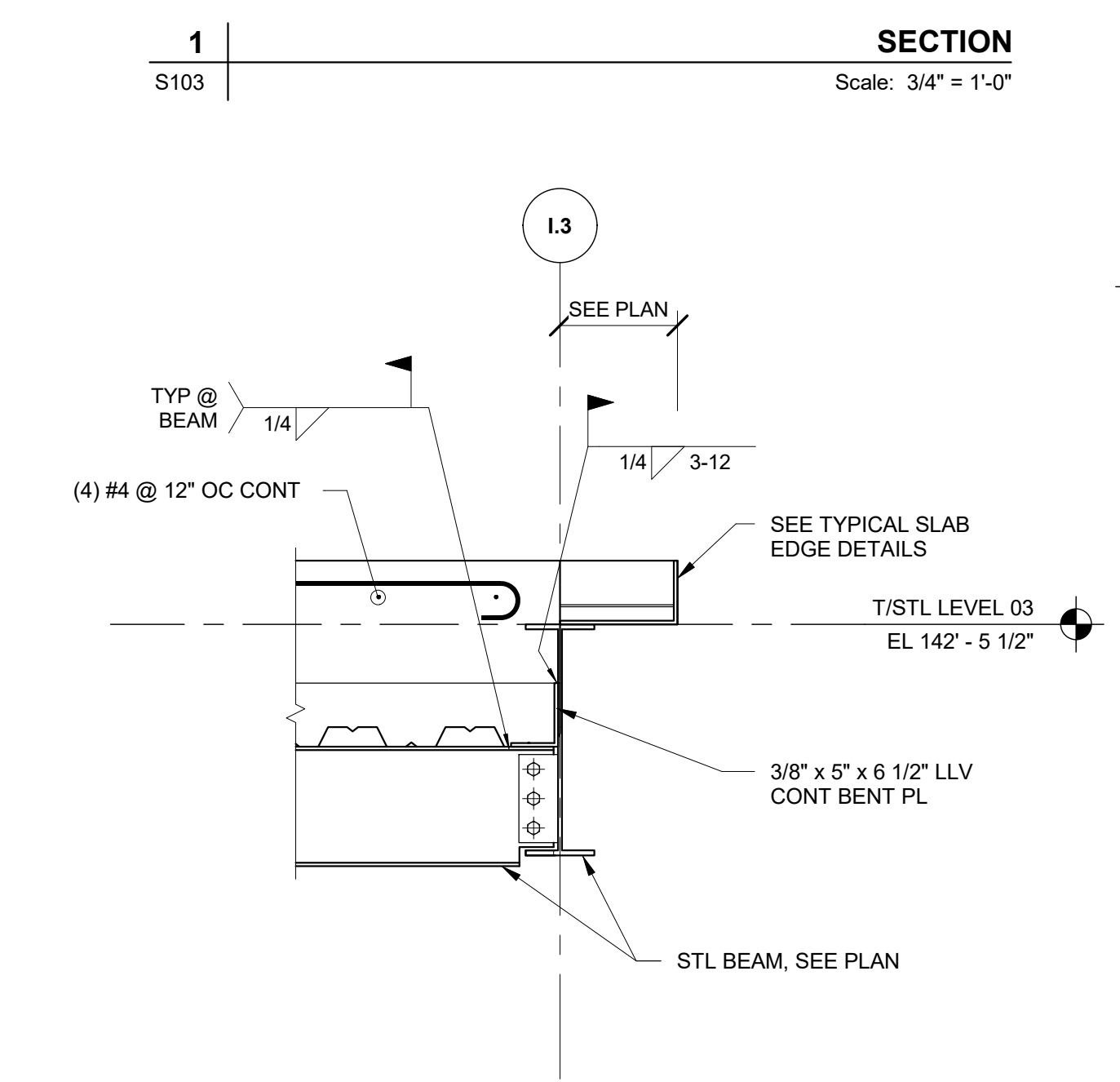
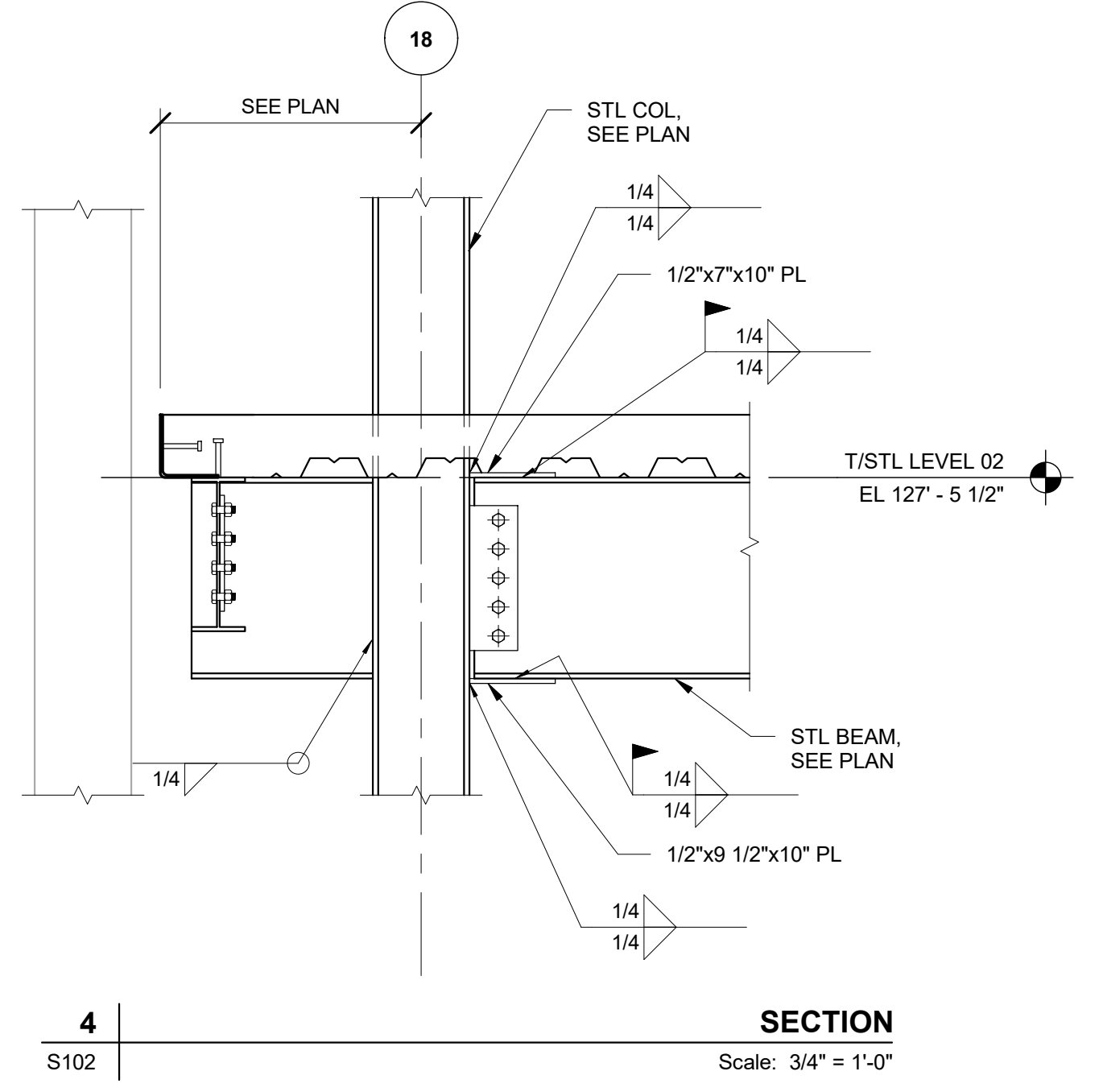
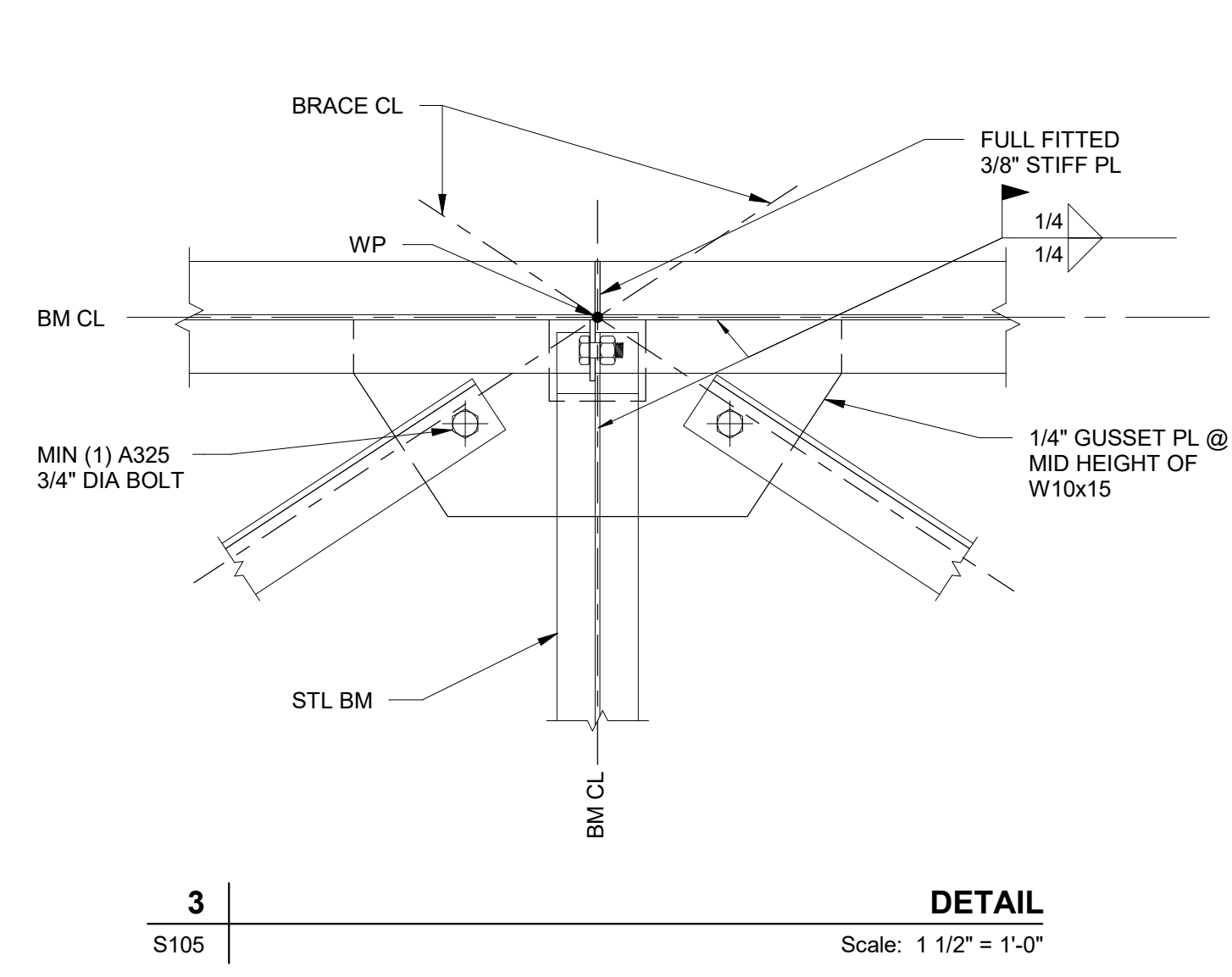
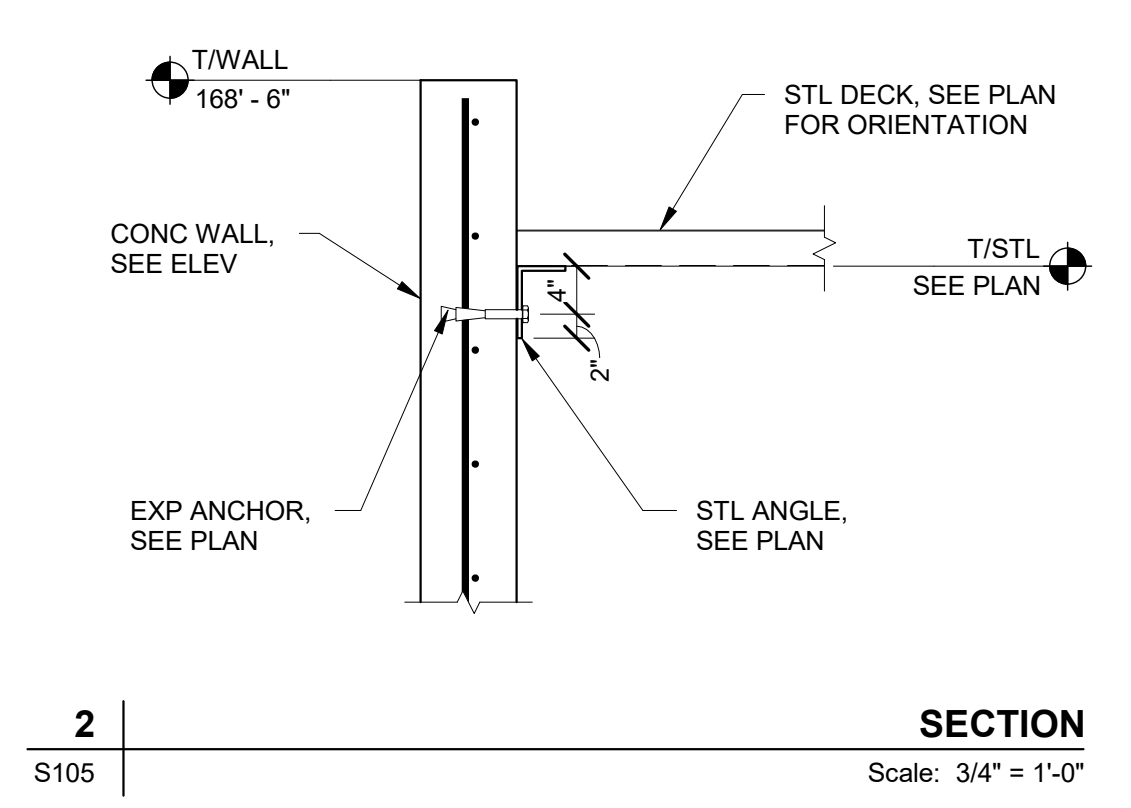
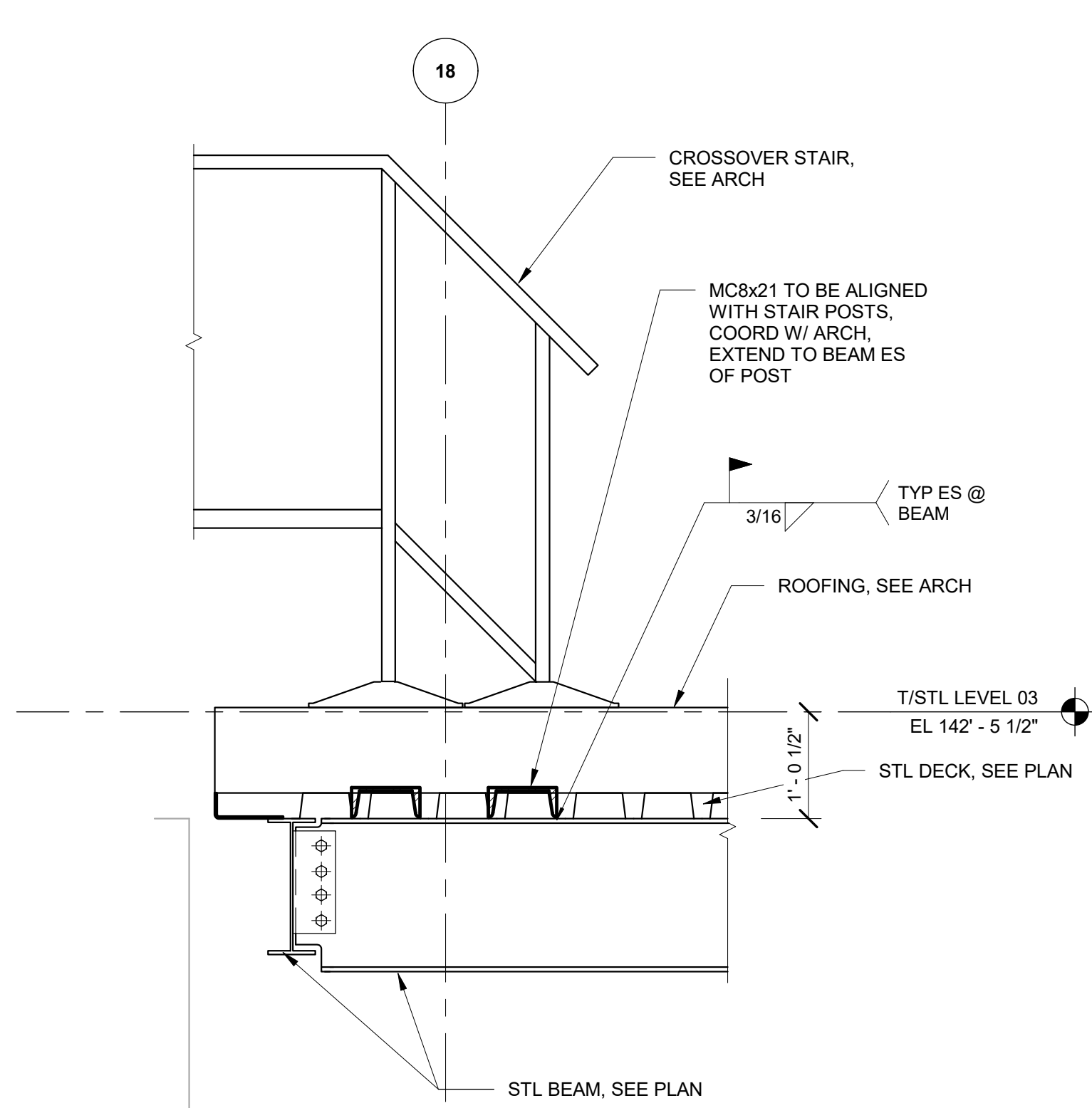
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SHEET TITLE
PARTIAL PLANS

SHEET NUMBER

S105





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SHEET TITLE
 SECTIONS & DETAILS

SHEET NUMBER
S404

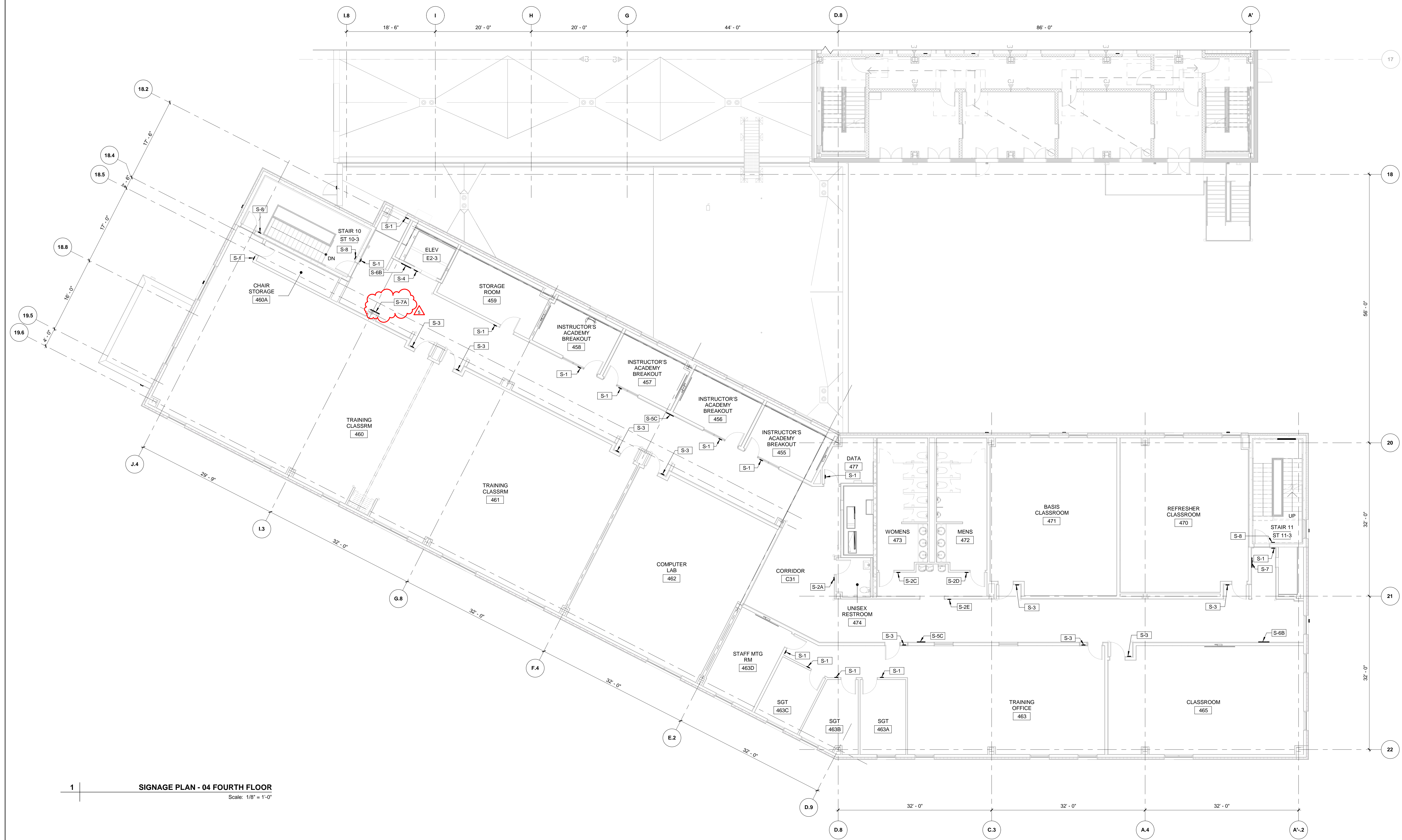
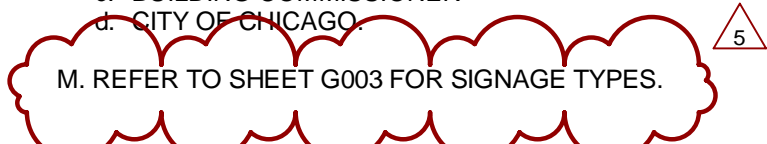
CCD ELEVATION 27.60' = 100'-0"

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GENERAL NOTES - SIGNAGE PLANS

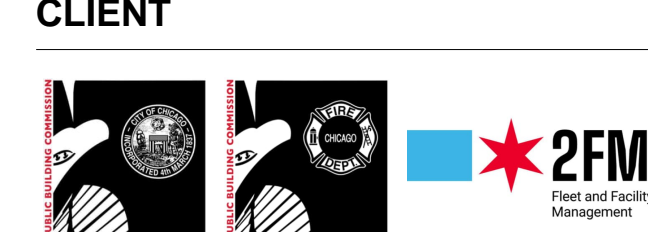
- A. ALL SIGNAGE SHALL BE CONTRACTOR FURNISHED AND INSTALLED.
- B. ALL SIGNAGE MUST CONFIRM TO AMERICANS WITH DISABILITIES ACT (ADA) AND ARCHITECTURAL BARRIERS ACT (ABA) ACCESSIBILITY GUIDELINES.
- C. PERMANENT ROOM SIGNAGE MUST INCLUDE RAISED LETTERS AND BRAILLE SIGNAGE SHALL BE LOCATED AT LATCH SIDE OF DOOR AND MUST BE MOUNTED IN ACCORDANCE WITH ALL CURRENT ADA STANDARDS.
- D. WHERE TACTILE SIGN IS PROVIDED AT A SINGLE DOOR, THE SIGN SHALL BE LOCATED ON LATCH SIDE OF DOOR. WHERE TACTILE SIGN IS PROVIDED AT A DOUBLE DOOR, THE SIGN SHALL BE LOCATED ON RIGHT SIDE OF THE RIGHT HAND DOOR. IF WALL SPACE IS NOT AVAILABLE FOR SIGNAGE PER MOUNTING STANDARDS, SIGNS SHALL BE INSTALLED PER CURRENT ADA STANDARDS ON NEAREST ADJACENT WALL, SO THAT CLEAR FLOOR SPACE OF 18" BY 18" MINIMUM, CENTERED ON TACTILE CHARACTERS IS PROVIDED BEYOND THE ARC OF ANY DOOR SWING BETWEEN THE CLOSED POSITION AND 45 DEGREE OPEN POSITION.
- E. PROVIDE PAPER AND SOFTWARE FOR FOR CREATING TEXT AND SYMBOLS FOR COMPUTERS INDICATED BY OWNER FOR OWNER PRODUCTION OF PAPER INSERTS AFTER INSTALLATION.
- F. FURNISH TWO DEVICES TO ASSIST IN REMOVING PAPER INSERTS.
- G. PROVIDE MAXIMUM OCCUPANCY SIGNS AS DIRECTED AND COORDINATE MESSAGE CONTENT PRIOR TO ORDER AND INSTALLATION.
- H. UPDATE ALL EXISTING PANELS/PROGRAMMING INCLUDING BUT NOT LIMITED TO BUILDING AUTOMATION SYSTEM, ELECTRICAL PANELS, AND FIRE ALARM PANELS. EXISTING PANELS TO BE RE-LABELLED/REPROGRAMMED AS INDICATED IN ROOM NUMBER CHANGES SCHEDULE.
- I. ALL BRAILLE TO BE STAINLESS STEEL GRADE II BRAILLE INTEGRAL TO SIGN PLATE; DO NOT USE "BRAILLE TAB".
- J. AT EACH ELEVATOR LANDING, PROVIDE RED SIGN WHICH INDICATES IN CASE OF FIRE USE STAIRWAY, MATCH EXISTING JPSTC BUILDING.
- K. FIELD VERIFY ALL SIGN QUANTITIES BEFORE FABRICATION.
- L. IF ROOM OCCUPANCY IS GREATER THAN 100 PERSONS, PROVIDE MAXIMUM CAPACITY SIGN ISSUED UNDER SECTION 14A-8-802 WHICH READS THE BELOW WORDS. LETTERING WILL BE OF BOLD GOTHIC TYPE IN RED ON A BACKGROUND OF WHITE, NOT LESS THAN ONE INCH IN HEIGHT. THE NUMERALS WILL BE ONE AND ONE-QUARTER INCHES IN HEIGHT.
 - a. OCCUPANCY MORE THAN _____ PERSONS IS DANGEROUS AND UNLAWFUL
 - b. BUILDING COMMISSIONER
 - c. CITY OF CHICAGO
- M. REFER TO SHEET 0003 FOR SIGNAGE TYPES.



1 | SIGNAGE PLAN - 04 FOURTH FLOOR
Scale: 1/8" = 1'-0"



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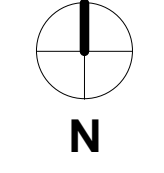
MILHOUSE ENGINEERING
ELECTRICAL ENGINEERING
333 S. Wabash Ave #2901
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LEVEL-1 GLOBAL SOLUTIONS
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233 S. Wacker Dr. #4400
Chicago, IL 60606
312-202-3300

REGISTRATION

NORTH ARROW



ISSUE/REVISION

NO.	DATE	DESCRIPTION
5	07/25/2024	ADD 03
2	07/05/2024	ISSUED FOR PERMIT
1	06/26/2024	ISSUED FOR BID
I/R	DATE	DESCRIPTION

PROJECT NUMBER
PBC: #07215 AECOM: 60710711

SHEET TITLE
FOURTH FLOOR - SIGNAGE PLAN

SHEET NUMBER

A163

ROOM FINISH SCHEDULE									
ROOM NO.	ROOM NAME	FLOOR	BASE	INTERIOR FINISHES				COMMENTS	
				NORTH	EAST	SOUTH	WEST		
SECOND FLOOR									
255	BREAK ROOM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
256	MECH RM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
257	ELECT RM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
258	GUARDHOUSE	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
259A	WEAPONS STORAGE	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
259	CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
260	CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
261	CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
262A	CLASSROOM - SKILLS	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
262B	SCENARIO TRAINING	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
262C	STORAGE	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
263	CLASSROOM (SIM LAB)	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
263A	CONTROL ROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
263B	SIMULATION CENTER	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
264	IT EQUIPMENT ROOM	SD-1	RB-1	PT-1	PT-1	PT-1	PT-1		
265	SIM CENTER - BAR	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
265A	SIM CENTER - ALLEY	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
266	SIM CENTER - LIVING RM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
266A	SIM - POWDER RM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
266B	SIM CENTER - KITCHEN	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
267	STORAGE	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
268	EAST VESTIBULE	EP-1	RB-1	PT-1	PT-1	PT-1	PT-1		
268A	PHASE II UNISEX RESTRM	EP-1	CT-1	CT-1	CT-1	CT-1	CT-1		REFER TO A402
268B	PHASE I UNISEX RESTRM	EP-1	CT-1	CT-1	CT-1	CT-1	CT-1		REFER TO A402
269	STORAGE	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
270	CLASSROOM	EP-2	RB-1	PT-1	PT-1	PT-1	PT-1		
270A	MODULAR AMBULANCE	EP-2	RB-1	PT-1	PT-1	PT-1	PT-1		REFER TO A402
271	UNISEX RESTROOM	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A402
272	MENS	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
273	WOMENS	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
274	UNISEX RESTROOM	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
275	JAN CS	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WP-3 SECOND SINK
276	WATER HTR RM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
277	DATA	SD-1	RB-1	PT-1	PT-1	PT-1	PT-1		
278	ELECT	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
279	STAFF WORKSTATIONS	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
279A	COPY	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
279B	CHIEF	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
279C	COMM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
279D	COORDINATING OFFICE	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
279E	RECORDS AND TESTING	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
C27	CORRIDOR	SC-1	RB-1	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE		
C28	CORRIDOR	CPT-1	RB-1	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE		REFER TO ELEVATOR SPECIFICATION FOR FINISHES
E2-1	ELEV	-	-	-	-	-	-		REFER TO ELEVATOR SPECIFICATION FOR FINISHES
ST 10-1	STAIR 10	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
ST 11-1	STAIR 11	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		

ROOM FINISH SCHEDULE									
ROOM NO.	ROOM NAME	FLOOR	BASE	INTERIOR FINISHES				COMMENTS	
				NORTH	EAST	SOUTH	WEST		
366	SIM CENTER - BEDROOM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
366A	SIM CENTER - NURSERY	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
366B	SIM CENTER BATHROOM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
369	TRAINING CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
370	TRAINING CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		REFER TO A401
372	MENS	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
373	WOMENS	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
374	UNISEX RESTROOM	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
377	DATA	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
378	ELECTRICAL	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
C29	CORRIDOR	SC-1	RB-1	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE		
C29-S1	SHAFT	-	-	-	-	-	-		
C29-S2	SHAFT	-	-	-	-	-	-		
E2-2	ELEV	-	-	-	-	-	-		REFER TO ELEVATOR SPECIFICATION FOR FINISHES
ST 10-2	STAIR 10	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
ST 11-2	STAIR 11	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
ST 12	STAIR 12	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		WASHABLE WALL PANEL TO 5' AFF W/ TRIM. BOD. INPRO
FOURTH FLOOR									
300-SE	SHAFT	-	-	-	-	-	-		
300-SM	SHAFT	-	-	-	-	-	-		
455	INSTRUCTOR'S ACADEMY BREAKOUT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
456	INSTRUCTOR'S ACADEMY BREAKOUT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
457	INSTRUCTOR'S ACADEMY BREAKOUT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
458	INSTRUCTOR'S ACADEMY BREAKOUT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
459	STORAGE ROOM	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
460	TRAINING CLASSRM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
460A	CHAIR STORAGE	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
461	TRAINING CLASSRM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
462	COMPUTER LAB	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
463	TRAINING OFFICE	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
463A	SGT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
463B	SGT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
463C	SGT	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
463D	STAFF MTG RM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
465	CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
470	REFRESHER CLASSROOM	CPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
471	BASE CLASSROOM	UPT-1	RB-1	PT-1	PT-1	PT-1	PT-1		
472	MENS	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
473	WOMENS	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
474	UNISEX RESTROOM	EP-1	CT-2 AND RB-2	FRP-1	FRP-1	FRP-1	CT-1		REFER TO A401
C31	CORRIDOR	SC-1	RB-1	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE	PT-2 UP TO 4' WP-1 @ 4' AFF, PT-1 ABOVE		REFER TO ELEVATOR SPECIFICATION FOR FINISHES
E2-3	ELEV	-	-	-	-	-	-		REFER TO ELEVATOR SPECIFICATION FOR FINISHES
ST 10-3	STAIR 10	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
ST 11-3	STAIR 11	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		
ROOF									
ST 11-4	STAIR 11	SC-1	RB-1	PT-1	PT-1	PT-1	PT-1		

FINISH LEGEND						
MATERIAL CODE	MATERIAL TYPE	MANUFACTURER	STYLE	MODEL NUMBER/COLOR	ADDITIONAL NOTES	SPEC SECTION
BASE						
RB-1	RUBBER BASE	TARKETT (JOHNSONITE)	BASEWORKS THERMOSET RUBBER (TYPE TS), 6"	38 PEWTER CG	6" TALL BASE	
RB-2	RUBBER BASE	TARKETT (JOHNSONITE)	BASEWORKS THERMOSET RUBBER (TYPE TS), 4"	38 PEWTER CG	4" TALL BASE AT LOCKERS	
CEILING						
ACT-1	ACOUSTIC CEILING TILE, TYP	USG	24" x 24" HALCYON	WHITE		
EXP-1	EXPOSED	-	-	-		
EXP-2	EXPOSED PAINTED STRUCTURE AND MFP/FIRE INFRASTRUCTURE	BENJAMIN MOORE	LATEX DRYFALL	OC - 64 PURE WHITE		
EXP-3	EXPOSED ACOUSTIC SPRAY ON DECK, PAINTED STRUCTURE AND MFP/FIRE INFRASTRUCTURE	K13; BENJAMIN MOORE	ACOUSTIC SPRAY INTEGRAL COLOR WHITE; MEPPP LATEX DRYFALL PAINT	WHITE	ACOUSTIC SPRAY INTEGRALLY COLORED	
GB-1	GYP/SLAB BOARD, PAINTED	BENJAMIN MOORE	ULTRA SPEC 500 FLAT CEILING PAINT	OC - 64 PURE WHITE		
FLOORING						
CPT-1	CARPET	INTERFACE	HUMAN NATURE COLLECTION HN80, ASHLAR PATTERN	104221 FLINT		
EP-1	EPOXY	DUR-A-FLEX	DUR-A-GARD	COLOR TO BE SELECTED FROM MANUFACTURERS FULL RANGE	MEDIUM DUTY	
RT-2	TILE	ARNSON FLOORS	STEEL STUDDED RUBBER TILES 12" X 12" X 1/8"	-	FOR USE IN ELEVATOR ONLY	
SC-1	CONCRETE	LATICRETE	L&M DENSIFIER/HARDENER	TBD		
SD-1	TILE	ARMSTRONG FLOORING	EXCELON SDT	-		
HIGH PRESSURE LAMINATE						
HPL-1	HIGH PRESSURE LAMINATE	TRESPA	TOPLAB BASE	S17-32	SIMULATION COUNTERTOPS	
LAMINATE	LAMINATE	WILSON ART	PORTICO TEAK, GLOSS LINE FINISH	8210K-28	FOR USE IN ALL BREAKROOMS	
PAINT						
PT-1	PAINT	BENJAMIN MOORE	ULTRA SPEC LOW SHEEN EGGSHHELL	OC - 64 PURE WHITE		
PT-2	PAINT	BENJAMIN MOORE	ULTRA SPEC SEMI GLOSS	OC - 64 PURE WHITE	IN CORRIDORS UP TO 4' AFF	
ROLLER SHADES						
WS-1	ROLLER SHADES	DRAPER	BEAD CHAIN CLUTCH FLEX SHADE	SUNLOC SERIES WHITE SB9010	FASCIA COLOR TO MATCH WINDOW FRAMES; CLEAR ANODIZED	
SOLID SURFACE						
SS-1	SOLID SURFACE	CORIAN QUARTZ	GRAPHITE	ZS4GRP		
WALL PROTECTION						
CG-1	CORNER GUARD	INPRO	STAINLESS STEEL SURFACE MTD	STAINLESS STEEL		
CG-2	CORNER GUARD	INPRO	STAINLESS STEEL SURFACE MTD - WIDE ANGLE	STAINLESS STEEL		
CRASH RAIL						
FRP-1	FIBER REINFORCED PLASTIC PANEL	MARLITE	STANDARD TEXTURED FINISH FRP	WHITE	IN JANITORS CLOSET AROUND SINK,	
FRP-2	FIBER REINFORCED PLASTIC PANEL	MARLITE	STANDARD SMOOTH FRP	WHITE	4'X10' HORIZONTAL PANELS	
FRP-3	FIBER REINFORCED PLASTIC PANEL	MARLITE	STANDARD SMOOTH FRP	WHITE	4'X8' PANELS	
WP-1	WALL PROTECTION	CONSTRUCTION SPECIALTIES	TP RUB RAIL	FOLKSTONE #927	12" TALL MOUNTED 1/4"-0" AFF	
WALL TILE						
CT-1	TILE	AMERICAN OLEAN	CERAMIC WALL TILE	COLOR STORY - ICE WHITE	BATHROOM WALLS	
CT-2	TILE	AMERICAN OLEAN	CERAMIC WALL TILE	COLOR STORY - ICE WHITE	BATHROOM WALL BASE	

GENERAL NOTES - FINISHES

- GENERAL**
- WALL AND CEILING FINISH REQUIREMENTS, CLASS A FLAME SPREAD INDEX OF 0-25, SMOKE DEVELOPED INDEX 0-50.
 - FLOOR FINISH REQUIREMENTS, CLASS I, CRITICAL RADIANT FLUX 0.45 WATTS PER SQUARE CENTIMETER OR GREATER.
 - SEE FINISH PLAN, ELEVATIONS, REFLECTED CEILING PLAN AND DETAILS FOR CLARIFICATION OF EXTENT OF FINISH MATERIALS.
 - NO PAINTING OR INTERIOR FINISHING SHALL BE DONE UNDER CONDITIONS WHICH WILL JEOPARDIZE THE QUALITY OR APPEARANCE OF SUCH WORK. ALL WORKMANSHIP WHICH IS JUDGED LESS THAN FIRST QUALITY BY THE ARCHITECT WILL BE REJECTED.
 - REMOVE ALL WALL MOUNTED FIXTURES, ELECTRICAL DEVICES ETC. PRIOR TO PAINTING VERTICAL SURFACES. REINSTALL AFTER PAINTING IS COMPLETE.
 - INTERIOR GYP. BOARD SURFACES SHALL BE WIPED WITH A DAMP CLOTH JUST PRIOR TO APPLICATION OF THE FIRST COAT OF PAINT IN ORDER TO LAY FLAT ANY NAP WHICH MAY HAVE FORMED IN SANDING PROCESS.
 - EXAMINE ALL FINISH SURFACES AFTER COMPLETION OF WORK AND PROCEED WITH "TOUCH-UP" AS REQUIRED.
 - COORDINATE FINISH OF ALL ELECTRICAL, DATA AND AV DEVICES LOCATED ON WALLS WHICH FINISH IS DESIGNATED OTHER THAN P1 WITH ARCHITECT.
 - ALL CRACKS, HOLES, IMPERFECTIONS IN EXISTING WALLS, PARTITIONS OR GYP BOARD SHALL BE FILLED WITH PARCHINGS PLASTER AND SMOOTHED OFF TO MATCH ADJOINING SURFACES TRANSITION FLOOR MATERIALS UNDER CENTERLINE OF DOORS/OPENINGS UNLESS NOTED OTHERWISE.

PROCEDURE

- THE CONTRACTOR SHALL SUBMIT (2) SAMPLES OF ALL FINISH MATERIALS TO THE ARCHITECT FOR APPROVAL, INCLUDING, BUT NOT LIMITED TO, PAINT, WALL COVERINGS, LAMINATES, FLOORING MATERIALS, ETC. ANY NEW WALL, FLOOR, CEILING OR WINDOW TREATMENTS MUST BE SUBMITTED FOR APPROVAL PRIOR TO ORDERING. FINISHES NOT SUBMITTED IN THE MINIMUM QUANTITY OF (2) SHALL BE REJECTED. SUBMIT SAMPLES TO ARCHITECT PRIOR TO PLACING FULL ORDERS WHERE MATERIALS ARE NOT RETURNABLE.
- INSTALL ALL FINISH MATERIALS IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDED SPECIFICATIONS, SURFACE PREPARATION, ADHESIVES AND BACKINGS, INCLUDING WALL COVERINGS, FLOORING MATERIALS, LAMINATES ETC.
- CONTRACTOR TO BE RESPONSIBLE FOR ALLOWING FOR DELIVERY AND LEAD TIMES FOR ALL FAB

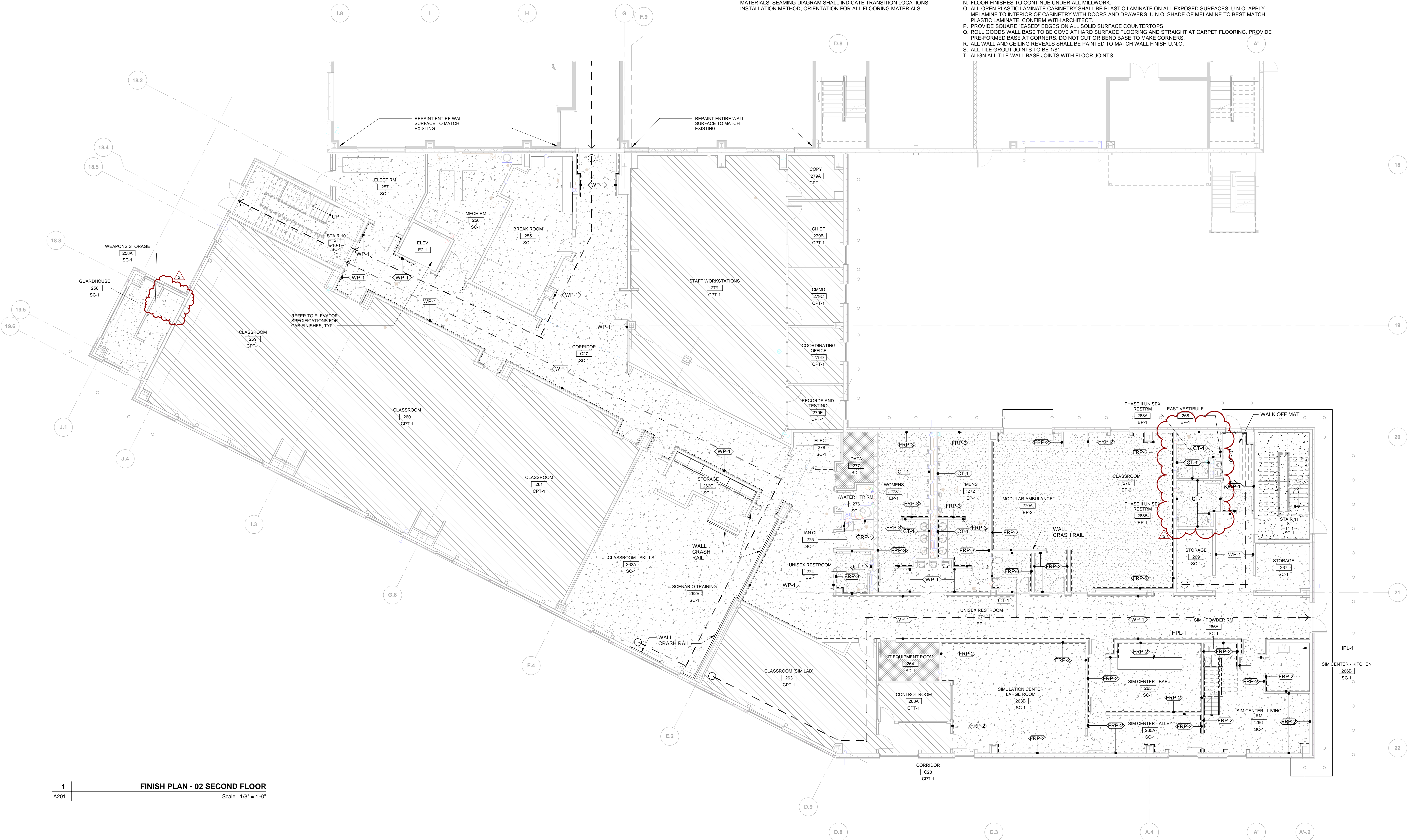
FINISH FLOOR PLAN LEGEND

FLOOR MATERIAL OR FINISH		ANNOTATIONS	
	CARPET (CPT-1)		ALIGN SYMBOL
	RUBBER TILE (RT-1) RUBBER TILE (RT-2)		FLOOR MATERIAL TRANSITION
	RESILIENT FLOORING (RF-1)		WALL FINISH TYPE REFER TO FINISH SCHEDULE
	SEALED CONCRETE (SC-1)		EXTENT OF WALL FINISH
	EPOXY (EP-1) EPOXY (EP-2)		MATERIAL DIRECTION
	STATIC DISSIPATIVE TILE (SD-1)		

GENERAL NOTES - FINISHES

- GENERAL**
- ALL WALL AND CEILING FINISH REQUIREMENTS, CLASS A FLAME SPREAD INDEX OF 0-25, SMOKE DEVELOPED INDEX 0-450.
 - FLOOR FINISH REQUIREMENTS: CLASS I CRITICAL RADIANT FLUX 0.45 WATTS PER SQUARE CENTIMETER OR GREATER.
 - SEE FINISH PLAN, ELEVATIONS, REFLECTED CEILING PLAN AND DETAILS FOR CLARIFICATION OF EXTENT OF FINISH MATERIALS.
 - NO PAINTING OR INTERIOR FINISHING SHALL BE DONE UNDER CONDITIONS WHICH WILL JEOPARDIZE THE QUALITY OR APPEARANCE OF SUCH WORK. ALL WORKMANSHIP WHICH IS JUDGED LESS THAN FIRST QUALITY BY THE ARCHITECT WILL BE REJECTED.
 - REMOVE ALL WALL MOUNTED FIXTURES, ELECTRICAL DEVICES ETC. PRIOR TO PAINTING VERTICAL SURFACES. REINSTALL AFTER PAINTING IS COMPLETE.
 - INTERIOR GYP. BOARD SURFACES SHALL BE WIPED WITH A DAMP CLOTH JUST PRIOR TO APPLICATION OF THE FIRST COAT OF PAINT IN ORDER TO LAY FLAT ANY NAP WHICH MAY HAVE FORMED IN SANDING PROCESS.
 - EXAMINE ALL FINISH SURFACES AFTER COMPLETION OF WORK AND PROCEED WITH "TOUCH-UP" AS REQUIRED.
 - COORDINATE FINISH OF ALL ELECTRICAL, DATA AND AV DEVICES LOCATED ON WALLS WHICH FINISH IS DESIGNATED OTHER THAN P1 WITH ARCHITECT.
 - ALL CRACKS, HOLES, IMPERFECTIONS IN EXISTING WALLS, PARTITIONS OR GYP BOARD SHALL BE FILLED WITH PATCHING PLASTER AND SMOOTHED OFF TO MATCH ADJOINING SURFACES TRANSITION FLOOR MATERIALS UNDER CENTERLINE OF DOORS/OPENINGS UNLESS NOTED OTHERWISE.

- PROCEDURE**
- THE CONTRACTOR SHALL SUBMIT (2) SAMPLES OF ALL FINISH MATERIALS TO THE ARCHITECT FOR APPROVAL, INCLUDING, BUT NOT LIMITED TO: PAINT, WALL COVERINGS, LAMINATES, FLOORING MATERIALS, ETC. ANY NEW WALL, FLOOR, CEILING OR WINDOW TREATMENTS MUST BE SUBMITTED FOR APPROVAL PRIOR TO ORDERING. FINISHES NOT SUBMITTED IN THE MINIMUM QUANTITY OF (2) SHALL BE REJECTED. SUBMIT SAMPLES TO ARCHITECT PRIOR TO PLACING FULL ORDERS WHERE MATERIALS ARE NOT RETURNABLE.
 - INSTALL ALL FINISH MATERIALS IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDED SPECIFICATIONS, SURFACE PREPARATION, ADHESIVES AND BACKINGS, INCLUDING WALL COVERINGS, FLOORING MATERIALS, LAMINATES ETC.
 - CONTRACTOR TO BE RESPONSIBLE FOR ALLOWING FOR DELIVERY AND LEAD TIMES FOR ALL FABRICS AND OTHER CUSTOM FINISHES WITHIN THE CONSTRUCTION SCHEDULE. ALL DELIVERY TIMES MUST BE CONFIRMED, AND ANY EXCESSIVE LEAD TIMES MUST BE BROUGHT TO THE ARCHITECT'S ATTENTION IMMEDIATELY TO ALLOW FOR RE-SPECIFICATION IF NECESSARY. SUBMIT FLOORING SEAMING DIAGRAM FOR REVIEW PRIOR TO PURCHASING MATERIALS. SEAMING DIAGRAM SHALL INDICATE TRANSITION LOCATIONS, INSTALLATION METHOD, ORIENTATION FOR ALL FLOORING MATERIALS.
- MATERIALS + FINISHES**
- ALL WALLS AND COLUMN SURFACES TO BE PAINTED PT-1 U.N.O.
 - ALL PAINTED WALLS TO HAVE EGGSHELL FINISH U.N.O.
 - ALL PAINTED CEILINGS TO HAVE FLAT FINISH.
 - ALL PAINTED WOOD WORK, HOLLOW METAL FRAMES AND DOORS TO HAVE SEMI-GLOSS FINISH.
 - PAINT UNDERCOUNTER SUPPORT BRACKETS TO MATCH WALL COLOR.
 - ALL EXPOSED CEILING AND EXPOSED EQUIPMENT INCLUDING ALL BEAMS, DUCTWORK, CONDUIT, ETC. SHALL BE PAINTED PER SPECIFICATIONS U.N.O. REVIEW ALL MATERIALS TO BE PAINTED AT EXPOSED AREAS AND PROVIDE PROPER PRIMER TO ENSURE PAINT ADHESION.
 - UNDERSIDE OF SOFFITS (WHERE OCCURS) TO RECEIVE A FINISH TO MATCH ADJACENT VERTICAL FINISH, U.N.O.
 - PAINT CEILING ACCESS PANELS WHERE THEY OCCUR TO MATCH ADJACENT CEILING FINISH.
 - PAINT ALL EXPOSED SURFACES U.N.O. INCLUDING HOLLOW METAL DOOR FRAMES, GRILLES, FIRE HOSE OR EXTINGUISHER CABINETS, EXPOSED PIPING, ETC. U.N.O. TO MATCH ADJACENT WALL FINISH. DO NOT PAINT EXTRUDED ALUMINUM FRAMES OR STOREFRONTS. UPON COMPLETION, REMOVE ALL PAINT FROM WHERE IT HAS SPILLED, SPLASHED, OR SPATTERED ON EXPOSED SURFACES.
 - EXISTING DOORS TO REMAIN TO BE PAINTED TO MATCH ADJACENT WALL COLOR.
 - ALL STAINED MATERIALS TO HAVE UNIFORM COLOR.
 - ALL VERTICAL SURFACES U.N.O. SHALL RECEIVE WALL BASE RB-1.
 - SUBMIT TILED GROUT MOCK-UP FOR REVIEW. REFER TO FINISH MATERIAL LEGEND FOR GROUT COLORS REQUIRED.
 - FLOOR FINISHES TO CONTINUE UNDER ALL MILLWORK.
 - ALL OPEN PLASTIC LAMINATE CABINETS SHALL BE PLASTIC LAMINATE ON ALL EXPOSED SURFACES, U.N.O. APPLY MELAMINE TO INTERIOR OF CABINETS WITH DOORS AND DRAWERS, U.N.O. SHADE OF MELAMINE TO BEST MATCH PLASTIC LAMINATE. CONFIRM WITH ARCHITECT.
 - PROVIDE SQUARE "EASED" EDGES ON ALL SOLID SURFACE COUNTERTOPS
 - ROLL GOODS WALL BASE TO BE COVE AT HARD SURFACE FLOORING AND STRAIGHT AT CARPET FLOORING. PROVIDE PRE-FORMED BASE AT CORNERS. DO NOT CUT OR BEND BASE TO MAKE CORNERS.
 - ALL WALL AND CEILING REVEALS SHALL BE PAINTED TO MATCH WALL FINISH U.N.O.
 - ALL TILE GROUT JOINTS TO BE 1/8".
 - ALIGN ALL TILE WALL BASE JOINTS WITH FLOOR JOINTS.



1 FINISH PLAN - 02 SECOND FLOOR
Scale: 1/8" = 1'-0"



PROJECT
Emergency Medical Services (EMS) Addition
701 N. Kilbourn Avenue, Chicago, IL 60651



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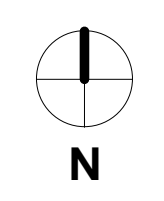
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ISSUE/REVISION

NO.	DATE	DESCRIPTION
5	07/25/2024	ADD 03
3	07/12/2024	ADD 01
2	07/05/2024	ISSUED FOR PERMIT
1	06/26/2024	ISSUED FOR BID
U/R	DATE	DESCRIPTION

PROJECT NUMBER
PBC: #07215 AECOM: 60710711

SHEET TITLE
SECOND FLOOR - INTERIOR FINISHES PLAN

SHEET NUMBER
A801

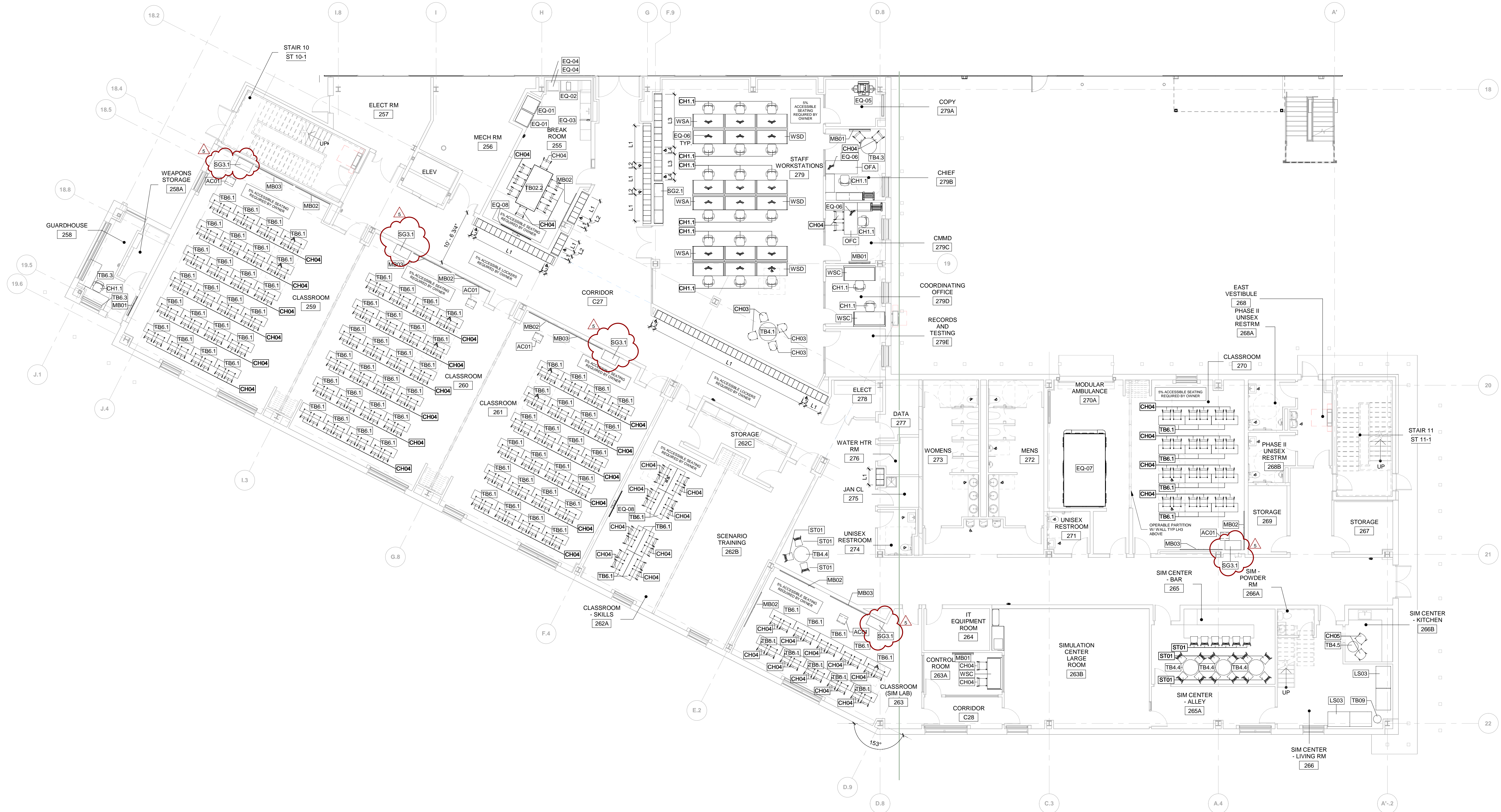
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EQUIPMENT SCHEDULE									
TAG	QTY	DESCRIPTION	MANUFACTURER	PRODUCT, COLOR/FINISH	FURNISHED BY	INSTALLED BY	COORDINATE	COMMENTS	
							BLOCKING	ELECTRICAL	PLUMBING
EQ-01	2	REFRIGERATOR	DELFIELD	COOLSCAPES LINE, ONE SECTION	O	O	X	X	
EQ-02	1	COFFEE MACHINE	TBD	TBD	O	O	X	X	
EQ-03	1	SOAP DISPENSER	SIMPLE HUMAN		O	O	X	X	
EQ-04	2	MICROWAVE OVEN	AMANA	RFS12TS MEDIUM	O	O	X	X	
EQ-05	1	PRINTER / COPIER	TBD	TBD	O	C	X	X	
EQ-06	104	COMPUTER MONITOR	TBD	TBD	O	O	X	X	
EQ-07	1	AMBULANCE TRAILER	TBD	TBD	O	O	X	X	
EQ-08	9	DISPLAY MONITOR	REFER TO AV (T SHEETS)	REFER TO AV PACKAGE (T SHEETS)	C	C	X	X	

LOCKER SCHEDULE - SECOND FLOOR		
LOCKER TYPE	COUNT	COMMENTS
L1	75	12X18X36, 2 TIER SINGLE DOOR WITH NUMBER LABEL
L2	8	12X18X36, 2 TIER SINGLE DOOR, BOTTOM LOCKER ADA WITH NUMBER LABEL
L3	11	15X18X36, 2 TIER SINGLE DOOR WITH NUMBER LABEL
L4	2	15X18X36, 2 TIER SINGLE DOOR, BOTTOM LOCKER ADA WITH NUMBER LABEL

FURNITURE SCHEDULE - SECOND FLOOR		
TAG	QTY	DESCRIPTION
AC01	5	LECTURE PEDESTAL
CH1.1	23	OFFICE CHAIR WITH SWIVEL BASE AND ARMS
CH04	4	CHAIR WITH SWIVEL BASE NO ARMS
CH04	218	4 LEG CHAIR NO ARMS
CH05	2	SCENARIO CHAIR
LS03	2	SOFA
MB01	4	48" X 48" MAGNETIC WHITEBOARD
MB02	7	48" X 96" MAGNETIC WHITEBOARD
MB03	5	60" X 96" WHITEBOARD, PROJECTABLE, MAGNETIC
OFA	1	PRIVATE OFFICE DESK CONFIGURATION
OFC	1	PRIVATE OFFICE DESK CONFIGURATION

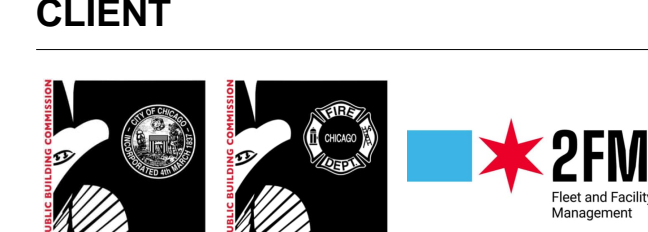
FURNITURE SCHEDULE - SECOND FLOOR		
TAG	QTY	DESCRIPTION
SG3.1	1	30" LATERAL FILING CABINET WITH COVERT LOCK
SG3.1	5	36" X 21" CABINET FOR COMPUTER WITH TOP GROMMET AND VENTED BACK
ST01	1	HIGH STOOL
TB02.2	1	96" W RECTANGULAR CONFERENCE TABLE
TB4.1	1	42" ROUND TABLE WITH BASE
TB4.3	1	36" ROUND TABLE WITH BASE
TB4.4	4	36" ROUND HIGH TOP TABLE
TB4.5	1	24" ROUND TABLE
TB6.1	102	60" X 20" RECTANGULAR TABLE
TB6.3	2	60" X 30" RECTANGULAR TABLE
TB09	1	18" ROUND SIDE TABLE
WSA	6	4 WORKSTATION SETUP
WSC	3	SINGLE WORKSTATION SETUP
WSD	3	2 WORKSTATION SETUP



1 FURNITURE PLAN - 02 SECOND FLOOR Scale: 1/8" = 1'-0"



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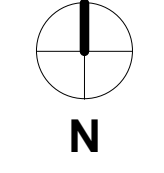
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5	07/25/2024	ADD 03
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I/R	DATE	DESCRIPTION

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

SHEET TITLE
SECOND FLOOR - EQUIPMENT AND FURNITURE PLAN

SHEET NUMBER

A901

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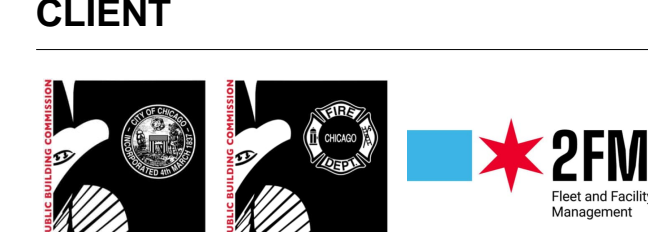
EQUIPMENT SCHEDULE							
TAG	QTY	DESCRIPTION	MANUFACTURER	PRODUCT, COLOR/FINISH	FURNISHED BY	INSTALLED BY	COORDINATE
EQ-01	2	REFRIGERATOR	DELFIELD	COOLSCAPES LINE, ONE SECTION	O	O	X X X
EQ-02	1	COFFEE MACHINE	TBD	TBD	O	O	X X X
EQ-03	1	SOAP DISPENSER	SIMPLE HUMAN	TBD	O	O	X X X
EQ-04	2	MICROWAVE OVEN	AMANA	RFS12TS MEDIUM	O	O	X X X
EQ-05	1	PRINTER / COPIER	TBD	TBD	O	C	X X X
EQ-06	104	COMPUTER MONITOR	TBD	TBD	O	O	X X X
EQ-07	1	AMBULANCE TRAILER	TBD	TBD	O	O	X X X
EQ-08	9	DISPLAY MONITOR	REFER TO AV (T SHEETS)	REFER TO AV PACKAGE (T SHEETS)	C	C	X X X

LOCKER SCHEDULE - THIRD FLOOR		
LOCKER TYPE	COUNT	COMMENTS
L3	69	15X18X36, 2 TIER SINGLE DOOR WITH NUMBER LABEL
L4	10	15X18X36, 2 TIER SINGLE DOOR, BOTTOM LOCKER ADA WITH NUMBER LABEL

FURNITURE SCHEDULE - THIRD FLOOR		
TAG	QTY	DESCRIPTION
THIRD FLOOR		
AC01	6	LECTURE PEDESTAL
BD1	1	SIMULATION CRIB WITH WATERPROOF MATTRESS COVER (CFCI)
BD2	1	SIMULATION QUEEN BED WITH WATERPROOF MATTRESS COVER (CFCI)
CH1.1	71	OFFICE CHAIR WITH SWIVEL BASE AND ARMS
CH04	242	4 LEG CHAIR NO ARMS
MB01	9	48" X 48" MAGNETIC WHITEBOARD
MB02	7	48" X 96" MAGNETIC WHITEBOARD
MB03	6	60" X 96" WHITEBOARD, PROJECTABLE, MAGNETIC
OFA	2	PRIVATE OFFICE DESK CONFIGURATION
OFC	1	PRIVATE OFFICE DESK CONFIGURATION
OFF	1	PRIVATE OFFICE DESK CONFIGURATION
OFF	2	PRIVATE OFFICE DESK CONFIGURATION
OFI	3	PRIVATE OFFICE DESK CONFIGURATION
SG3.1	2	30" LATERAL FILING CABINET WITH COUNTERTOP
SG3.1	6	36" X 21" CABINET FOR COMPUTER WITH TOP GROMMET AND VENTED BACK
ST01	1	HIGH STOOL
TB6.1	1	60" W RECTANGULAR CONFERENCE TABLE
TB4.4	1	36" ROUND HIGH TOP TABLE
TB6.1	112	60" X 20" RECTANGULAR TABLE
TB09	1	18" ROUND SIDE TABLE
WSA	11	4 WORKSTATION SETUP
WSD	5	2 WORKSTATION SETUP



PROJECT
Emergency Medical Services (EMS) Addition
 701 N. Kildbourn Avenue, Chicago, IL 60651



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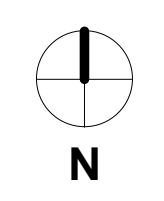
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5	07/25/2024	ADD 03
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1	06/26/2024	ISSUED FOR BID
I/R	DATE	DESCRIPTION

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

SHEET TITLE
THIRD FLOOR - EQUIPMENT AND FURNITURE PLAN

SHEET NUMBER

A902

1 FURNITURE PLAN - 03 THIRD FLOOR
 Scale: 1/8" = 1'-0"

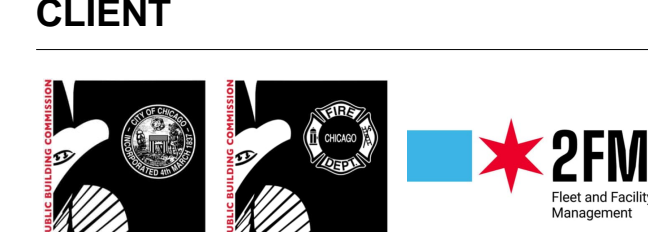
EQUIPMENT SCHEDULE											
TAG	QTY	DESCRIPTION	MANUFACTURER	PRODUCT, COLOR/FINISH	FURNISHED BY	INSTALLED BY	COORDINATE			COMMENTS	
							BLOCKING	ELECTRICAL	DATA	PLUMBING	
EQ-01	2	REFRIGERATOR	DELFIELD	COOLSCAPES LINE, ONE SECTION	O	O	X	X	X		
EQ-02	1	COFFEE MACHINE	TBD	TBD	O	O	X	X	X		
EQ-03	1	SOAP DISPENSER	SIMPLE HUMAN	TBD	O	O	X	X	X		
EQ-04	2	MICROWAVE OVEN	AMANA	RFS12TS MEDIUM	O	O	X	X	X		
EQ-05	1	PRINTER / COPIER	TBD	TBD	O	C	X	X	X		
EQ-06	104	COMPUTER MONITOR	TBD	TBD	O	O	X	X	X		
EQ-07	1	AMBULANCE TRAILER	TBD	TBD	O	O	X	X	X		
EQ-08	9	DISPLAY MONITOR	REFER TO AV (T SHEETS)	REFER TO AV PACKAGE (T SHEETS)	C	C	X	X	X		

LOCKER SCHEDULE - FOURTH FLOOR		
LOCKER TYPE	COUNT	COMMENTS
L3	47	15X18X36, 2 TIER SINGLE DOOR WITH NUMBER LABEL
L4	7	15X18X36, 2 TIER SINGLE DOOR, BOTTOM LOCKER ADA WITH NUMBER LABEL

FURNITURE SCHEDULE - FOURTH FLOOR		
TAG	QTY	DESCRIPTION
AC01	6	LECTURE PEDESTAL
CH1.1	52	OFFICE CHAIR WITH SWIVEL BASE AND ARMS
CH04	282	4 LEG CHAIR NO ARMS
MB01	3	48" X 48" MAGNETIC WHITEBOARD
MB02	11	48" X 96" MAGNETIC WHITEBOARD
MB03	5	60" X 96" WHITEBOARD, PROJECTABLE, MAGNETIC
OF1	1	PRIVATE OFFICE DESK CONFIGURATION
SG3.1	6	36" X 21" CABINET FOR COMPUTER WITH TOP GROMMET AND VENTED BACK
ST01	4	BAR STOOL
TB02.1	4	84" W RECTANGULAR CONFERENCE TABLE
TB02.2	1	96" W RECTANGULAR CONFERENCE TABLE
TB4.4	1	38" ROUND HIGH TOP TABLE
TB6.1	134	60" X 20" RECTANGULAR TABLE
WSA	3	4 WORKSTATION SETUP
WSD	3	2 WORKSTATION SETUP



PROJECT
Emergency Medical Services (EMS) Addition
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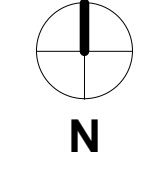
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U/R	DATE	DESCRIPTION

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

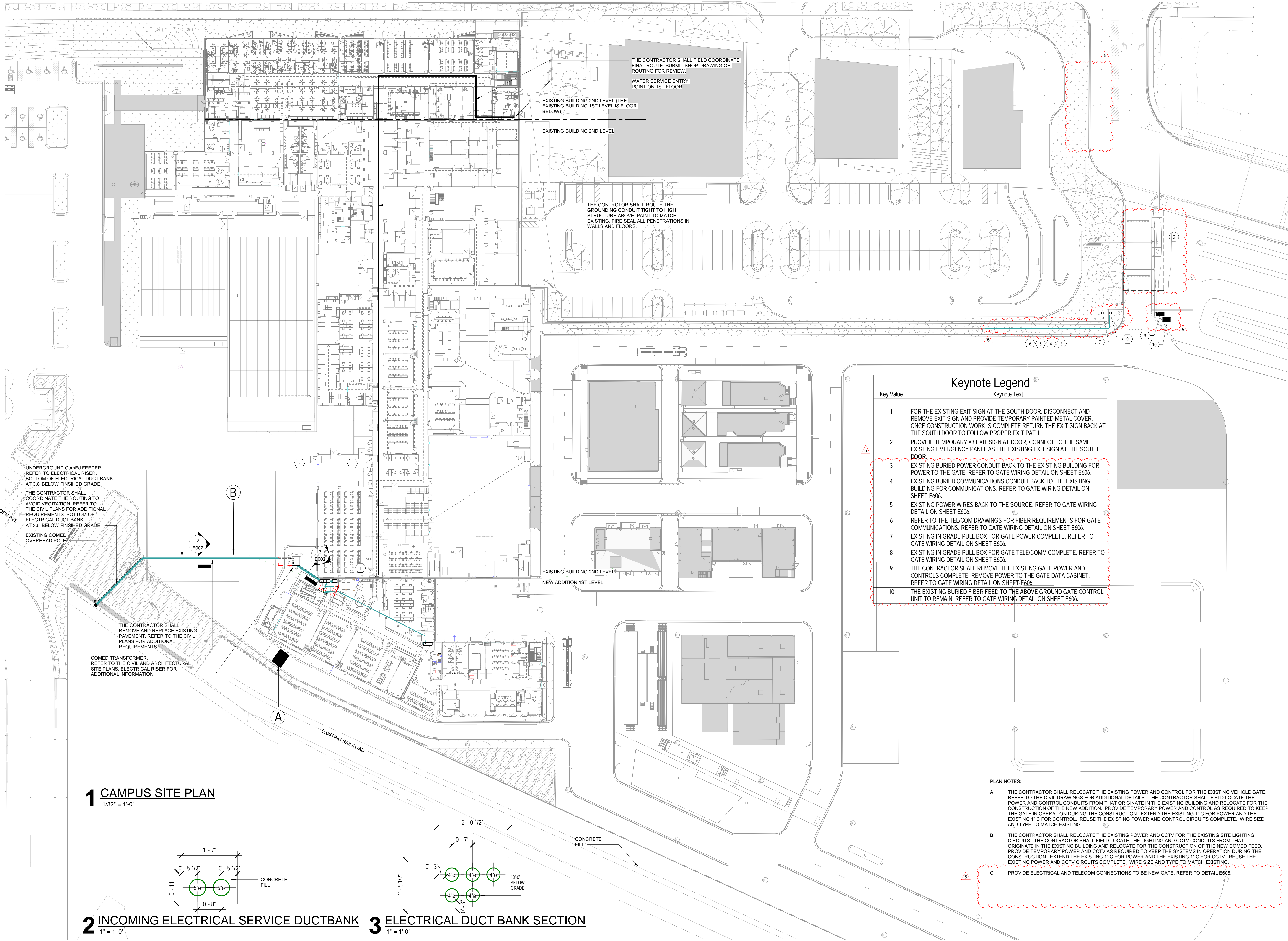
SHEET TITLE
FOURTH FLOOR - EQUIPMENT AND FURNITURE PLAN

SHEET NUMBER

A903

1 FURNITURE PLAN - 04 FOURTH FLOOR
 Scale: 1/8" = 1'-0"

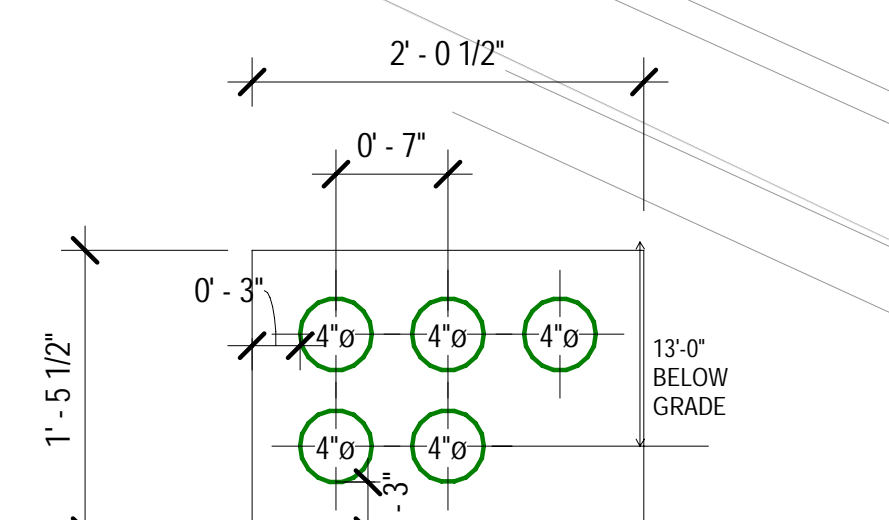
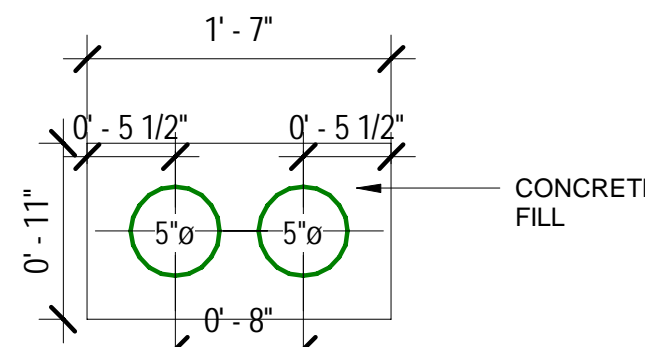
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1 CAMPUS SITE PLAN
1/32" = 1'-0"

2 INCOMING ELECTRICAL SERVICE DUCTBANK
1" = 1'-0"

3 ELECTRICAL DUCT BANK SECTION
1" = 1'-0"



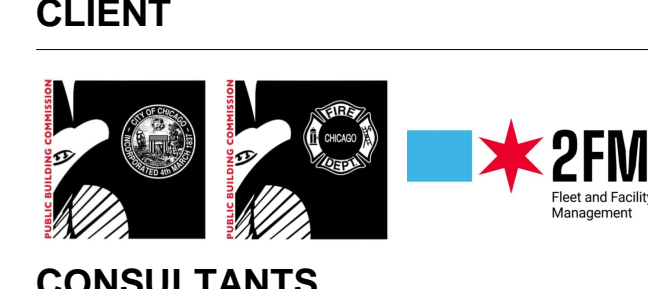
Key Value	Keynote Text
1	FOR THE EXISTING EXIT SIGN AT THE SOUTH DOOR, DISCONNECT AND REMOVE EXIT SIGN AND PROVIDE TEMPORARY PAINTED METAL COVER. ONCE CONSTRUCTION WORK IS COMPLETE RETURN THE EXIT SIGN BACK AT THE SOUTH DOOR TO FOLLOW PROPER EXIT PATH.
2	PROVIDE TEMPORARY #3 EXIT SIGN AT DOOR, CONNECT TO THE SAME EXISTING EMERGENCY PANEL AS THE EXISTING EXIT SIGN AT THE SOUTH DOOR.
3	EXISTING BURIED POWER CONDUIT BACK TO THE EXISTING BUILDING FOR POWER TO THE GATE. REFER TO GATE WIRING DETAIL ON SHEET E606.
4	EXISTING BURIED COMMUNICATIONS CONDUIT BACK TO THE EXISTING BUILDING FOR COMMUNICATIONS. REFER TO GATE WIRING DETAIL ON SHEET E606.
5	EXISTING POWER WIRES BACK TO THE SOURCE. REFER TO GATE WIRING DETAIL ON SHEET E606.
6	REFER TO THE TEL/COM DRAWINGS FOR FIBER REQUIREMENTS FOR GATE COMMUNICATIONS. REFER TO GATE WIRING DETAIL ON SHEET E606.
7	EXISTING IN GRADE PULL BOX FOR GATE POWER COMPLETE. REFER TO GATE WIRING DETAIL ON SHEET E606.
8	EXISTING IN GRADE PULL BOX FOR GATE TELE/COMM COMPLETE. REFER TO GATE WIRING DETAIL ON SHEET E606.
9	THE CONTRACTOR SHALL REMOVE THE EXISTING GATE POWER AND CONTROLS COMPLETE. REMOVE POWER TO THE GATE DATA CABINET. REFER TO GATE WIRING DETAIL ON SHEET E606.
10	THE EXISTING BURIED FIBER FEED TO THE ABOVE GROUND GATE CONTROL UNIT TO REMAIN. REFER TO GATE WIRING DETAIL ON SHEET E606.

PLAN NOTES:

- A. THE CONTRACTOR SHALL RELOCATE THE EXISTING POWER AND CONTROL FOR THE EXISTING VEHICLE GATE. REFER TO THE CIVIL DRAWINGS FOR ADDITIONAL DETAILS. THE CONTRACTOR SHALL FIELD LOCATE THE POWER AND CONTROL CONDUITS FROM THAT ORIGINATE IN THE EXISTING BUILDING AND RELOCATE FOR THE CONSTRUCTION OF THE NEW ADDITION. PROVIDE TEMPORARY POWER AND CONTROL AS REQUIRED TO KEEP THE GATE IN OPERATION DURING THE CONSTRUCTION. EXTEND THE EXISTING 1" C FOR POWER AND THE EXISTING 1" C FOR CONTROL. REUSE THE EXISTING POWER AND CONTROL CIRCUITS COMPLETE. WIRE SIZE AND TYPE TO MATCH EXISTING.
- B. THE CONTRACTOR SHALL RELOCATE THE EXISTING POWER AND CCTV FOR THE EXISTING SITE LIGHTING CIRCUITS. THE CONTRACTOR SHALL FIELD LOCATE THE LIGHTING AND CCTV CONDUITS FROM THAT ORIGINATE IN THE EXISTING BUILDING AND RELOCATE FOR THE CONSTRUCTION OF THE NEW COMED FEED. PROVIDE TEMPORARY POWER AND CCTV AS REQUIRED TO KEEP THE SYSTEMS IN OPERATION DURING THE CONSTRUCTION. EXTEND THE EXISTING 1" C FOR POWER AND THE EXISTING 1" C FOR CCTV. REUSE THE EXISTING POWER AND CCTV CIRCUITS COMPLETE. WIRE SIZE AND TYPE TO MATCH EXISTING.
- C. PROVIDE ELECTRICAL AND TELECOM CONNECTIONS TO BE NEW GATE, REFER TO DETAIL E606.



PROJECT
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1/R		DESCRIPTION

PROJECT NUMBER

PBC: #07215 AECOM: 60710711

SHEET TITLE

CAMPUS SITE PLAN

SHEET NUMBER

E002

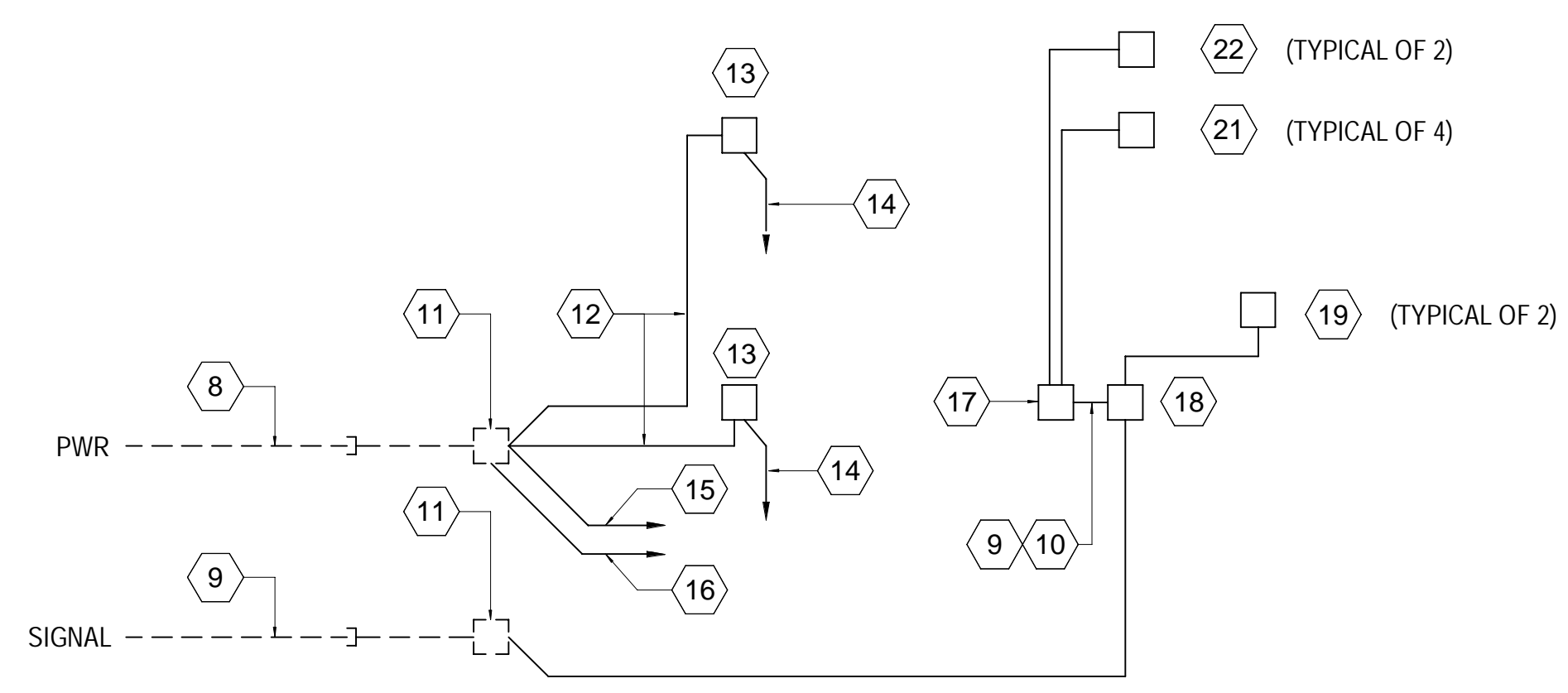
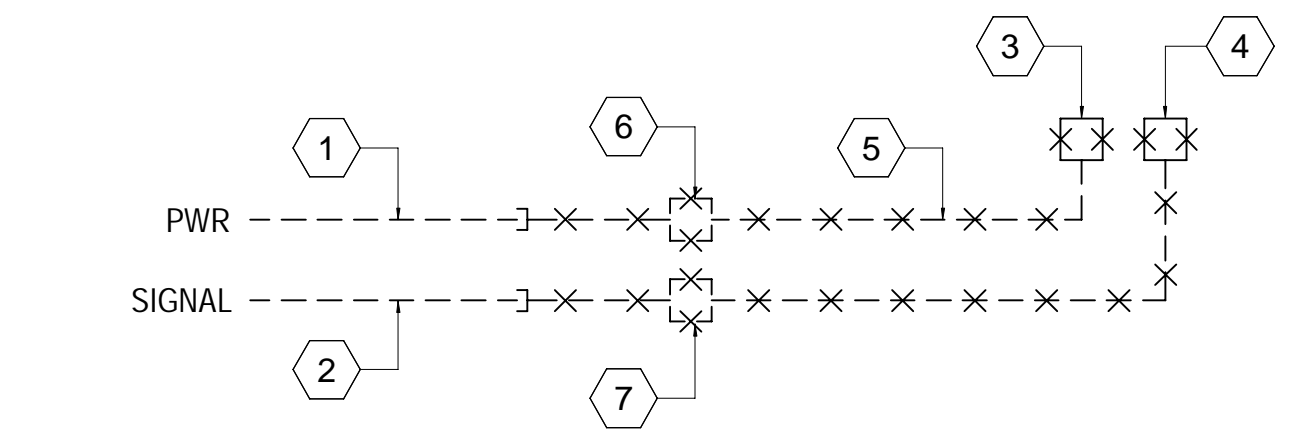
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CLASSROOMS / TRAINING ROOMS	FSLV	MS	CEILING	WS	DT	OC	YES	NO	LDIM	NO	YES	NO	YES	NO
CONFERENCE ROOMS	FSLV	MS	CEILING	WS	DT	OC	YES	NO	LDIM	NO	YES	NO	YES	NO
CORRIDOR, CIRCULATION, ELEV LOBBY	FSLV	MS	CEILING	WS	DT	OC	YES	NO	LDIM	NO	YES	NO	YES	NO
EXTERIOR GENERAL	FSLV	NLCS	NONE	NONE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EXTERIOR MECHANICAL ROOF AREA	FSLV	MS	NONE	WS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
GENERAL AREAS NOT OTHERWISE NOTED	FSLV	MS	CEILING	WS	DT	OC	YES	NO	LDIM	NO	NO	NO	YES	NO
JANITORS CLOSET	FSLV	MS	WALL	WS	DT	VS	NO	NO	NO	NO	NO	YES	NO	NO
LOBBY, VESTIBULE	FSLV	MS	CEILING	WS	DT	OC	YES	NO	LDIM	NO	NO	NO	YES	NO
EQUIP AREAS - SPECIAL: ELEV. PITS, ELECTRICAL ROOMS	FSLV	MS	WALL	WS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
MEP AREAS: MECHANICAL, PLUMBING ROOMS (TYPICAL)	FSLV	MS	CEILING	WS	DT	OC	NO	NO	NO	NO	NO	NO	NO	NO
OFFICE OPEN	FSLV	MS	CEILING	WS	DT	OC	YES	NO	LDIM	NO	NO	NO	YES	NO
OFFICE SMALL OR PRIVATE	FSLV	MS	CEILING	WS	DT	VS	NO	NO	LDIM	NO	NO	NO	YES	NO
SECURITY ROOM	FSLV	MS	CEILING	WS	DT	OC	YES	NO	NO	NO	NO	YES	NO	NO
STAIRS & STAIR TOWER	FSLV	CB	FIXTURE	NONE	DT	OC	NO	NO	NO	NO	NO	NO	YES	NO
STORAGE AREA - SMALL	FSLV	MS	WALL	WS	DT	VS	NO	NO	NO	NO	NO	NO	NO	NO
STORAGE AREA - LARGE	FSLV	MS	CEILING	WS	DT	OC	NO	NO	NO	NO	NO	NO	NO	NO
RESTROOM - SINGLE	FSLV	MS	CEILING	WS	DT	OC	NO	NO	NO	NO	NO	NO	NO	NO
RESTROOM - MULTIPLE STALLS	FSLV	MS	CEILING	WS	DT	OC	NO	NO	NO	NO	NO	NO	NO	NO

1 EMS ADDITION LIGHTING CONTROL SCHEDULE

LIGHTING CONTROL SEQUENCE OF OPERATION:

- THE LIGHTING CONTROL IS SEPARATE INDEPENDENT FREE STANDING LINE VOLTAGE CONTROL BY ROOM. THIS IS TO BE A FULLY WIRED SYSTEM, NO WIRELESS DEVICES. THERE IS NO CENTRAL LIGHTING CONTROL SYSTEM. ALL LIGHTING CONTROL DEVICES SHALL BE BY THE SAME MANUFACTURER.
- REFER TO THE EMS ADDITION LIGHTING CONTROL SCHEDULE FOR REQUIREMENTS BY ROOM TYPE. REFER TO PLANS FOR LIGHTING CONTROL DEVICE LOCATIONS, HOWEVER ADJUST THE LOCATIONS AS REQUIRED FOR A PROPERLY FUNCTIONAL SYSTEM. PROVIDE SHOP DRAWINGS SHOWING ALL DEVICES. IN AREAS WITHOUT CEILING, PROVIDE PENDANT MOUNTING AS REQUIRED.
- ROOMS WITH WINDOWS SHALL HAVE DAYLIGHT HARVESTING USING DIMMING.
- ROOMS WITH MOVABLE PARTITIONS SHALL HAVE A ROOM PARTITION SWITCH THAT WHEN CLOSED, EACH ROOM ACTS INDEPENDENTLY. WHEN THE MOVABLE PARTITION IS OPEN THE ROOMS ACT TOGETHER AS ONE.
- PROVIDE A PROGRAMMABLE SOLID STATE TIME CLOCK WITH PHOTOCELL CONTROL FOR CONTROLLING THE EXTERIOR LIGHTING (NOT ROOF LIGHTING).

2 GATE WIRING DETAIL - DEMO



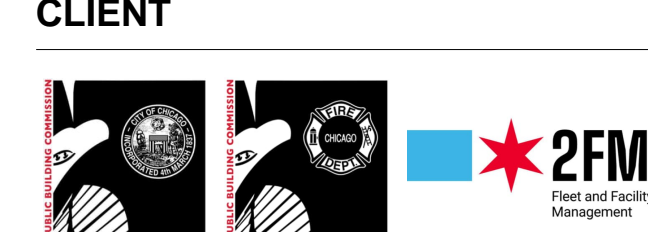
3 GATE WIRING DETAIL - NEW

GATE WIRING KEY NOTES:

- EXISTING BURIED 2" POWER CONDUIT BACK TO THE EXISTING BUILDING FOR POWER TO THE GATE. THE CONTRACTOR SHALL FIELD VERIFY THE EXISTING ROUTE FROM THE GATE TO THE SOURCE BOTH OUTSIDE AND INSIDE THE BUILDING. PROVIDE AS BUILT PLANS PRIOR TO STARTING THE GATE WORK.
- EXISTING BURIED 2" COMMUNICATIONS CONDUIT BACK TO THE EXISTING BUILDING FOR COMMUNICATIONS TO THE GATE. THE CONTRACTOR SHALL FIELD VERIFY THE EXISTING ROUTE FROM THE GATE TO THE SOURCE BOTH OUTSIDE AND INSIDE THE BUILDING. PROVIDE AS BUILT PLANS PRIOR TO STARTING THE GATE WORK.
- THE EXISTING GATE POWER AND CONTROLS TO THE GATE DATA CABINET TO REMAIN. REDIRECT AND EXTEND THE EXISTING BURIED POWER CONDUIT AS REQUIRED FOR THE NEW GATE POWER, INTERCOM AND GATE CONTROLS.
- THE EXISTING BURIED FIBER FEED TO THE ABOVE GROUND GATE CONTROL UNIT. CAREFULLY REMOVE AND STORE THE GATE DATA CONTROL CABINET FOR REUSE. REDIRECT AND EXTEND THE EXISTING BURIED COMMUNICATIONS CONDUIT AS REQUIRED FOR THE NEW GATE CONTROLS.
- THE POWER WIRES BACK TO THE SOURCE.
- EXISTING IN GRADE PULL BOX FOR GATE POWER TO REMAIN. REDIRECT AND EXTEND THE EXISTING BURIED POWER CONDUIT AS REQUIRED FOR THE NEW GATE POWER, INTERCOM AND GATE CONTROLS.
- EXISTING IN GRADE PULL BOX FOR GATE TELECOM TO REMAIN. REDIRECT AND EXTEND THE EXISTING BURIED POWER CONDUIT AS REQUIRED FOR THE NEW GATE POWER, INTERCOM AND GATE CONTROLS.
- THE CONTRACTOR PROVIDE 8#6, 1/10 GRD, IN THE EXISTING BURIED 2". CONNECT TO (4) 20A-1P 120V CIRCUITS IN THE EXISTING POWER PANEL IN THE BUILDING. FIELD VERIFY PANEL AND CIRCUITS, UPDATE PANEL SCHEDULE.
- REFER TO THE TELCOM DRAWINGS FOR FIBER REQUIREMENTS FOR GATE COMMUNICATIONS.
- EXTEND BURIED 2" PVC CONDUIT WITH 2" CONCRETE ENCASUREMENT.
- EXISTING IN GRADE BOX
- PROVIDE BURIED 2" PVC, 2" CONCRETE ENCASED, 2#6, 1/10 GRD.
- GATE POWER UNIT, PROVIDE WP LINE VOLTAGE DISC 30A-1P DISCONNECT, 120V 1/2 HP.
- PROVIDE BURIED 1" PVC, 2" CONCRETE ENCASED GATE CONTROL CABINET. REFER TO GATE SPECIFICATION AND TELECOM PLANS FOR CONTROL WIRING THAT OPENS AND CLOSES THE GATE.
- PROVIDE BURIED 1" PVC, 2" CONCRETE ENCASED, 2#6, 1/10 GRD TO THE GATE COMMUNICATIONS UNIT. PROVIDE WP LINE VOLTAGE DISC 20A-1P DISCONNECT, 120V.
- PROVIDE BURIED 1" PVC, 2" CONCRETE ENCASED, 2#6, 1/10 GRD TO THE GATE MAIN CONTROLLER. PROVIDE WP LINE VOLTAGE DISC 20A-1P DISCONNECT, 120V.
- INSTALL GATE CONTROLLER FURNISHED WITH THE GATE. PROVIDE STAINLESS STEEL METAL FRAMING CHANNEL SUPPORT. REFER TO THE CIVIL / ARCHITECTURAL PLANS FOR CONCRETE PAD DETAILS AND LOCATIONS.
- EXISTING GATE COMMUNICATIONS CABINET. REFER TO THE CIVIL / ARCHITECTURAL PLANS FOR CONCRETE PAD DETAILS AND LOCATIONS.
- INTERCOM STATION AND CARD ACCESS CONTROLLER. REFER TO THE CIVIL / ARCHITECTURAL PLANS FOR CONCRETE PAD DETAILS AND LOCATIONS. PROVIDE BURIED 1" PVC WITH 2" CONCRETE ENVELOPE. REFER TO GATE SPECIFICATIONS AND TELCOM DRAWINGS FOR WIRING REQUIREMENTS.
- FLUSH IN GRADE GATE LOOP PROXIMITY SENSOR THAT IS FURNISHED WITH THE GATE. REFER TO THE CIVIL / ARCHITECTURAL PLANS FOR CONCRETE PAD DETAILS AND LOCATIONS. PROVIDE BURIED 1" PVC WITH 2" CONCRETE ENVELOPE. REFER TO GATE SPECIFICATIONS AND TELCOM DRAWINGS FOR WIRING REQUIREMENTS.
- PEDESTAL MOUNTED GATE SENSOR THAT IS FURNISHED WITH THE GATE. REFER TO THE CIVIL / ARCHITECTURAL PLANS FOR CONCRETE PAD DETAILS AND LOCATIONS. PROVIDE BURIED 1" PVC WITH 2" CONCRETE ENVELOPE. REFER TO GATE SPECIFICATIONS AND TELCOM DRAWINGS FOR WIRING REQUIREMENTS.
- PEDESTAL MOUNTED TRAFFIC SIGNALS THAT IS FURNISHED WITH THE GATE. REFER TO THE CIVIL / ARCHITECTURAL PLANS FOR CONCRETE PAD DETAILS AND LOCATIONS. PROVIDE BURIED 1" PVC WITH 2" CONCRETE ENVELOPE. REFER TO GATE SPECIFICATIONS AND TELCOM DRAWINGS FOR WIRING REQUIREMENTS.



PROJECT
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REGISTRATION

NORTH ARROW

ISSUE/REVISION

NO.	DATE	DESCRIPTION
5	07/25/2024	ADD 03
2	07/05/2024	ISSUED FOR PERMIT
1	06/26/2024	ISSUED FOR BID
U/R		

PROJECT NUMBER
 PBC: #07215 AECOM: 60710711

SHEET TITLE
LIGHTING CONTROL SCHEDULE

SHEET NUMBER

E606

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TECHNOLOGY SHEET INDEX table with columns SHEET NUMBER and Sheet Name. Lists sheets T001 through T771 including Technology Legend, Notes, Site Plan, Floorplans, Pathway Plans, Elevation Plans, Enlarged Floor Plans, Details, Diagrams, Simulations, Schedules, and Conduit/Pathway Details.

AV EQUIPMENT SYSTEM DESCRIPTION table. Lists equipment types 1 through 6 & 7 with detailed descriptions of office/break rooms, conference rooms, training classrooms, and group instruction rooms, including TV display sizes, audio systems, and optional features like document cameras and interactive monitors.

AV ROOM TYPE SCHEDULE

SECURITY/LIFE SAFETY and PATHWAY AND SPACES DEVICES table. Contains detailed specifications for security cameras, doors, readers, releases, sensors, switches, and various pathway devices like ladders, trays, busbars, runways, and outlets. Includes rough-in and detail callouts.

TELECOMMUNICATIONS and AUDIO-VISUAL SYSTEMS table. Contains specifications for voice outlets, data outlets, fire alarm panels, security alarm panels, building automation systems, data outlets, wireless LAN access points, time clocks, and various audio-visual components like speakers, microphones, and control outlets.

- LEGEND NOTES: 1) BASE SYMBOLS ARE UTILIZED TO REFERENCE THE FLOORPLAN LOCATION AND PROPER ROUGH-IN REQUIREMENTS... 2) PRIOR TO INSTALLATION OF ROUGH-IN, VERIFY ROUGH-IN SIZE REQUIREMENTS WITH DEVICE SUPPLIER... 3) INCREASE SIZE OF BOX, AS REQUIRED TO ACCOMMODATE THE QUANTITY AND SIZE OF CONDUITS ENTERING BOX... 4) ALL 1-GANG AND 2-GANG ROUGH-IN BOXES, RECESS/FLUSH MOUNTED, SHALL BE ASSEMBLED FROM 4" SQUARE BOXES AND SEPARATE TRIM RINGS... 5) IN APPLICATIONS WHERE THE DRAWINGS AND/OR SPECIFICATIONS REQUIRE THE USE OF SURFACE RACEWAY AND BOXES IN LIEU OF CONCEALED ROUGH-IN, CONTRACTOR SHALL MATCH THE SIZE OF THE BOX LISTED ON THE LEGEND... 6) WHERE FIELD CONDITIONS INVOLVE INACCESSIBLE AREAS THE ROUGH-IN SHALL BE MODIFIED TO ALLOW THE PATHWAY TO BE ACCESSIBLE AND REUSABLE... 7) COLOR CODING OF CABLING SHALL BE COORDINATED AND APPROVED PRIOR TO PROCUREMENT AND INSTALLATION... 8) SYMBOLS AND SUBSCRIPTS MAY DISTINGUISH BETWEEN VOICE (V) AND DATA (D) INTENDED USES... 9) MATERIALS AND INSTALLATION FOR VOICE AND DATA USES SHALL BE IDENTICAL UNLESS SPECIFICALLY NOTED... 10) SYMBOLS PLACED ON EXTERIOR WALLS WITH A 'WP' SUBSCRIPT SHALL BE INSTALLED WITH WEATHERPROOF HOUSINGS AND THE ROUGH-IN SEALED FROM MOISTURE INGRESS... 11) WHERE A TELECOMMUNICATIONS OUTLET LOCATION IS ADJACENT TO AN ELECTRICAL OUTLET, THE MOUNTING HEIGHT WILL BE THE SAME FOR EACH WHERE MULTIPLE TELECOMMUNICATIONS ARE ADJACENT (SUCH AS TELECOMMUNICATIONS AND SOUND DEVICES). FACEPLATES SHALL BE COORDINATED TO THE SAME TYPE AND COLOR AND MOUNTED AT THE SAME HEIGHT.



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REGISTRATION

ISSUE/REVISION table with columns for issue number, date, and description.

PROJECT NUMBER: PBC: #07215 AECOM: 60710711

SHEET TITLE: TECHNOLOGY LEGEND

SHEET NUMBER: T001

Table with 2 columns: Issue No, Description. Shows issues 1, 2, and 5 with their respective dates and descriptions.

PROJECT NUMBER: PBC: #07215 AECOM: 60710711

SHEET TITLE: TECHNOLOGY LEGEND

SHEET NUMBER: T001